# The Impact of E-commerce on GDP and Labor Productivity in IRAN

Sarvenaz Hojabr Kiani *

**Introduction**

The advancement of information and communication technology in the past two decades, and spreading its applications in different economic and social fields has caused new forms of mutual relations between individuals, institutions, businesses, and governments to be emerged. Traditional ways of doing trade and business are being revised and under the beam of this transformation, new kinds of jobs and economic activities are being created. Some analysts believe that the advancement of information and communication technology is the greatest technological revolution since the Industrial Revolution, and some others name it as the New or Digital Economy.

Ways of evolution and improvement of information in different fields help the big world to become smaller and interrelated place. Convergence between information and business started too many years ago. But nowadays, Internet has become part of people's life, and offers a new way of doing business under the name of e-commerce[1].

A global economy and strong competition, unique work force, and powerful consumers make today's marketplace. So for having this situation and using various market opportun-

* M.B.A Minsistry of Commerce

1. electronic commerce

eities, e-commerce and using internet are critical.

Interaction between technology and business process and electronic commerce and its concepts and measures are the key factors for understanding the impact of electronic commerce on the economy. What makes the electronic commerce to be distinguished from traditional commerce is basically the way by which information is processed and exchanged between buyers and sellers.

In e-commerce, information is transferred through a digital network or other electronic channels rather than direct contacts. In some cases, an extra channel may be created for selling, marketing or distribution alongside the traditional channel of doing business through e-commerce, and in some other cases the e-commerce may create new goods, services and market (Discussion Paper 2000).The main issue that policy makers and analysts are facing with, is the lack of an internationally accepted definition, methodology and guidelines related to the e-commerce.

As a matter of fact, without having a reliable data and information, policy makers, businesses and people will no longer be able to recognize real impacts of e-commerce on the economy. In order to be able to compare the electronic commerce's level, growth and comparison across countries, it is necessary to standardize the related statistics and measurement approaches.

Since in many cases, there are some mistakes in determining the differences between e-commerce and ICT[2] it is necessary to clarify them before discussing the concepts of e-commerce and its measures.

**Concepts, Definitions and Measurements**

The New Economy phenomenon which is often referred as "the Knowledge Economy", "the Digital Economy", "the Electronic Economy" and the Virtual or the Network Economy is on sub sectors such as purely digital goods and services, mixed goods as well as physical goods that are sold through the Internet, and the ICT industry as its supply side. If we want to see it from another point of view, we might interpret it as a phenomenon arising as a result of ICT use at microeconomic level, where its consequence is low inflation, increased productivity, structural changes in the production and employment sector, the new definition of the role of government, etc. at macroeconomic level (UNCTAD 2003).

The components of the new economy are as follows:

- ICT: Infrastructure of the New Economy
- Agents of the New Economy
- Virtual goods
- The Electronic Market Places

2. Information and Communication Technology

Electronic market places, which are referred to as virtual process are networks of interactions and relations by which information, goods and services are exchanged electronically between the agents of the New Economy (UNCTAD 2003). However non-commercial transactions such as supply chain management process, advertisement, etc. are of vital importance. The macro impact of virtual process is far beyond doing just a mere efficient transaction. Basically this kind of interactions changes the production, consumption and all economic activities. Furthermore, online transactions can also change the ways of collecting taxes, tariffs and government regulations.

**E-commerce and ICT Definitions**

The development and growth of information technology is changing economies. The search for more efficient methods for doing economic affairs has led to another revolution in trading field. This revolution has been called electronic commerce. Here electronic commerce is treated as a subset of all types of uses of ICT – based goods and services.

According to some definitions, e-commerce is defined as the all business and financial transactions conducted electronically such as, Electronic Fund (EFT), Electronic Data Interchange (EDI) and all debit/credit cards related activities. While some others, confine electronic commerce to retailing to consumers, in which transactions and payments for goods and services are done through the Internet. The first definition refers to the forms of electronic commerce that has been popular for several decades, and billions of dollars worth of transactions are done everyday by that. The second definition refers to the new form of electronic commerce which has been popular in recent years, and volume of business transaction by it is not so much. (Lee Foong Yeuw 1998)

According to one of these definitions, electronic commerce is defined as buying and selling of goods, services and information through computer networks such as Internet (Turban 2002), while in another definition, electronic commence is defined as doing business through the Internet, which includes buying and selling of those goods and services that can be exchanged and delivered online.

Here are some definitions that are used over the world:

- The UK's newly formed e-centre is a merger between the Article Numbering Association and the Electronic Commerce Association. They define e-commerce in the following way; "Electronic commerce covers any form of business or administrative transaction or information exchange that is executed using any information and communications technology (ICT)." (Global Telecoms Business, May 1999).

• Electronic commerce or e-commerce is the buying, selling, marketing, and servicing of products or services over computer networks. And it's a conduct of business commercial communications and managements through electronic methods, such as electronic data interchange and automated data collection systems. (From Wikipedia, the free encyclopedia[3]).

• A new method of guidance , management and running of commercial exchanges, by using computer or any remote communication networks. (Benjamin,2002)

• Selling and buying information , products and services by computer networks or any network which makes informational highways. (Turban,1999)

• Electronic commerce is selling and buying goods, services and information by using computer networks like internet. (Turban 2002)

• According to professor Norman Archer from Macmaster University-Canada, electronic commerce is a new method for guiding business and it has a hand in all parts of business, including marketing, engineering production and also supporting fields such as financial, information systems, accounting, human resources, buying, transporting, receiving goods and managing.

Based on these definitions, commodities that lie within electronic commerce activities are those that can be digitized and delivered.

The example that can be seen is computer soft wares. This kind of transaction can be done between businesses or between businesses and consumers. However, the only point that should be noted is that, the Internet covers a vast variety of transactional activities and information exchange, apart from those mentioned above. (Coppell Jonathans 2000).

The OECD members have made great efforts to give a standard definition and its measurement based on the OECD measures, which has been an internationally accepted standard.

The first aspect or dimension relates to Networks over which the relevant activities are carried out. With respect to networks, over which e-commerce activities are carried out, OECD member countries have presented two kinds of definitions.

Based on a broad definition, an electronic transaction is the sale and purchase of goods and services between businesses, households, individuals, governments and other public and private organizations, conducted over computer – mediated networks. The goods and services are ordered over these networks, but the payment and ultimate delivery of them, which may be conducted on or off-line, basis are also included in this definition.

