Empirical Investigation of IT Diffusion Drivers in Developed & Developing Countries

Ali Asghar Anvary Rostamy

Abstract

This paper provides an empirically based insight into IT diffusion drivers in developed and developing countries. For this purpose, a new conceptual model with five main factors has been provided and tested using data from 34 developed and 209 developing countries in 2008. The results explore major role of factor "Trade Related Knowledge Spillovers: TRKS) in promoting IT diffusion in both developed and developing countries, and the importance of factor "Financial Resources" in accelerating IT diffusion in developing countries. The results can help IT policymakers improve greater IT diffusion in a way that developing countries can take advantage of what already being enjoyed by the developed world.

Keywords: IT diffusion drivers, Developing countries, Developed counties, Trade related knowledge spillovers.
1. Introduction

Many specialists believe that IT diffusion helps countries accelerate their development (Winston, 2009). Although many countries have experienced the benefits of IT diffusion (Kim et al. 2009), however, IT investments and diffusion had a positive and significant relationship with productivity growth at the macroeconomic level in developed countries, but not in developing countries (James, 2009). Hence, one of the key questions of researchers now becomes what factors influence IT diffusion in developed and developing countries. Moreover, it is rational if we expect that developing economies have different drivers for IT diffusion than their wealthier brethren. In spite of several studies on IT diffusion (such as Shih et al. 2008), only a few empirical studies have investigated the relationship between factors influencing the level of IT diffusion in developed and developing countries.

This paper aims at offering an empirically based insight into IT diffusion drivers. It will discuss how IT diffusion drivers may be correlated differently with IT diffusion levels in developed and developing countries. In other words, it explains whether there are differences in these factors between developed and developing countries. It is anticipated that result of this research can improve greater IT diffusion in a way that developing countries can take advantage of what already being enjoyed in the developed world and aid policy makers in their future strategies.

There are some major differences between the present study and that was conducted by Shih, Kenneth, Kraemer and Dedrick (2008). Although both researches study Resources to Make Investment (RMI), Structure of the Economy (SE), and the Quality of General Infrastructural (QGI) factors, however, their measures are almost different. Moreover, we examined the effects of two new factors named Trade Related Knowledge Spillovers (TRKS) and the Easiness of Doing Business and Competiveness (EDBC) as well.

The remainder of the paper is structured as follows. Next section of the paper briefly explains the literature. Section 3 introduces the theoretical framework, the conceptual and operational models, and the research hypotheses. The data and methodology described in section 4. The data analysis presented in section 5. Finally, the paper ends with a brief summary, conclusions and final remarks.

2. The Literature

2.1. Knowledge Spillovers and Trade Related Knowledge Spillovers

Today, there is a widespread belief among the specialist about the fundamental role of technological change and knowledge to the competitiveness and long-term growth of economies. In fact, knowledge creation is the engine for economic growth. The importance of knowledge and information has increased with
the formation about the new economy and advances in Information and Communication
Technologies (ICT).

There are different ways by which a firm, a country or a group of countries (such as
developed or/and developing countries) can receive new technologies and information. One
of the cheapest ways is called Knowledge Spillover (KS). The non-appropriable amount
of knowledge generated by a firm’s or country’s innovation efforts is called KS.

KS among different economic units are one of the most intriguing aspects of technological
innovations and are of great importance for public policy making. There are several papers
that analyze the impact of technology and information on productivity. On the other
hands, the literature shows that most of recent attentions have shifted from analysis of the
productivity enhancing impact of technology to knowledge diffusion of new knowledge among
people, especially to IT.

Coe, Helpman and Hoffmaister (1997) discuss that foreign knowledge can be transferred by
several channels (such as by imports of intermediate and capital goods, cross-border
learning of production methods, product design and organization, imitation of new products,
development of technologies, and imitation of foreign technology). This argument let researcher
to examine links between KS through trade and output or productivity growth. Accordingly, Coe
et al. (1997) argue that developing countries can benefit from trading with industrial countries with
a large stock of knowledge from their past R&D activities and investments and examine the extent
to which developing countries benefit from R&D is performed in industrial countries. They study
the relationship between countries total factor productivity with their investment in R&D, the
degree of openness to trades that is measured by imports of machinery and equipments relative to
Growth Domestic Productions (GDP), the quality of human forces that is measured by secondary
school enrolment ratio, Foreign Direct Investment (FDI) as proxy of foreign R&D capital stock, and
imports from industrial countries as % of GDP. Using 22 OECD countries and 77 developing
countries data, they find that R&D spillovers from industrial countries are robust and countries with
open economies gain most.

