Analysis of the Impact of Information and Communication Technologies on the Development of Latvia as a New Member of the EU

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Abstract: - The data from three reports, namely, the Global Information Technology Report 2004 – 2005, the International Benchmarking Study 2004 and similar report from Latvia are analyzed in the present paper. The objective of the analysis is to highlight relative strengths and weaknesses of Latvia with respect to the use and adoption of information and communication technologies. Methods of analysis include regression analysis and hypotheses testing.

Key-Words: - linear regression model, information and communication technology, hypothesis testing

1 Introduction

Much of the increase in U.S. output and productivity growth since the mid-1990's has been attributed, at least partially, from the impact of the adoption and use of information and communications technology (ICT) [1]-[4]. The influence of ICT on the growth of the European economy has not been as noticeable as it has been in the U.S. during this same period of time [5]-[6]. Understanding the causes for this economic gap is especially emphasized by the Kok Commission of the Lisbon agenda for reform in Europe, whose goal is to improve Europe's global competitiveness [7]. The passive role and commitment of European national governments and excess government regulation were mentioned as areas that hinder ICT diffusion [8].

The data from the Global Information Technology Report 2004 – 2005 [9] are used in the present paper to assess the role of ICT in rapidly developing countries like Latvia, one of the new members of the EU. The data presented in [9] are summarized in the form of a Networked Readiness Index (NRI) for different countries in the world. The selection of countries is based on the availability of data and, therefore, is limited to 104 countries studied by the Executive Opinion Survey of the World Economic Forum. The NRI is defined in [9] as "the degree of preparation of a nation or community to participate in and benefit from ICT developments". It can be used to analyze a country's use of ICT and relative development in comparison with other countries. In addition, the NRI shows also the country's relative strengths and weakness in terms of using ICT. The NRI is computed on the basis of the three basic components: Environment (E), Readiness (R), and Usage (U). In addition, the score for each component is calculated as an arithmetic average of the scores on three subcategories for each component. In particular, the score for the Environment component is the average of the scores on Market (M), Political/Regulatory (PR), and Infrastructure (I) categories. Similarly, the Readiness component is calculated as the mean of the Individual Readiness (IR), Business Readiness (BR) and Government Readiness (GR). Finally, the score on the Usage component is the average of the scores of the Individual Usage (IU), Business Usage (BU), and Government Usage (GU) categories. The scores are standardized with a mean of zero. Thus, a positive score for a particular country indicates that this country had a better performance than the mean among the 104 countries studied.

The second report used in the paper is the International Benchmarking Study 2004 [10]. The report is based on a survey of business use of ICT in the UK and 10 other participating countries. More precisely, 2716 businesses in the UK and 500 in each of the 10 countries (Australia, Canada, France, Germany, Italy, Japan, the Republic of Ireland, South Korea, Sweden and the USA) were contacted and asked to respond on ICT usage. The report analyzes the ICT progress of 11 nations in five

categories: environmental influence, awareness and people, technology and adoption, process and deployment, and perceived impact. Major conclusions from the data are as follows. First, more businesses are measuring the benefits of technology. Second, businesses are becoming more selective in the way they use technology (in particular, they are more interested in applications that provide measurable benefits). Third, the proportion of businesses that consider competitors as major drivers for ICT implementation has increased significantly. Fourth, there are significant differences in the level of ICT adoption across sectors.

The third report analyzed in the paper is based on the data collected by the authors. The objective of the study was to compare the situation in the Republic of Ireland (ROI) and Latvia in terms of the ICT progress with respect to the five major categories mentioned above. It was expected that the comparative analysis of the data could shed some light on the major factors which influence the ICT adoption in Latvia. The Republic of Ireland was selected as a country for comparison because of the "Irish miracle"(the country was in a similar situation in Europe a few decades ago in comparison with the present position of Latvia). The questions in the Latvian survey were exactly the same as in [10]. The report is based on responses from 505 businesses in Latvia. The methodology and data collection procedure is explained in detail in the next section.

The analysis of data from the three reports shows major trends and factors that may be used to speed up the ICT adoption process in different countries. Mathematical methods that are used in the paper include regression analysis and hypothesis testing. In particular, comparative analysis of data indicates what need to be done in Latvia in order to overcome the current gap between developed countries and Latvia in terms of the ICT adoption.