Based on a narrow definition, e-commerce is the sale and purchase of goods and services, whether between businesses, households,

3. http://en.wikipedia.org/wiki/Electronic_business

individuals, governments, and other public and private organizations over the Internet. According to this kind of definition, ordering the goods and services over the Internet which their payment or delivery may be conducted on or off-line basis is also an e-commerce activity.

The most important distinction between these two types of definitions is the network over which transaction is conducted. The broad definition covers all kinds of networks, such as, the Internet, proprietary networks, EDI and etc,. while narrow definition includes only Internet networks. Therefore, the broad definition is important for capturing electronic transactions in those countries where electronic commerce has been a regular feature of business activities for many years. While in developing countries where the major network involved is the Internet, the narrow definition of the e-commerce is relevant. (Unctad 2001)

The activities and transactions domain included in the e-commerce definitions, may be broader (such as, different layers of economic activities in trade, transportation, marketing, advertisement information services, band account opening, health, procurement, education and etc.) and or narrow (such as retailing and delivery of goods and services by the Internet).

Communication infrastructure in return can be viewed in two dimensions: its applications and networks. Application refers to all kinds of possible users (Web, EDI, etc.), while the communication network is all kinds of open, closed, proprietary and non-proprietary networks. Research institutes usually apply both of the definitions.

For example, in the definition given by the Forrester (1999) e-commerce includes only those transactions, which their final order made over the Internet. In the definition given by the Goldman Sachs institute, e-commerce includes only those transactions that all of its process starts and ends over the Internet.

Some universities and research institutes include all kinds of business activities in e-commerce definition, which are conducted by the use of information and communication technology (Broad definition of the e-commerce). Their view at the e-commerce is beyond an electronic transaction, rather than an application of technology and is viewed as a strategy or model of business (Alessandra Colecchia 2000). Policy maker's definition of e-commerce is often very broad in order to capture the impacts of e-commerce and cover all segments of transactions and all actors in the economy.

Therefore, what is needed in a policy context is a set of definitions of e-commerce that capture both its size and its impacts, and that are measurable (Ibid). Finally it should be noted, that e-commerce definition is a dynamic one and will continue to be improved,

along with the advancement in computer mediated networks.

The second aspect of the definition relates to the activities or business processes being included, or excluded, from the electronic commerce domain. While many countries want to restrict the definition to the purchasing and selling aspect incorporated in the above definitions, many others want to include other types of business processes. (Unctad 2001)

**Table 1: E-commerce and other Applications over Computer Mediated Networks**

| | Government | Business | Consumer |
|---|---|---|---|
| Government | **G2G** co-ordination | **G2B** information | **G2C** information |
| Business | **B2G** procurement | **B2B** e-commerce | **B2C** e-commerce |
| Consumer | **C2C** tax compliance | **C2B** price comparison | **C2C** auctions |

**Source:** "E-commerce: Impact and Policy challenges", OECD Economics Department Working Papers, 2000, No. 252

The third aspect of the definition relates to the actors involved in the electronic commerce process. In table 1, different forms of e-commerce and relations between actors are shown:

While the term e-commerce refers to all online transactions, B2C stands for "business-to-consumer" and applies to any business or organization that sells its products or serviees to eonsumers over the Internet for their own use. When most people think of B2C e-commerce, they think of Amazon.com, the online bookseller that launched its site in 1995 and quickly took on the nation's major retailers. However, in addition to online retailers, B2C has grown to include services such as online banking, travel services, online auctions, health information and real estate sites.[4]

Although the popular press has given the most attention to business – to –consumer (B2C) web sites, even more activity is being conducted on business-to-business (B2B) sites. Forrester and Gartner, major research firms on online commerce, estimate that B2B commerce is 10 to 15 times greater that B2C commerce. Gartner estimates that by 2005, more than 500,000 enterprises will participate in e-markets as buyers, sellers, or both.[5] We also have C2C that is customer- to- customer communication on the web on a whole range of subjects, like AOL that boasts chat rooms.

Consumers are also finding it easier to communieate with companies. Companies often encourage communication by inventing prospects and customers to send in questions, suggestions, and even complaints via e-mail. This is the other kind of using internet by the name of C2B (consumer to business).eBay is a person-to-person online trading community that is used today. It has more than 23 million registered users. The company's web

4.http://www.cio.com/ec/edit/b2cabc.html
5. Adapting marketing to the new economy book, chapter two

site hosts more than two million auctions each month for items in more than 1000 categories, from jewellery to stamps, from antiques to electronics.[6]

Applications over computer-mediated networks encompass a wider spectrum of activities and information exchanges. For example, Internet technology is being used by governments for transmission or receipt of information (G2B, G2C) to improve convenience and to lower the cost of payment systems and tax compliance (C2G), and also used by businesses to improve after sale services and marketing. According to studies conducted in Europe, e-commerce valued at 172 billion EUR. In 2001 in Europe, out of that, 87 percent was in the area of B2B and 13 percent in B2C transaction. (Eito 2002)

**E-commerce Measurement**

Another issue that is of vital importance from the point of view of policy makers and researchers is the measuring of different aspects of electronic commerce both at micro and macro levels. Bouwman H.et al (1999) has suggested three types of indicators for measuring.

- Indicators relating to the basic conditions governing the use of e-commerce (such as, ease of access, the availability of computers, modems and the Internet in the home).
- Indicators that take into account the actual use of e-commerce (such as, usage data, types of usage, sectors and products, etc.).
- Indicators that measure the effects and implications of the use of e-commerce, with its distinctive and separate effects on businesses, sectors and the economy as a whole.

Elmer (1999), points to the need to obtain indicators in four areas:

- Demand variables
- Supply variables
- Technology used, and macro-economic variables.

Figuera (1999) develops a series of indicators relating exclusively to the aspects of electronic commerce: infrastructure, number of Internet hosts, and number of computer, modems and mobile phones.

According to Nuria Hernandez and Fernando Lera (2001), given the inter-connection between the so-called Old Economy and the New Economy, it may be necessary to combine both types of indicators. In other words, conventional economic indicators should be used alongside the new ones specifically designed to measure the implications of ICT under current economic conditions. They suggest the indicators to be grouped under three main headings:

1- Indicators to measure ICT infrastructure.

2- Indicators to measure activity on the Internet and in e-commerce.

6. Ibid.

3- Indicators used to quantify the economic and social implications of the phenomenon.