Lee (2006) using data from 16 OECD countries for the period 1981–2000 examines the
significance of international KS through inward and outward FDI, intermediate goods imports,
and disembodied direct channel that is approximated using a measure of technological
proximity and patent citations between countries. They study the effectiveness of four different
major channels for international KS that have been investigated separately in previous studies
by relating the national productivity and these channels. They conclude that although
international KS are significant and substantial,
outward FDI and imports of intermediate goods are not conducive to international KS.

Falveya, Foster and Greenaway (2007) argue that although trade facilitate KS from developed to developing countries, the extent of KS benefits depend on domestic factors specifically relative backwardness and absorptive capacity. They relate growth rate of output per worker to growth of Trade Related Knowledge Spillovers (TRKS) and the ratio of investment to GDP, labor force growth, measure of schooling, the average ratio of imports plus exports to GDP (capturing other benefits of openness), and the measure of relative backwardness that is the proportional difference of initial GDP per worker in the recipient from that in the US. Their investigation on North–South TRKS show that absorptive capacity increases the benefits of knowledge spillovers, and that spillovers have least impact in countries closest to and farthest from the technological frontier.

2.2. IT Diffusion Drivers

Although various theoretical and empirical studies show that IT diffusion is correlated with the level of national wealth, other factors such as RMI, SE, QGI, EDBC and TRKS have been proved significant as well.

- **Resources for Making Investments (RMI).** Specialists believe that promoting IT diffusion level requires increasing investment in IT and investment, in turn, requires the availability of capital either from internal sources (such as equity markets and domestic loans and credits) or from external sources (such as FDI and/or foreign aid). For developed countries, equity markets and for most developing countries foreign aid as a substitute for scarce domestic capital and stimulate plays a significant role [Shih et al., 2008]. Then, we would expect that RMI positively correlate with IT diffusion.

- **Structure of the Economy (SE).** Various studies have noted that in financial services, the use of IT is much more pervasive and countries with larger financial services sectors have higher rates of diffusion in IT. Moreover, several earlier researches have found a significant positive association between the size of a country’s services sector and IT investment and diffusion. Thus, one can expect the positive impact of the financial services sector on IT investment and diffusion to be more profound in developed countries than developing countries. [Kraemer and Dedrick, 1994; Caselli and Coleman, 2001; Robison and Crenshaw, 2002]. Accordingly, we would expect that there is a positive correlation between the sizes of a country’s financial services sectors and IT diffusion level.

- **Quality of General Infrastructures (QGI).** Various studies show that effective adoption and usage of technologies such as IT requires strong infrastructures and good supplementary assets
Falveya, Foster and Greenaway (2007) argue that trade facilitate KS from developed to developing countries, but the extent of KS benefits depend on domestic factors specifically relative backwardness and absorptive capacity. Accordingly, we would expect that there is a positive correlation between the quality of a country’s infrastructures and absorptive capacity with IT diffusion level.

- **Easiness of Doing Business and Competition (EDBC).** Numerous studies have noted that the EDBC facilitates the technology adoption and diffusion. Several measures have been introduced to quantify the easiness of doing business and soundness of a competitive climate in a country. Ten measures that is widely used by international organizations (such as World Bank) are as follows:
  1. Easiness of starting a business [Djankov et al., 2002]
  3. Easiness of employing workers [Botero et al., 2004]
  5. Easiness of getting credit [Djankov et al., 2007]
  6. Easiness of protecting investors [Djankov et al., 2006]
  7. Paying taxes [Djankov et al., 2008]
  8. Easiness of trading across borders [Djankov et al., 2007]
  9. Enforcing contracts [Djankov et al., 2003]
  10. Easiness of closing a business [Djankov et al., 2006; http://www.doingbusiness.org/MethodologySurveys]

Accordingly, we would expect that there is a positive correlation between the easiness of doing business and IT diffusion level.