2 Description of the survey methodology

Survey method and justification

The LBS 2006 survey was performed using telephone interviews with the top managers (owners) of companies who make decisions regarding IT issues. This method was used because one of the tasks was to obtain comparable data with other previously conducted studies (Eurostat's Eurobarometer, DTI's International Benchmarking Survey, ITU and OECD working papers, national surveys) This meant an analogous use of methodology.

Method of sample formation and justification

The "general population" was defined as all active operating private companies, an not labeled as "inactive", that are registered in Latvia as registered by the Central Stastics Bureau (CSP, Centrālā Statistikas Pārvalde). The CSP applies this approach when calculating the number of economically active companies and this is reflected in CSP publications. A total of 500 companies were included in the sample. This sample size has been reflected in similar studies as an adequate representation of a country's business population. Our research is based on the DTI International Benchmarking Survey, where 11 countries are represented and 500 ICT business and ICT professionals from each country were contacted and asked to respond to questions on ICT usage, plans, usage and attitudes within their businesses. We used stratified simple random sample. The following parameter was used as the feature of stratification: size of the company (number of employees in the company).According to statistics, the breakdown of companies registered in Latvia, according to the number of employees, is the following (Ekonomiski Aktīvie Uzņēmumi un Uzņēmējsabiedrības Latvijā 2000 – 2003.gads, CSB):

Micro companies (1 – 9 employees)	75.9%
Small companies (10 – 49 employees)	19.5%
Medium-size companies (50 – 249 employees)	4.0%
Large companies (250 and more employees)	0.6%

In order to obtain representativeanswers for each company group, as well as to keep the sample structure similar to previous studies, the following clusters were formed:

Micro companies	25.0%
Small companies	25.0%
Medium-size companies	25.0%
Large companies	25.0%

The companies were selected from the Central Statistics Bureau of Latvia (CSP) from the CSP data base of economically active companies.Taking into account the required proportions of different sized companies, the structure of the sample was defined (the number of companies in each stratum was determined). The sample was developed as a stratified simple random sample. The sample frame divided the companies into four strata. The strata

were defined based on the company size parameter (micro, small, medium and large companies).

Strata	Size of strata	Number of companies in the sample to be achieved
Micro companies	25%	125
Small companies	25%	125
Medium-size companies	25%	125
Large companies	25%	125
Total	100%	500

All the active companies based upon the data of CSB as of August 19, 2005 were included in the selection frame. In accordance with the typological classification of the CSB, the following companies were not included in the selection:
Companies where the share of the state, municipalities or their entities in the equity capital is equal to or over 50% and which do not have any participation of foreign capital;
Companies where the share of the state, municipalities or their entities in the equity capital is equal to or over 50% and which have the participation of foreign capital;
Budget entities;
Foundations, societies;
Political organizations;
Religious organizations;
Farms;
Rural craftsman enterprises;
Family enterprises;
Individual work;
Fisheries;
Subsidiaries of individual merchants;
Non-commercial subsidiaries of foreign merchants.
All the companies on which in the CSB data base of the economically active companies the following features of liquidation have been marked were excluded from the selection frame (the information source or the status of the company is noted):
Subsidiaries and representation offices
Newspapers
Bankruptcy
Notification from the Privatisation AgencyThe operation has been temporary suspended or has not been commenced
Notification of the State Revenue Service for liquidation has been received
Insolvency
Latvijas Vēstnesis
The operation has been terminated without legal liquidation (information from CSB surveys)
The company has been legally liquidated
Ordinances of ministries or municipality resolutions on liquidation of companies
The company has not been re-registered in the Commercial Register
The operation has been terminated without legal liquidation (information from regional surveys)
Court judgement on liquidation
Government ordinance
Thus the selection frame contained 47694 companies.

Based upon the sample structure (established stratas) the number of the companies to be selected was calculated. For the purposes of achieving 500 successful interviews a total of 3000 companies were selected according the random principle.