It is believed that there is a life cycle for research needs which follows the pattern of growth of e-commerce markets. At the first stage, there is a need for information on enabling factors and barriers to e-commerce. At a more mature stage, one should look for e-commerce use to enable policy makers to address imbalances, and at a later stage one should be able to measure the impact of e-commerce on the economy and society. (Ibid)

The OECD has categorized information and indicators needs, based on the three mentioned stages:

The first stage called e-commerce readiness includes issues for preparing the technical, commercial and social infrastructures that are necessary to support e-commerce. It is essential for each country to be able to construct a statistical picture of the state of the readiness of each infrastructure element to engage with e-commerce. These types of indicators are more likely necessary for those countries that are at initial or natural stage of e-commerce.

The second stage called e-commerce intensity relates to the state of the e-commerce usage, volume, value and nature of the transactions. At this stage, the statistical requirements of those exploiting e-commerce possibilities are addressed. These types of indicators may be the interest of those countries where e-commerce is used widely.

The third stage called e-commerce impact is related to multiplier effects of the e-commerce. In other words, e-commerce goes beyond substitution effects and creates new value added. Statistics are needed to evaluate whether and to what extent e-commerce makes some kind of difference in terms of efficiency and the creation of new sources of wealth. These types of indicators are more likely needed in the countries where e-commerce has been developed. (OECD 1999)

Having in mind all of the above considerations, we can use following indexes for measuring e-commerce:

- The Internet usage.
- To use Internet for business and information searching.
- Online sale and purchase.
- Use of Internet for communication in business.
- Online ordering of goods and services.
- Online payment.
- To develop a proprietary program for doing business electronically.
- Online after – sale service.
- Online marketing.
- Development of business model or models.

**Literature Review**

It is clear that e-commerce has sensible and

almost widespread effect on the economy as a whole. Economic policy makers now believe that the benefits that economic analysts name it as productivity gains of the e-commerce have had its effect considerably. There are many reasons that e-commerce can increase productivity. The firms can benefit the maximum capacity of the technology by reengineering. For example, the firms can decrease their inventory costs and other input costs by selling their goods electronically and/or even can change their sale and purchase process, and decrease marketing related costs.

By taking a closer look at the concepts and definitions we see that, the concepts of the e-commerce, ICT and IT are much closer to each other. In fact, the e-commerce is a part of the widespread transformation process that is created by the information and communication technology. Therefore, as it will be seen, in economic literature and empirical results, the basis for impacts analysis of all three concepts is similar, and the only difference is the related measures that are substituted in mathematical relations. As a result, the mathematical model we develop for the Islamic Republic of Iran is based on the existing literature and empirical evidences, in EC, IT and ICT.

Productivity is simply the ratio of output to input. In fact, productivity measurement is an attempt to measure the increase in output of a firm, an industry, a sector or the whole economy, not accounted for by the growth in production inputs.

The partial factor productivity is the ratio of output to a single production factor. Measurement units of outputs and inputs, in partial productivity, are usually expressed in physical terms.

In contrast to the partial productivity measure, multi-factor productivity (MFP) measures the productivity of two or more inputs. In order to combine different inputs with different units of measurement, in the denominator of the ratio, they are usually expressed in monetary terms.

Total Factor Productivity (TFP) shows the relation between output and all the inputs used in the production process.

Theoretical background and empirical evidence of the benefits of investment in information infrastructures have been the source of controversy among economists for a long time. The findings of the researches show that, using information and communication technology from the mid 1970s to now, has been coupled with decrease in labor and capital productivity in most of the developed countries. This issue leads to a well-known claim by the Nobel Prize winner Robert Solow (1957), known as Productivity Paradox: "You can see computer age everywhere, but productivity".

The first wave of empirical analysis on the impact of ICT on productivity, showed

no signs on the impact of computer on production increase. The Growth Accounting Methodology has been used in many studies relating to the direct effect of the ICT on production. Based on this approach, the outputs can be obtained, using the services of different inputs. The cost minimizing firm will continue to use its inputs, until marginal cost of each factor equals the marginal product of the factor.

Under the growth accounting framework, all incomes are treated as payments to production factors. Given this condition, growth rate of output equals the average weighted growth of production factors, plus the growth which is not taken into account.[7]

The ignored growth is total factor productivity (TFP). Therefore, total productivity remains as a measure of our ignorance, i.e., part of the growth that is not explicitly taken into account by the firm's costs. Consider now a production function with three inputs:

$$Q_t = AK_{1t}^{\alpha 1}\ K_{2t}^{\alpha 2}\ L_t^{\alpha 3} \qquad (1)$$

where: Q is output; $K_1$ is IT related capital, K2, non-IT capital and L, labor.

By taking logarithm from the two sides of the function (1) and then differentiating it with respect to time, we have[8]:

$$Q^0 = A^0 + \alpha_1 K_1^0 + \alpha_2 K_2^0 + \alpha_3 L^0 \qquad (2)$$

As noted at the beginning of the discussion, despite of the huge amount of investment in the United States and other countries, in the late 1990's, following the Productivity Paradox, it was concluded that productivity benefits of it had not been significant. (Roach 1988) Economists and IT researchers had different reasons for the Paradox.

According to David (1990), existing considerable time lags between investment and its return due to the structural changes in firm or industry is the main reason for the Paradox, while Griliches (1994) notes to measurement problem (especially in services sector). Oliner and Sichel (1994, 2000) believe that investment in IT compared to total investment has been insignificant, despite of increase in IT investment. Brynjolfsson and Hitt (2002) blame the smallness of the sample size due to the shortage of information.

Recently some analysts claim that in growth accounting models, computed coefficients of the costs (income) share, are smaller than their corresponding coefficients, estimated econometrically. In other words, if the coefficients are estimated (econometrics) rather than computed (growth accounting), ICT capital deepening (more capital for per labor), is an important factor, for the growth

7. The ignored term is called "measure of our ignorance"

8.In continuing the survey of our selected models, we can change the equation (2), and obtain the labor productivity growth instead of GDP growth, Meanwhile, the symbol dot (0) on the top of the variables shows the rate of growth.

of labor productivity, in econometric models relative to growth accounting models, and this different result may be related to the ICT spillover effect, that is hidden in growth accounting approach, while in econometric models appear in estimated elasticities.