- **Openness to External Influences and Trade Related Knowledge Spillovers (TRKS).** IT diffusion requires a broad range of technical and managerial knowledge. Researchers believe that foreign trade facilitates the diffusion of such knowledge across borders and FDI has a positive impact on technical progress in the host country [Coe et al., 1997; Barrell and Pain, 1997]. Greater external openness should lead to more rapid diffusion of technologies into a country because multinational firms bring with them business practices that rely intensively on IT and knowledge of how to use IT productively. Moreover, openness to trade forces a country to greater international competition, driving IT investment and diffusion as a tool of survival, and to adopt IT to meet the requirements of foreign suppliers or customers. Thus, we would expect that there is a positive correlation between the level of openness and the use of IT and that the impacts
would be more significant for developing countries. [Coe et al., 1997; Barrell and Pain, 1997; Shih et al., 2008]

The TRKS literature implies that:

• KS is one of the cheapest ways of receiving knowledge
• R&D spillovers from industrial countries are robust
• Countries with open economies gain the most

• The effects of inward and outward FDI are not similar
• Absorptive capacity increases the benefits of knowledge spillovers
• KS have the least impact in countries closest to and farthest from the technological frontier.

Table 1 summarizes the literature on IT diffusion drivers.

<table>
<thead>
<tr>
<th>Factors</th>
<th>Related References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resources for technology investments</td>
<td>[Shih et al., 2008]</td>
</tr>
<tr>
<td>Structure of the economy</td>
<td>[Kraemer and Dedrick, 1994; Caselli and Coleman, 2001; Robison and Crenshaw, 2002]</td>
</tr>
<tr>
<td>Openness to external influences and trade knowledge spillovers</td>
<td>[Coe et al., 1997; Barrell and Pain, 1997; Shih et al., 2008]</td>
</tr>
<tr>
<td>Knowledge Spillovers and (KS) Trade Related Knowledge Spillovers (TRKS)</td>
<td>[Coe et al., 1997; Lee, 2006; Falveya et al., 2007; Deng, 2008; Shih et al., 2008]</td>
</tr>
<tr>
<td>Infrastructures</td>
<td>[Falveya et al., 2007; Kraemer and Dedrick, 1994; Caselli and Coleman, 2001; Robison and Crenshaw, 2002; Shih et al., 2008]</td>
</tr>
<tr>
<td>Easiness of Doing Business and Competition</td>
<td>[Djankov et al., 2002; Djankov et al., 2003; Botero et al., 2004; Djankov et al., 2007; Djankov et al., 2008]</td>
</tr>
<tr>
<td></td>
<td>[<a href="http://www.doingbusiness.org/MethodologySurveys">http://www.doingbusiness.org/MethodologySurveys</a>]</td>
</tr>
</tbody>
</table>

3. The Model and Research Hypotheses

Figure 1 shows the conceptual model of this research. In this model, IT diffusion relates to five main factors; TRKS, RMI, SE, EDBC, and QGI. Table 2 describes types of variables, IT diffusion drivers or the factors, and the measures that quantify each factors.
Figure 1 The Conceptual Model

Table 2 Type of variables, affective factors and measures

<table>
<thead>
<tr>
<th>Type of Variables</th>
<th>Factors</th>
<th>Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trade Related Knowledge Spillovers-TRKS</td>
<td>1. Stock of direct foreign investment - abroad (X11) 2. Stock of direct foreign investment - at home (X12) 3. Foreign trade (Exports) (X13) 4. Foreign trade (Imports) (X14) 5. Foreign companies listed in country (X15)</td>
<td></td>
</tr>
<tr>
<td>Structure of the Economy-SE</td>
<td>1. Unemployment rate (X31) 2. Population below poverty line (X32) 3. Inflation rate (consumer prices) (X33) 4. Labor forces by occupation in services (X34) 5. Industrial production growth rate (X35) 6. GDP real growth rate (X36)</td>
<td></td>
</tr>
<tr>
<td>Quality of General Infrastructural-QGI</td>
<td>1. Literacy (X51) 2. Age structure 15-64 years (X52) 3. Median age (X53) 4. HIV/AIDS (X54) 5. Infant mortality rate (X55) 6. Total fertility rate (X56) 7. Life expectancy at birth (X57)</td>
<td></td>
</tr>
<tr>
<td>Wealth</td>
<td>1. GDP - per capita (X58)</td>
<td></td>
</tr>
<tr>
<td>Dependent Variable</td>
<td>Information Technology Diffusion-ITD (Y)</td>
<td>1. IT Diffusion indicator* (Y)</td>
</tr>
</tbody>
</table>

* We used mean rank of each country in terms of 5 measures. The measures that quantify IT Diffusion are internet hosts, internet users, telephones main lines in use, telephones- mobile cellular, and television - broadcast stations.
This research investigates the following hypotheses:

**H1: TRKS correlates with IT diffusion level**
- H11: Stock of direct foreign investment abroad correlates positively with IT diffusion level
- H12: Stock of direct foreign investment at home correlates positively with IT diffusion level
- H13: Exports correlate positively with IT diffusion level
- H14: Imports correlate positively with IT diffusion level
- H15: Number of foreign companies listed in an economy correlate positively with IT diffusion level

**H2: RMI correlates with IT diffusion level**
- H21: Reserves of foreign exchange and gold correlate positively with IT diffusion level
- H22: Investment (gross fixed) correlates positively with IT diffusion level
- H23: Public debts correlate positively with IT diffusion level
- H24: External debts correlate positively with IT diffusion level
- H25: Economic aid as a donor correlates positively with IT diffusion level
- H26: Economic aid as recipient correlates positively with IT diffusion level
- H27: Market value of publicly traded shares correlate positively with IT diffusion level

**H3: SE correlates with IT diffusion level**
- H31: Unemployment rate correlates negatively with IT diffusion level
- H32: Population below poverty line correlates negatively with IT diffusion level
- H33: Inflation rate or consumer prices correlate negatively with IT diffusion level
- H34: Labor forces in services correlate positively with IT diffusion level
- H35: Industrial production growth rate correlates positively with IT diffusion level
- H36: GDP real growth rate correlates positively with IT diffusion level

**H4: EDBC correlate with IT diffusion level**
- H41: Easiness of doing business rank correlates positively with IT diffusion level
- H42: Easiness of starting a business correlates positively with IT diffusion level
- H43: Easiness of dealing with licenses correlates positively with IT diffusion level
- H44: Easiness of employing workers correlates positively with IT diffusion level
- H45: Easiness of registering property correlates positively with IT diffusion level
- H46: Easiness of getting credit correlates positively with IT diffusion level
- H47: Easiness of protecting investors’ correlates positively with IT diffusion level
- H48: Easiness of paying taxes correlates positively with IT diffusion level
- H49: Easiness of trading across borders correlate positively with IT diffusion level
- H410: Easiness of enforcing contracts correlates positively with IT diffusion level
- H411: Easiness of closing a business correlates positively with IT diffusion level

**H5: QGI correlates to IT diffusion.**
- H51: The level of literacy correlates positively with IT diffusion level
- H52: The population in age 15-64 years correlates positively with IT diffusion level
H53: Median age correlates positively with IT diffusion level
H54: The population with HIV/AIDS correlates negatively with IT diffusion level
H55: Infant mortality rate correlates negatively with IT diffusion level
H56: Total fertility rate correlates negatively with IT diffusion level
H57: Life expectancy at birth correlates positively with IT diffusion level
H58: GDP per capita correlates positively with IT diffusion level

Our main idea is that the factors shaping IT diffusion in developing countries differ from those in developed ones. Figure 2 shows the operational model of this research.

**Figure 2** The Operational Model
4. Data and Methodology

We developed model of IT drivers to identify which are correlated with IT diffusion in the entire sample of developed and developing countries. We used multiple measures to capture the factors hypothesized to correlate with the level of IT diffusion.

In order to test the hypotheses, we divide the sample into developed and developing countries. Developed countries usually have economic systems based on continuous, self-sustaining economic growth in the tertiary and quaternary sectors and high standards of living. Countries not fitting this definition may be referred to as developing countries. Accordingly, developed countries are Andorra, Australia, Austria, Belgium, Canada, China, Denmark, Faroe Islands, Finland, France, Germany, Gibraltar, Greece, Hong Kong, Iceland, Ireland, Territories not administered by the Palestinian authority, Italy, Japan, Luxembourg, Malta, Netherlands, New Zealand, Norway, Portugal, Singapore, Slovenia, Spain, South Korea, Sweden, Switzerland, Taiwan, United Kingdom, and United States of America (n=34). Countries not including in this list referred to as developing countries (n=209).

The main part of data is based on a well-structured international database for year 2008 [http://www.theodora.com/wfb]. This website strategizes historical information in the Library of Congress, World Fact Books and some other major international databases such as UNCTAD, World Bank database, International Monetary Funds (IMF) database, as well as some other international geography, economic, social and cultural related organizations. In order to calculate rank of each country, in terms of number of foreign companies listed there, we used final World Exchange database for 2007 [http://www.world-exchange.org].