Since, ICT goods and services are both the output of the ICT industries and inputs of the industries using ICT, therefore, ICT can affect economic growth through four channels: (Pohjola 2000)

1- Through the production of ICT goods and services which directly affects the value added.

2- Increase in productivity of ICT production sector which affects total productivity (TFP).

3- Using ICT capital as an input in producing other goods and services.

4- Production and using the ICT, increases the productivity in the sectors that do not produce ICT, and hence increases total productivity (spillover effects).

The methodologies for measuring ICT and EC share in productivity growth are mainly based on the initial work of Solow (1957), Griliches and Jorgenson (1967) which accordingly have been expanded by Oliner, Sichel (2000) and Jorgenson and Stiroh (2000).

Some of these methodologies are as follows:

1. Inclusion of ICT capital as a separate capital stock in labor or total factor productivity analysis, (e.g.: Hempell 2000; Brynjolfsson and Hitt 2001)

2. Inclusion ICT capital alongside with other measures of ICT use, such as, Internet usage or number of employees using ICT. (e.g.: Maliranta & Rouvinen 2003).

3. Inclusion of ICT capital alongside with measures of innovation, or organizational structure, (e.g.: Leeuwen & Wiel 2003, Brnjolfsson & Hitt 2001).

4. Inclusion of e-commerce measures, such as, sale, purchase, and sale and purchase over computer mediated networks (e.g.: Criscuolo and Walderon 2003, Clagton, Crisucuolo, Goodridge and Waldren 2003).

Dedrick, Gurbaxoni and Kraemer (2003) have found interesting evidence known as dualistic nature of the ICT capital. They believe that like the physical capital, the ICT capital can also be used to create efficient (capital deepening) technology in production sectors, that gives the possibility to organizations to increase the labor productivity. However, in their opinion, another role of the ICT is to lower the coordination costs of economic activities between organizations. The authors show that evidence based on the coordinator role is more effective than capital deepening.

There are vast varieties of studies relating to the impact of ICT and its subsets, like e-commerce. There are various studies at all levels of aggregation such as, factories, firms, industries, sectors, national and international. Most of the models are based on Cobb-Douglas function.

At macro level, the results are different according to the time period of study. Kiley

(1999), Council of Economic Advisors (2000-2001), Jorgenson and Stiroh (2000), Oliner & Seichel (2000) found evidences that information technology had a minor share in the U.S. economic growth until 1995, while its share has been increased considerably in the mid 1990s. Oulton (2001) has reached the same results for England, that is, increased share of ICT in output growth over time.

However, according to the results obtained from the comprehensive cross-country studies, relating to the return of investment in IT, in developed and developing countries, ICT use in developing countries has not had any impact. (Dewan, Kraemer, 2000). The study shows that in developed countries capital return of IT has been significantly positive, while in developing countries it has not been significant. According to the results of the study, the production elasticity of the IT in developed countries was 0.57 and significant.

Pohjola (2000) showed that the share of the IT in the GDP of the developing countries (China, India, Argentina, Chile, Brazil, Thailand, Venezuela) had been less than 2 percent, between 1980 to 1995, while this figure had been 10 percent in developed countries (United States, Finland, Canada, Sweden and England). Apparently, there is not any study that might have estimated the share of the ICT in the growth of developing countries significant.

Using cross-section analyses, Lichtenberg (1995), Brynjolfsson and Hitt (1995), Black and Lynch (1997), Lehr and Lichtenberg (1999), Dunne, Foster, Haltinwanger and Trotske (2000), Bresnahan, Bryjolfsson and Hitt (2001) found that there is a mutual relation between the ICT and other factors of production in the firms of the United States. Furthermore, Mairesse and Greenan (2000), Greenan, Mairesse and Topid-Bensaid (2001) observed a positive correlation between computer, ICT, R&D and the average productivity of wage and management in France.

**Models and Estimations**

Based on the empirical studies and theoretical approaches discussed earlier, the purpose of this section is to introduce the appropriate models and estimate the coefficient of the models for Iran. Like all other developing countries, lack of data is a main problem. The fact that the country is in the stage of readiness with respect to use of e-commerce, due to lack of the sufficient data, the model estimation and analysis becomes more difficult.

To overcome the mentioned problem partially, we limited the study to the industrial sector. This is the approach of Kraemer and Plice (2001). The authors extended the results of industry to the country as a whole, and also, compared the estimated coefficients with those of other

countries (i.e. the extension of the results to international level). Kraemer and Plice (2001) in page 24 of their article argue that this change of the level of aggregation is even an advantage.

The industrial sector of Iran consists of 57 three digit ISIC [9] codes industry. We selected 45 of these industries which their share in GDP is over 95 percent. Therefore, the empirical results of the study can be extended to the industry, and also based on the above reasoning to the economy as a whole.

**GDP Growth**

To study the impact of e-commerce on the rate of growth of GDP we use growth accounting approach. This standard model is based on Cobb-Douglas production function with labor, capital and a measure of e-commerce as inputs. If we use the notation eActivity for the e-commerce variable, the model will be:

$$LnQ = a + beActivity + cLnK + dLnL + U \quad (3)$$

where:

Q=Gross Domestic Product (GDP)

K=Stock of Capital

L=Number of Employees

Ln=Natural Logarithm

u= Error Term

a, b, c, d = Parameters to be estimated

The above regression is estimated using cross-section of forty-five observations. (number of industries)

Using SPSS software, ordinary least square (OLS) method we estimated the above regression equation.[10] With different measures of e-commerce the data is collected from different issues of Statistical Center of Iran and Ministry of Industry and Mine and also Questionnaires of Ministry of Commerce. The variable Activity is a dummy (Qualitative or Binary) which takes value I if the industry has electronic buying and selling (or uses Internet, or PC) and takes value 0 otherwise.

After using several measures of E-C or ICT, using $R^2$ and t-values we selected the final estimated model. It is important to note that, in the first step, we used the E-C measure defining dummy variable for e-buy and e-sell. Since, the collected data come from sample of firms in each industry; we were not able to assign 0 and 1 value, because if for example 3 out of 20 firms did not have e-buying or e-selling we could not say whether the value of dummy variable is 0 or 1 in the industry level. To overcome the problem we used 3/20=0.15 (i.e. penetration rate) for the value of e-commerce (eActivity) variable.

In the second step, using the above approach defined e-commerce (eActivity) variable as

9.International Standard for Industrial Classification

10. I would like to express my deepest gratitude and appreciation to Dr. kiani , for his help and guidance in econometric models.

ratio of numbers of firms using internet to the total numbers of firms in industry.