As mentioned earlier, we used multiple measures to capture the factors hypothesized to correlate with the level of IT diffusion. We used ranks of countries in terms of each measure of independent variable and in order to measure the dependent variable, IT diffusion level, we used mean rank of each country in terms of five different measures of ICT (internet hosts, internet users, telephones main lines in use, telephones- mobile cellular, and television-broadcast stations).

In order to analyze the data and compare the correlation coefficients in developed and developing counties, first we applied simple regression method. Since a systematic analysis of correlations requires incorporating all factors in a unique regression equation, we applied stepwise regression method as well. In order to adjust data for Skeweness, logarithm of data was applied. Finally, we have reported the results in terms of research hypotheses in developed and developing counties.
5. Results of Data Analysis

5.1. Simple Regression Analysis

Table 3 shows the results of simple regression analysis for developed and developing countries. For developing countries most of research hypotheses (H1, H11, H12, H13, H14, H15, H2, H21, H22, H23, H24, H26, H27, H3, H34, H35, H36, H4, H41, H42, H43, H44, H45, H46, H47, H48, H49, H410, H411, H5, H51, H52, H53, H56, H57, H58) were significantly supported. In contrast, we could not find empirical evidences for H25, H31, H32, H33, H34, H35, H48, H52, H53, H54, and H55. The results imply that all five factors (TRKS, RMI, SE, EDBC and QGI) significantly correlated with IT diffusion level in developing countries.

For developed countries, H1, H11, H12, H13, H14, H2, H21, H22, H23, H24, H25, H27, H31, H36, H4, H41, H42, H43, H44, H45, H46, H47, H49, H410, H411, H5, H51, H54 were significantly supported. In contrast, we could not find empirical evidences for H15, H26, H3, H32, H33, H34, H35, H48, H52, H53, H55, H56, H57 and H58. The results imply TRKS, RMI, EDBC and QGI significantly correlated with IT diffusion level in developed countries but not with SE.

5.2. Stepwise Regression Analysis

We have applied multivariate stepwise regression method for developed and developing countries. Tables 4 and 5 show results of data analysis for developed and developing countries. Table 4 implies that $X_{14}$, $X_{48}$, and $X_{43}$ have significant correlation with IT diffusion in developed countries. The regression equation that defines the relation between them is as following

\[(1)\]

\[\ln y = 2.042897 + 0.62\ln x_{14} - 0.411\ln x_{48} + 0.300\ln x_{43}\]

By Removing the constant value from the equation (1) and using standard beta coefficients, the final equation becomes as Equation (2).

\[(2)\]

\[\ln y = 0.782\ln x_{14} - 0.437\ln x_{48} + 0.335\ln x_{43}\]

Table 5 shows $X_{13}$, $X_{48}$, $X_6$, $X_{25}$, $X_{27}$, $X_{49}$, $X_{42}$, $X_{31}$ have correlation with IT diffusion and the regression equation that defines the relation is as Equation 3:

\[(3)\]

\[\ln y = 0.037\ln x_{31} - 0.069\ln x_{42} + 0.111\ln x_{49} - 0.156\ln x_{27} + 3.141\ln x_{25} - 0.109\ln x_{6} - 0.107\ln x_{48} - 0.897\ln x_{13} + 10.729\]

By Removing the constant value from the equation (3) and using standard beta coefficients, the final equation will be as Equation (4):

\[(4)\]

\[\ln y = 0.942\ln x_{13} - 0.107\ln x_{48} - 0.112\ln x_{6} - 0.058\ln x_{25} + 0.120\ln x_{27} - 0.118\ln x_{49} + 0.069\ln x_{42} - 0.048\ln x_{31}\]

Equations (2) and (4) clearly show that there is a significant differences between developed and developing countries in terms of IT diffusion drivers.
<table>
<thead>
<tr>
<th>Problem</th>
<th>Research Question</th>
<th>Methodology</th>
<th>Data Collection</th>
<th>Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>How does the adoption of IT affect productivity?</td>
<td>Surveys</td>
<td>Questionnaires</td>
<td>Regression analysis</td>
</tr>
<tr>
<td>2</td>
<td>What factors influence the success of IT projects?</td>
<td>Case studies</td>
<td>Interviews</td>
<td>Content analysis</td>
</tr>
<tr>
<td>3</td>
<td>How can organizations better manage IT investments?</td>
<td>Experimental</td>
<td>Controlled experiments</td>
<td>ANOVA</td>
</tr>
</tbody>
</table>

**Table 1:** Research Question, Methodology, and Data Collection

Empirical Investigation of IT Diffusion...
Tables 6 and 7 show results of the examination of the model for developing and developed countries conceptual model. They study the correlations between each factors (TRKS, RMI, SE, EDBC, QGI) and IT diffusion level in developed and developing countries. As shown in Table 6, the regression equation for developed countries can be defined as

<table>
<thead>
<tr>
<th>Model</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig</th>
<th>Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Regression</td>
<td>16.498</td>
<td>1</td>
<td>16.498</td>
<td>66.298</td>
<td>0.000</td>
<td>Predictors: (Constant), lnX14</td>
</tr>
<tr>
<td>Residual</td>
<td>6.469</td>
<td>33</td>
<td>0.249</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>22.965</td>
<td>34</td>
<td>0.249</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Regression</td>
<td>15.760</td>
<td>2</td>
<td>8.880</td>
<td>42.657</td>
<td>0.000</td>
<td>Predictors: (Constant), lnX4, lnX45</td>
</tr>
<tr>
<td>Residual</td>
<td>5.204</td>
<td>32</td>
<td>0.208</td>
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<td></td>
</tr>
<tr>
<td>Total</td>
<td>22.965</td>
<td>34</td>
<td>0.208</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 Regression</td>
<td>19.106</td>
<td>3</td>
<td>6.369</td>
<td>39.606</td>
<td>0.000</td>
<td>Predictors: (Constant), lnX4, lnX44, lnX47</td>
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<tr>
<td>Residual</td>
<td>3.859</td>
<td>31</td>
<td>0.161</td>
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<tr>
<td>Total</td>
<td>22.965</td>
<td>34</td>
<td>0.161</td>
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<table>
<thead>
<tr>
<th>Model</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig</th>
<th>Considerations</th>
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<tbody>
<tr>
<td>1 Regression</td>
<td>90.379</td>
<td>1</td>
<td>90.379</td>
<td>1347.966</td>
<td>0.000</td>
<td>Predictors: (Constant), lnX14</td>
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<tr>
<td>Residual</td>
<td>44.798</td>
<td>208</td>
<td>0.067</td>
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<tr>
<td>Total</td>
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<td>209</td>
<td>0.067</td>
<td></td>
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<tr>
<td>2 Regression</td>
<td>92.523</td>
<td>2</td>
<td>46.263</td>
<td>777.486</td>
<td>0.000</td>
<td>Predictors: (Constant), lnX14, lnX48, lnX43</td>
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<tr>
<td>Residual</td>
<td>12.734</td>
<td>207</td>
<td>0.060</td>
<td></td>
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<tr>
<td>Total</td>
<td>105.257</td>
<td>209</td>
<td>0.060</td>
<td></td>
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</tr>
<tr>
<td>3 Regression</td>
<td>93.694</td>
<td>3</td>
<td>31.231</td>
<td>575.208</td>
<td>0.000</td>
<td>Predictors: (Constant), lnX14, lnX48, lnX43, lnX25</td>
</tr>
<tr>
<td>Residual</td>
<td>11.865</td>
<td>206</td>
<td>0.054</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Total</td>
<td>105.259</td>
<td>209</td>
<td>0.054</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 Regression</td>
<td>94.991</td>
<td>4</td>
<td>23.521</td>
<td>446.535</td>
<td>0.000</td>
<td>Predictors: (Constant), lnX14, lnX48, lnX43, lnX25, lnX42</td>
</tr>
<tr>
<td>Residual</td>
<td>11.168</td>
<td>205</td>
<td>0.053</td>
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</tr>
<tr>
<td>Total</td>
<td>105.259</td>
<td>209</td>
<td>0.053</td>
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</tr>
<tr>
<td>5 Regression</td>
<td>94.566</td>
<td>5</td>
<td>18.915</td>
<td>373.201</td>
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<td>Predictors: (Constant), lnX14, lnX48, lnX43, lnX25, lnX42, lnX49</td>
</tr>
<tr>
<td>Residual</td>
<td>10.693</td>
<td>204</td>
<td>0.051</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>105.259</td>
<td>209</td>
<td>0.051</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 Regression</td>
<td>94.932</td>
<td>6</td>
<td>15.828</td>
<td>321.741</td>
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<tr>
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<td>203</td>
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<td>209</td>
<td>0.049</td>
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<tr>
<td>7 Regression</td>
<td>95.208</td>
<td>7</td>
<td>13.601</td>
<td>282.845</td>
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<tr>
<td>Residual</td>
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<td>202</td>
<td>0.048</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>105.258</td>
<td>209</td>
<td>0.048</td>
<td></td>
<td></td>
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<tr>
<td>8 Regression</td>
<td>95.447</td>
<td>8</td>
<td>11.931</td>
<td>252.935</td>
<td>0.000</td>
<td>Predictors: (Constant), lnX14, lnX48, lnX43, lnX25, lnX42, lnX49, lnX47, lnX46, lnX44</td>
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<tr>
<td>Residual</td>
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<td>203</td>
<td>0.047</td>
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<tr>
<td>Total</td>
<td>105.259</td>
<td>209</td>
<td>0.047</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
ln\(Y = 1.403 + 0.709 \cdot \text{TRKS}\). By removing the constant value from the equation and using standard beta coefficients, the final equation will be as ln\(Y = 0.767 \cdot \text{TRKS}\). It means that in developed countries, TRKS is the only variable that has significant correlation with IT diffusion.