Finally, in the third step, using the above approach we defined e-commerce (eActivity) variable as ratio of numbers of firms using PC to the total numbers of firms in industry. It is important to note that, all of the above measures and proxies are proper measures of e-commerce for the countries that are still in the stage of readiness, as is mentioned in (Unctad 2003) and other recent studies.

The results of our first step estimation using e-buying and e-selling as e-commerce measurement which we defined as e-Activity3 and corresponding descriptive statistics are given in tables, heading results of regression No.1 in appendix. The results and calculations are based on data in table 1.

The results of regression show that all of the coefficients except e-commerce measurement coefficient are significant. (Note that the coefficient of labor is significant at 11 percent meaning that we can interpret the effect of this variable only with 89 percent confidence). The standardize coefficients (Beta coefficients) show that 1 percent change in labor and capital changes GDP by 0.06 percent and 0.94 percent respectively. In other words, labor and capital have significant positive effects on GDP growth.

The concluding point is that e-commerce measured by e-buy & e-sell does not have any effect on the GDP growth of Iran's industrial sector. The result is consistent with the other studies for developing countries.

The results of our second step estimation using Internet as e-commerce measurement which we defined as e-Activity1 and corresponding descriptive statistics are given in tables, heading results of regression No.2 in appendix. The results and calculations are based on data in table 1.

The results of regression show that all of the coefficients except e-commerce measurement coefficient are significant. (Note that the coefficient of labor is significant at 9 percent meaning that we can interpret the effect of this variable only with 91 percent confidence). The standardized coefficients (Beta coefficients) show that 1 percent change in labor and capital changes GDP by 0.06 percent and 0.94 percent respectively. In other words, labor and capital have significant positive effects on GDP growth.

The concluding point is that e-commerce measured by Internet does not have any effect on the GDP growth of Iran's industry sector. The result is consistent with the other studies for developing countries.

The results of our third step estimation using PC as e-commerce measurement which we defined as e-Activity2 and corresponding descriptive statistics are given in tables, heading results of regression No.3 in appendix. The results and calculations are based on data in table 1.

The results of regression show that the coefficients of capital is highly significant and the coefficient of labor is only at 12 percent level of significance shows the coefficient is non zero. (i.e. we can refer to this coefficient with 88 percent confidence). The standardized coefficients (Beta coefficients) show that 1 percent change in labor and capital changes GDP by 0.06 percent and 0.94 percent respectively. In other words, labor and capital have significant positive effects on GDP growth.

The concluding point is that e-commerce measured by PC does not have any effect on the GDP growth of Iran's industrial sector. The result is consistent with the other studies for developing countries.

We conclude this section with the final result that, since Iran is in the stage of readiness with respect to the e-commerce usage of e-commerce does not have any significant impact on GDP growth of the country.

**Labor Productivity Growth**

The purpose of this section is to study the impact of e-commerce on the labor productivity growth.

For estimating the impact of e-commerce on labor productivity it is sufficient to assume that the above said Cobb-Douglas production function has constant returns to scale property. The assumption can be tested, but following the growth accounting approach and many empirical studies we assume it without testing.

Now, if before taking Ln from both sides of Cobb-Douglas production function we divide both sides of the equation by L, we will have the model to be estimated as follows:

$$Ln(\frac{Q}{L}) = a + bLn(\frac{K}{L}) + ceActivity + U \qquad (4)$$

All of the variables in equation 4 are defined in the same way as those in equation 3. All the steps taken to estimate equation 4 are exactly the same as those of equation 3.

The results of our first step estimation using e-buying and e-selling as e-commerce measurement which we defined as e-Activity3 and corresponding descriptive statistics are given in tables, heading results of regression No.4 in appendix. The results and calculations are based on data in table 1.

The results of regression show that all of the coefficients are highly significant except e-commerce. The standardized coefficients (Beta coefficients) show that 1 percent change in capital-output ratio (i.e. capital deepening) will change the labor productivity by 0.98 percent.

The concluding point is that this e-commerce measurement does not have any effect on labor productivity but capital deepening changes labor productivity significantly.

The results of our second step estimation

using Internet as e-commerce measurement which we defined as e-Activity1 and corresponding descriptive statistics are given in tables, heading results of regression No.5 in appendix. The results and calculations are based on data in table 1.

The results of regression show that all of the coefficients are highly significant except e-commerce. The standardized coefficients (Beta coefficients) show that 1 percent change in capital-output ratio (i.e. capital deepening) will change the labor productivity by 0.97 percent.

The concluding point is that this e-commerce measurement does not have any effect on labor productivity but capital deepening changes labor productivity significantly.

The results of our third step estimation using PC as e-commerce measurement which we defined as e-Activity2 and corresponding descriptive statistics are given in tables, heading results of regression No.6 in appendix. The results and calculations are based on data in table 2.

The results of regression show that only capital-output ratio coefficient is significant. The standardize coefficients (Beta coefficients) show that 1 percent change in capital-output ratio (i.e. capital deepening) will change the labor productivity by 0.97 percent. Conclusion is that this e-commerce measurement does not have any effect on labor productivity but capital deepening changes labor productivity significantly.

For this section our overall conclusion is that e-commerce does not have any effect on industry and the whole country's labor productivity growth too. The result is consistent with the other studies for developing countries.

**Summary and Conclusion**

In this paper we tried to go through the related concepts and definitions and the review of literature of the impact of e-commerce. Based on the theories reviewed for investigating the impact of e-commerce on GDP growth and productivity growth the most suitable model is growth accounting approach. Many researchers have used this approach and techniques of econometrics to estimate the impact of e-commerce in all aggregation levels i.e., firm, industry, country and international levels in different countries. As mentioned before, the empirical results concerning developed countries is that the e-commerce has significant positive effect on both output and productivity growth. By contrast the results for developing countries, in general, do not show any significant impact of e-commerce on output and labor productivity growth. We used the same approach and conducted an empirical study for Iran. Using three measures of e-commerce (e-buying & e-selling, internet and PC), we tried to see if e-commerce has any impact on the growth of GDP and labor productivity.

Using the data for 45 industries of Iran which contribute over 95 percent to the industry sector's GDP, the following are the results of the study:

1- E-commerce in Iran does not have any significant effect on GDP growth at industry level.

2- E-commerce does not have any impact on labor productivity at industry level.