Table 6: Model summary, ANOVA and coefficients of the model for developed countries

<table>
<thead>
<tr>
<th>Model Summary</th>
<th>Model</th>
<th>R</th>
<th>R Square</th>
<th>Adjusted R Square</th>
<th>Std. Error of the Estimate</th>
<th>Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.767</td>
<td>0.588</td>
<td>0.573</td>
<td>0.04298</td>
<td>Predictors: (Constant), Trade Knowledge Spillovers, Dependent Variable: ln(Y)</td>
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</tr>
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</table>

**ANOVA**

<table>
<thead>
<tr>
<th>Model</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig</th>
<th>Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>13.511</td>
<td>1</td>
<td>13.511</td>
<td>37.160</td>
<td>0.000</td>
<td>Predictors: (Constant), Trade Knowledge Spillovers, Dependent Variable: ln(Y)</td>
</tr>
</tbody>
</table>

**Coefficients**

<table>
<thead>
<tr>
<th>Model</th>
<th>Unstandardized Coefficients</th>
<th>Standardized Coefficients</th>
<th>t</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>B</td>
<td>t Sig</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trade Knowledge Spillovers</td>
<td>0.709</td>
<td>0.116</td>
<td>0.767</td>
<td>0.001</td>
</tr>
</tbody>
</table>

**Excluded Variables**

<table>
<thead>
<tr>
<th>Model</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig</th>
<th>Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>13.511</td>
<td>1</td>
<td>13.511</td>
<td>37.160</td>
<td>0.000</td>
<td>Predictors: (Constant), Trade Knowledge Spillovers, Dependent Variable: ln(Y)</td>
</tr>
</tbody>
</table>

**Table 7: Model summary, ANOVA and coefficients of the model for developing countries**

<table>
<thead>
<tr>
<th>Model Summary</th>
<th>Model</th>
<th>R</th>
<th>R Square</th>
<th>Adjusted R Square</th>
<th>Std. Error of the Estimate</th>
<th>Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.879</td>
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<td>0.771</td>
<td>0.33400</td>
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</tr>
<tr>
<td>2</td>
<td>0.883</td>
<td>0.780</td>
<td>0.778</td>
<td>0.32862</td>
<td>Predictors: (Constant), Trade Knowledge Spillovers, Recourses to Make Investment, Dependent Variable: ln(Y)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>0.888</td>
<td>0.789</td>
<td>0.786</td>
<td>0.32259</td>
<td>Predictors: (Constant), Trade Knowledge Spillovers, Recourses to Make Investment, Doing Business Competitiveness, Dependent Variable: ln(Y)</td>
<td></td>
</tr>
</tbody>
</table>

**ANOVA**

<table>
<thead>
<tr>
<th>Model</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig</th>
<th>Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>13.511</td>
<td>1</td>
<td>13.511</td>
<td>37.160</td>
<td>0.000</td>
<td>Predictors: (Constant), Trade Knowledge Spillovers, Recourses to Make Investment, Doing Business Competitiveness, Dependent Variable: ln(Y)</td>
</tr>
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</table>

**Coefficients**

<table>
<thead>
<tr>
<th>Model</th>
<th>Unstandardized Coefficients</th>
<th>Standardized Coefficients</th>
<th>t</th>
<th>Sig</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>B</td>
<td>t Sig</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trade Knowledge Spillovers</td>
<td>0.709</td>
<td>0.116</td>
<td>0.767</td>
<td>0.001</td>
</tr>
</tbody>
</table>