The results are perfectly consistent with the results of almost all of the other studies concerning developing countries. We may justify the results noting that Iran is still at the stage of readiness of e-commerce.

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**Appendix**

**Regression 1**

**Table1: GDP (Q), K (Capital), L (Labor), Data of Iran's Industries**

| cod | K | Q | L | eActivity 1 | eActivity 2 | eActivity 3 |
|---|---|---|---|---|---|---|
| 151 | 471261.5 | 2034511.4 | 20089 | 0.46 | 0.86 | 0.01 |
| 152 | 123318.9 | 501434.8 | 3495 | 0 | 1 | 0.01 |
| 153 | 47243.79 | 189892.8 | 1811 | 0 | 1 | 0.01 |
| 154 | 169127 | 704071.8 | 7685 | 0.81 | 0.81 | 0.06 |
| 155 | 162240 | 700417.8 | 4853 | 0.66 | 1 | 0.01 |
| 171 | 190847.7 | 823920.1 | 17200 | . | . | . |
| 172 | 3413.33 | 101079.1 | 1505 | 1 | 1 | 0.01 |
| 173 | 18622.06 | 84570.75 | 1234 | 0.42 | 0.73 | 0.01 |
| 181 | 25308.39 | 109260.3 | 1859 | 1 | 1 | 0.01 |
| 191 | 21704.3 | 99865.4 | 679 | 1 | 1 | 0.01 |
| 192 | 62752.91 | 270914.3 | 7192 | 1 | 1 | 0.01 |
| 202 | 8777.8 | 37895.5 | 748 | 0 | 1 | 0.01 |
| 210 | 84995.8 | 366940.7 | 3560 | 0.2 | 0.8 | 0.01 |
| 221 | 144434.1 | 561190.7 | 5755 | 1 | 1 | 0.01 |
| 222 | 35719.2 | 154205.8 | 2180 | 0.4 | 1 | 0.01 |
| 232 | 841380.2 | 4203174.7 | 3698 | 1 | 1 | 0.01 |
| 241 | 33368.1 | 144055.4 | 1561 | 1 | 1 | 0.01 |
| 242 | 780973.8 | 3371589.4 | 19529 | 0.53 | 0.93 | 0.21 |
| 251 | 168671.9 | 728183.6 | 6198 | 0.42 | 1 | 0.12 |
| 252 | 124584.5 | 484066.3 | 5432 | 0.5 | 1 | 0.01 |
| 261 | 56031.64 | 241879.5 | 3523 | 1 | 1 | 0.01 |
| 269 | 512879.2 | 2214259.5 | 22017 | 0.2 | 0.46 | 0.01 |
| 271 | 164331.2 | 709444.3 | 4496 | 0.66 | 1 | 0.01 |
| 272 | 43306.4 | 186960.7 | 1978 | 0.5 | 1 | 0.01 |
| 273 | 402322.8 | 174080.1 | 2453 | 0 | 1 | 0.01 |
| 281 | 97707.2 | 421817.7 | 5144 | 0.25 | 1 | 0.01 |
| 289 | 296978.1 | 1282101.9 | 13266 | 0.33 | 0.83 | 0.16 |
| 291 | 243876.3 | 1052853 | 11523 | 0.5 | 0.91 | 0.01 |
| 292 | 89043.69 | 384415.9 | 5514 | 0.4 | 1 | 0.01 |
| 293 | 303721.8 | 1311216 | 10405 | 0.36 | 1 | 0.01 |
| 300 | 18827.23 | 182880.3 | 1412 | 1 | 1 | 0.01 |
| 311 | 87647.63 | 378388.8 | 3168 | 1 | 1 | 0.01 |
| 313 | 73785.37 | 318543.28 | 1403 | 0.5 | 1 | 0.01 |
| 314 | 80894.74 | 349235.59 | 1685 | . | 1 | 0.01 |
| 315 | 10510.76 | 48361.94 | 892 | 1 | 1 | 0.01 |
| 319 | 52011.1 | 224540.2 | 2765 | 1 | 1 | 0.4 |
| 321 | 1809.7 | 7812.8 | 134 | 1 | 1 | 0.5 |
| 322 | 50435.2 | 187624.58 | 1564 | 1 | 1 | 0.01 |
| 323 | 182064.6 | 786002.14 | 3816 | 0 | 1 | 0.01 |
| 331 | 108325.6 | 467658.95 | 4970 | 1 | 1 | 0.01 |
| 341 | 513560 | 2217122.5 | 35565 | 1 | 1 | 0.01 |
| 342 | 16778.7 | 72436.3 | 1030 | 1 | 1 | 0.01 |
| 343 | 491573.7 | 1888993.6 | 11500 | 0.45 | 1 | 0.01 |
| 359 | 16417.4 | 70876.7 | 1138 | 1 | 1 | 0.01 |
| 361 | 65996.8 | 284918.8 | 3827 | 1 | 1 | 0.01 |
| 369 | 179980.8 | 67609.8 | 966 | 1 | 1 | 0.01 |
| Others | 99.6 | 430.1 | 12 | 1 | 1 | 0.01 |

**Descriptive Statistics**

| | Mean | Std. Deviation | N |
|---|---|---|---|
| LNQ | 11.1897 | 1.76631 | 45 |
| LNL | 7.9687 | 1.52244 | 45 |
| LNK | 11.0141 | 1.79668 | 45 |
| EACTIVI1 | .6567 | .36530 | 45 |

**Correlations**

| | | LNQ | LNL | LNK | EACTIVI1 |
|---|---|---|---|---|---|
| Pearson Correlation | LNQ | 1.000 | .888 | .993 | -.251 |
| | LNL | .888 | 1.000 | .880 | -.247 |
| | LNK | .993 | .880 | 1.000 | -.252 |
| | EACTIVI1 | -.251 | -.247 | -.252 | 1.000 |
| Sig. (1-tailed) | LNQ | . | .000 | .000 | .048 |
| | LNL | .000 | . | .000 | .051 |
| | LNK | .000 | .000 | . | .048 |
| | EACTIVI1 | .048 | .051 | .048 | . |
| N | LNQ | 45 | 45 | 45 | 45 |
| | LNL | 45 | 45 | 45 | 45 |
| | LNK | 45 | 45 | 45 | 45 |
| | EACTIVI1 | 45 | 45 | 45 | 45 |