**Excluded Variables**

<table>
<thead>
<tr>
<th>Model</th>
<th>Sum of Squares</th>
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<th>Mean Square</th>
<th>F</th>
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<tbody>
<tr>
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<td>13.511</td>
<td>1</td>
<td>13.511</td>
<td>37.160</td>
<td>0.000</td>
<td>Predictors: (Constant), Trade Knowledge Spillovers, Recourses to Make Investment, Doing Business Competitiveness, Dependent Variable: ln(Y)</td>
</tr>
</tbody>
</table>

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According Table 7, the regression equation for developing can be defined as following:

\[ (5) \]
\[ \ln Y = -1.057 + 1.125 \ln TRK + 0.364 \ln RMI - 0.128 EDBC \]

By removing the constant value from the equation (5) and using standard beta coefficients, the final equation will be as (6).

\[ (6) \]
\[ \ln Y = 0.769 \ln TRK + 0.209 \ln RMI - 0.108 EDBC \]

Equation (6) implies that TRKS, RMI and EDBC have significant correlations with IT diffusion in developing countries.

As a general conclusion, we find that among five factors, TRKS is the only factor that has positive and significant correlates with IT diffusion in both developed and developing countries, which support Coe et al. (1997), Lee (2006), Falveya et al. (2007), and Deng (2008). Moreover, we find that RMI plays a key role in developing countries.

6. Concluding Remarks

Many specialists believe that IT diffusion accelerates countries’ development, but there is a few empirical researches on IT diffusion in developed and developing countries. This paper aims at offering an empirically based insight into IT diffusion drivers in developed and developing countries. It determines IT diffusion drivers in developed and developing countries. The empirical results imply that TRKS has significant positive correlation with IT diffusion in both developed and developing countries but in developing countries, TRKS, RMI and EDBC have significant correlations with IT diffusion. We found that because of the lack of financial resources in developed countries, RMI has a significant correlation with IT diffusion for developing countries but not for developed countries.

Generally speaking, the greater countries’ openness and international trade through knowledge spillovers can develop IT diffusion in both developed and developing countries and that financial resources to make investment regards the other factor that helps developing countries accelerate their IT diffusion level.

References


آزمون تجربی محرک‌های به‌کارگیری تکنولوژی اطلاعات در کشورهای توسعه‌یافته و در حال توسعه

علي اصغر انواری رستمی

تاریخ پذیرش: 1387/11/16
تاریخ دریافت: 1388/22/26

این مقاله نتایج آزمون تجربی محرک‌های به‌کارگیری تکنولوژی اطلاعات در کشورهای توسعه‌یافته و در حال توسعه را ارائه می‌نماید. جهت نیل به این هدف، ابتدا مدلی مفهومی متشکل از 5 فاکتور اصلی ارائه گردیده است و سپس این مدل بر اساس داده‌های 24 کشور توسعه‌یافته و 211 کشور در حال توسعه در سال 2008 از جمله ایران مورد آزمون تجربی قرار گرفته است. نتایج بیانگر نقش مهم و بر جسته و معنادار فاکتور "انتقال دانش از طریق تجارت" یا فاکتور (Trade-Related Knowledge Spillover: TRKS) کارگیری تکنولوژی اطلاعات در هر دو دسته از کشورهای توسعه‌یافته و در حال توسعه و همچنین نشانگر اهمیت معنادار فاکتور "منابع مالی جهت سرمایه‌گذاری" در شتاب بخشیدن به میزان به کارگیری تکنولوژی اطلاعات در کشورهای در حال توسعه می‌باشد. نتایج حاصله را می‌توان از اجرای جهت سیاست سازان در راستای توسعه به کارگیری تکنولوژی اطلاعات به‌صورت آورده به تحریک کشورهای در حال توسعه را نیز قادر به بهره‌مندی از مواردی نماید که کشورهای توسعه‌یافته تا گوناگون آن بهره‌مند بوده اند.

واژگان کلیدی: محورهای به‌کارگیری تکنولوژی اطلاعات، کشورهای توسعه‌یافته، کشورهای در حال توسعه، انتقال دانش میانی بر تجارت

انواری@مدرس.ایران

1. دانشیار و عضو هیات علمی دانشگاه تربیت مدرس.