**Variables Entered/Removed[b]**

| Model | Variables Entered | Variables Removed | Method |
|---|---|---|---|
| 1 | EACTIVI1, LNL, LNK[a] | . | Enter |

a. All requested variables entered.

b. Dependent Variable: LNQ

**Model Summary**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | .994[a] | .988 | .987 | .20389 |

a. Predictors: (Constant), EACTIVI1, LNL, LNK

**ANOVA[b]**

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 135.569 | 3 | 45.190 | 1087.069 | .000[a] |
| | Residual | 1.704 | 41 | .042 | | |
| | Total | 137.273 | 44 | | | |

a. Predictors: (Constant), EACTIVI1, LNL, LNK

b. Dependent Variable: LNQ

**Coefficients[a]**

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. | Correlations | | |
|---|---|---|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | | Zero-order | Partial | Part |
| 1 | (Constant) | .450 | .218 | | 2.061 | .046 | | | |
| | LNL | 7.380E-02 | .043 | .064 | 1.736 | .090 | .888 | .262 | .030 |
| | LNK | .922 | .036 | .937 | 25.555 | .000 | .993 | .970 | .445 |
| | EACTIVI1 | 1.518E-03 | .087 | .000 | .017 | .986 | -.251 | .003 | .000 |

a. Dependent Variable: LNQ

# Regression 2

**Descriptive Statistics**

| | Mean | Std. Deviation | N |
|---|---|---|---|
| LNQ | 11.2026 | 1.74876 | 46 |
| LNL | 7.9589 | 1.50689 | 46 |
| LNK | 11.0252 | 1.77818 | 46 |
| EACTIV3 | .0402 | .09744 | 46 |

**Correlations**

| | | LNQ | LNL | LNK | EACTIV3 |
|---|---|---|---|---|---|
| Pearson Correlation | LNQ | 1.000 | .884 | .993 | -.119 |
| | LNL | .884 | 1.000 | .876 | -.116 |
| | LNK | .993 | .876 | 1.000 | -.116 |
| | EACTIV3 | -.119 | -.116 | -.116 | 1.000 |
| Sig. (1-tailed) | LNQ | . | .000 | .000 | .216 |
| | LNL | .000 | . | .000 | .221 |
| | LNK | .000 | .000 | . | .222 |
| | EACTIV3 | .216 | .221 | .222 | . |
| N | LNQ | 46 | 46 | 46 | 46 |
| | LNL | 46 | 46 | 46 | 46 |
| | LNK | 46 | 46 | 46 | 46 |
| | EACTIV3 | 46 | 46 | 46 | 46 |

**Variables Entered/Removed[b]**

| Model | Variables Entered | Variables Removed | Method |
|---|---|---|---|
| 1 | EACTIV3, LNK, LNL[a] | . | Enter |

a. All requested variables entered.

b. Dependent Variable: LNQ

**Model Summary**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | .994[a] | .987 | .987 | .20277 |

a. Predictors: (Constant), EACTIV3, LNK, LNL

**ANOVA[b]**

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 135.891 | 3 | 45.297 | 1101.727 | .000[a] |
| | Residual | 1.727 | 42 | .041 | | |
| | Total | 137.618 | 45 | | | |

a. Predictors: (Constant), EACTIV3, LNK, LNL

b. Dependent Variable: LNQ

**Coefficients[a]**

| Model | | Unstandardized Coefficients | | Standardized Coefficients | | | Correlations | | |
|---|---|---|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | t | Sig. | Zero-order | Partial | Part |
| 1 | (Constant) | .455 | .193 | | 2.355 | .023 | | | |
| | LNL | 6.809E-02 | .042 | .059 | 1.636 | .109 | .884 | .245 | .028 |
| | LNK | .926 | .035 | .942 | 26.252 | .000 | .993 | .971 | .454 |
| | EACTIV3 | -6.03E-02 | .312 | -.003 | -.193 | .848 | -.119 | -.030 | -.003 |

a. Dependent Variable: LNQ

## Regression 3

**Descriptive Statistics**

| | Mean | Std. Deviation | N |
|---|---|---|---|
| LNQ | 11.2026 | 1.74876 | 46 |
| LNL | 7.9589 | 1.50689 | 46 |
| LNK | 11.0252 | 1.77818 | 46 |
| EACTIV2 | .9637 | .09905 | 46 |

**Correlations**

| | | LNQ | LNL | LNK | EACTIV2 |
|---|---|---|---|---|---|
| Pearson Correlation | LNQ | 1.000 | .884 | .993 | -.243 |
| | LNL | .884 | 1.000 | .876 | -.273 |
| | LNK | .993 | .876 | 1.000 | -.239 |
| | EACTIV2 | -.243 | -.273 | -.239 | 1.000 |
| Sig. (1-tailed) | LNQ | . | .000 | .000 | .052 |
| | LNL | .000 | . | .000 | .033 |
| | LNK | .000 | .000 | . | .055 |
| | EACTIV2 | .052 | .033 | .055 | . |
| N | LNQ | 46 | 46 | 46 | 46 |
| | LNL | 46 | 46 | 46 | 46 |
| | LNK | 46 | 46 | 46 | 46 |
| | EACTIV2 | 46 | 46 | 46 | 46 |

**Variables Entered/Removed [b]**

| Model | Variables Entered | Variables Removed | Method |
|---|---|---|---|
| 1 | EACTIV2, [a] LNK, LNL | . | Enter |

a. All requested variables entered.

b. Dependent Variable: LNQ

**Model Summary**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | .994[a] | .987 | .987 | .20280 |

a. Predictors: (Constant), EACTIV2, LNK, LNL

**ANOVA[b]**

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 135.891 | 3 | 45.297 | 1101.351 | .000[a] |
| | Residual | 1.727 | 42 | .041 | | |
| | Total | 137.618 | 45 | | | |

a. Predictors: (Constant), EACTIV2, LNK, LNL

b. Dependent Variable: LNQ

**Coefficients[a]**

| Model | | Unstandardized Coefficients | | Standardized Coefficients | | | Correlations | | |
|---|---|---|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | t | Sig. | Zero-order | Partial | Part |
| 1 | (Constant | .501 | .399 | | 1.256 | .216 | | | |
| | LNL | .747E-02 | .042 | .058 | 1.606 | .116 | .884 | .241 | .028 |
| | LNK | .926 | .035 | .942 | 26.264 | .000 | .993 | .971 | .454 |
| | EACTIV2 | -4.82E-02 | .317 | -.003 | -.152 | .880 | -.243 | -.023 | -.003 |

a. Dependent Variable: LNQ

# Regression 4

**Descriptive Statistics**

| | Mean | Std. Deviation | N |
|---|---|---|---|
| LNQL | 3.2438 | .81875 | 46 |
| LNKL | 3.0663 | .85885 | 46 |
| EACTIV3 | .0402 | .09744 | 46 |

**Correlations**

| | | LNQL | LNKL | EACTIV3 |
|---|---|---|---|---|
| Pearson Correlation | LNQL | 1.000 | .971 | -.040 |
| | LNKL | .971 | 1.000 | -.035 |
| | EACTIV3 | -.040 | -.035 | 1.000 |
| Sig. (1-tailed) | LNQL | . | .000 | .396 |
| | LNKL | .000 | . | .408 |
| | EACTIV3 | .396 | .408 | . |
| N | LNQL | 46 | 46 | 46 |
| | LNKL | 46 | 46 | 46 |
| | EACTIV3 | 46 | 46 | 46 |

**Variables Entered/Removed[b]**

| Model | Variables Entered | Variables Removed | Method |
|---|---|---|---|
| 1 | EACTIV3, LNKL[a] | . | Enter |

a. All requested variables entered.

b. Dependent Variable: LNQL

**Model Summary**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | .971[a] | .943 | .940 | .20060 |

a. Predictors: (Constant), EACTIV3, LNKL

**ANOVA[b]**

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 28.436 | 2 | 14.218 | 353.307 | .000[a] |
| | Residual | 1.730 | 43 | .040 | | |
| | Total | 30.166 | 45 | | | |

a. Predictors: (Constant), EACTIV3, LNKL

b. Dependent Variable: LNQL

**Coefficients[a]**

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. | Correlations | | |
|---|---|---|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | | Zero-order | Partial | Part |
| 1 | (Constant) | .408 | .112 | | 3.648 | .001 | | | |
| | LNKL | .925 | .035 | .971 | 26.560 | .000 | .971 | .971 | .970 |
| | EACTIV3 | -4.97E-02 | .307 | -.006 | -.162 | .872 | -.040 | -.025 | -.006 |

a. Dependent Variable: LNQL

## Regression 5

**Descriptive Statistics**

| | Mean | Std. Deviation | N |
|---|---|---|---|
| LNQL | 3.2211 | .81321 | 45 |
| LNKL | 3.0455 | .85670 | 45 |
| EACTIVI1 | .6567 | .36530 | 45 |

**Correlations**

| | | LNQL | LNKL | EACTIVI1 |
|---|---|---|---|---|
| Pearson Correlation | LNQL | 1.000 | .970 | -.084 |
| | LNKL | .970 | 1.000 | -.089 |
| | EACTIVI1 | -.084 | -.089 | 1.000 |
| Sig. (1-tailed) | LNQL | . | .000 | .292 |
| | LNKL | .000 | . | .280 |
| | EACTIVI1 | .292 | .280 | . |
| N | LNQL | 45 | 45 | 45 |
| | LNKL | 45 | 45 | 45 |
| | EACTIVI1 | 45 | 45 | 45 |

**Variables Entered/Removed** [b]

| Model | Variables Entered | Variables Removed | Method |
|---|---|---|---|
| 1 | EACTIVI1, LNKL [a] | . | Enter |

a. All requested variables entered.

b. Dependent Variable: LNQL

**Model Summary**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | .970[a] | .941 | .939 | .20157 |

a. Predictors: (Constant), EACTIVI1, LNKL

**ANOVA**[b]

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 27.392 | 2 | 13.696 | 337.096 | .000[a] |
| | Residual | 1.706 | 42 | .041 | | |
| | Total | 29.098 | 44 | | | |

a. Predictors: (Constant), EACTIVI1, LNKL

b. Dependent Variable: LNQL

**Coefficients**[a]

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. | Correlations | | |
|---|---|---|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | | Zero-order | Partial | Part |
| 1 | (Constant) | .411 | .129 | | 3.181 | .003 | | | |
| | LNKL | .921 | .036 | .970 | 25.868 | .000 | .970 | .970 | .967 |
| | EACTIVI1 | 6.177E-03 | .084 | .003 | .074 | .941 | -.084 | .011 | .003 |

a. Dependent Variable: LNQL



## Regression 6

**Descriptive Statistics**

| | Mean | Std. Deviation | N |
|---|---|---|---|
| LNQL | 3.2438 | .81875 | 46 |
| LNKL | 3.0663 | .85885 | 46 |
| EACTIV2 | .9637 | .09905 | 46 |

**Correlations**

| | | LNQL | LNKL | EACTIV2 |
|---|---|---|---|---|
| Pearson Correlation | LNQL | 1.000 | .971 | -.017 |
| | LNKL | .971 | 1.000 | -.015 |
| | EACTIV2 | -.017 | -.015 | 1.000 |
| Sig. (1-tailed) | LNQL | . | .000 | .455 |
| | LNKL | .000 | . | .460 |
| | EACTIV2 | .455 | .460 | . |
| N | LNQL | 46 | 46 | 46 |
| | LNKL | 46 | 46 | 46 |
| | EACTIV2 | 46 | 46 | 46 |

**Variables Entered/Removed[b]**

| Model | Variables Entered | Variables Removed | Method |
|---|---|---|---|
| 1 | EACTIV2, LNKL[a] | . | Enter |

a. All requested variables entered.

b. Dependent Variable: LNQL

**Model Summary**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | .971[a] | .943 | .940 | .20065 |

a. Predictors: (Constant), EACTIV2, LNKL

**ANOVA[b]**

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 28.435 | 2 | 14.217 | 353.124 | .000[a] |
| | Residual | 1.731 | 43 | .040 | | |
| | Total | 30.166 | 45 | | | |

a. Predictors: (Constant), EACTIV2, LNKL

b. Dependent Variable: LNQL

**Coefficients[a]**

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. | Correlations | | |
|---|---|---|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | | Zero-order | Partial | Part |
| 1 | (Constant) | .427 | .313 | | 1.364 | .180 | | | |
| | LNKL | .926 | .035 | .971 | 26.571 | .000 | .971 | .971 | .971 |
| | EACTIV2 | -2.17E-02 | .302 | -.003 | -.072 | .943 | -.017 | -.011 | -.003 |

a. Dependent Variable: LNQL