Strata	Size of strata	Number of companies in the planned sample	Number of companies obtained from CSB
Micro companies	25%	125	1000
Small companies	25%	125	1000
Medium-size companies	25%	125	750
Large companies	25%	125	250
Total	100%	500	3000

Thus, in the first strata in the selection frame there were 34374 companies, out of which 1000 companies were selected. In the second strata of the selection frame there were 8824 companies, out of which 1000 companies were selected. In the third strata of the selection frame there were 1816 companies, out of which 750 companies were selected. In the fourth strata of the selection frame there were 286 companies, out of which 250 companies were selected.

Organization of field work and quality control

For the purpose of insuring the content quality of the survey questionnaire, five pilot interviews were performed in different companies (different with respect to size, location and industry). Both, Latvian and Russian languages were used inthe pilot interviews.In accordance with the defined structure of the sample, and based upon the companies selected by CSB, a total of 505 interviews were performed (the required number of companies/ respondents were surveyed in each cluster).
Interviews with the compliant respondents were performed in two stages:

1. Contacting the potential respondents by telephone;

2. Performance of the telephone interviews.

For the purpose of finding the compliant respondent (company manager or owner who is the decision maker regarding IT issues), to receive his/her acceptance to participate in the survey, and agree on the time of the interview, initial phone calls were made to the selected companies. The call centre of the research centre SKDS was utilized for this function. Interviewers of SKDS who are prepared for the performance of phone interviews called all of the companies listed in the data base to obtain their acceptance to participate in the survey. The objectives, tasks, importance of the survey, as well as the motivation of the selection of the particular respondent were explained to the potential respondents. In cases of a positive reply:

An agreement on the time of the interview was made;

The respondent was informed about the length of the interview (approximately 30 minutes).

In accordance to the agreements made with the respondents, telephone interviews were performed either immediately or later in the prior agreed time.Prior to the survey, all the interviewers who participated in the project were trained on the content of the questionnaire and the methods of the particular survey in a special training seminar.The pre-programmed CATI system RM PLUS was used during the interviews.The CATI system was programmed to choose the respondents from the sample and automatically follow the numbers of completed interviews in clusters.

Since the sample was not representative to the distribution of companies by total number of persons employed, the weighting should be applied to guarantee the correspondence of data to the statistics.

For the calculation of sample weights, the inclusion probabilities of the companies in the sample should be determined. The design weights (Di) are inversely proportional to the inclusion probability (Wi).

$$Di=1 / Wi$$

The inclusion probabilities (Wi) are calculated as follows:

$$Wi = xi / yi$$

Wi – inclusion probability for i-th respondent

xi – the number of respondents for i-th group in the reached sample

yi – the coefficient that shows the number of respondents for i-th group that should be in an ideal sample according to statistics (general population)

$$yi = (Ci * S) / G$$

Ci – number of respondents in i-th group in general population

S – sample size

G – total number of respondents in general population

G – number of units in the general aggregate

Future recommendations regarding the LBS survey

It is recommmended to repeat the survey in 2007 for comparison purposes, and make it an annual survey in the future.

The survey's experimental status should be reviewed. It is recommended not to be a "one time" survey. One option could be involving the Ministry of Electronic Commerce, Department of Statistics, and Latvia Business Development and Investment Agency and other users of the survey. They could play a part in assuring the quality of future development and implementation of the LBS.The survey questionnaire should continue to be designed to meet international and Eurostat data requirements including investigating any improvements that will benefit respondents who are experiencing problems providing the required data or having difficulties understanding the definitions. The implications of collecting statistics by sector (banking, transportation, etc.) and regional statistics (Latgale, Kurzeme, Vidzeme, Zemgale) should be investigated. Developing an index that would meet international requirementsReporting the data and results to the press, trade associations, businesses and academics

3 Analysis of ICT Development in Latvia

The data presented in [9] are analyzed for each of the nine components of the NRI versus GDP. It is well-known that GDP per capita is one of the variables (but certainly not the only one!) which is usually used as an indicator of global competitiveness and economic activity of a country. A series of linear regression equations is analyzed where the dependent variable is one of the nine components of the NRI while the independent variable is GDP per capita. The results are summarized in the table below.

Component of the NRI	R^2	R^2_{adj}	F
BR	0.536	0.532	117.88
BU	0.567	0.563	93.69
GR	0.308	0.301	45.40
GU	0.400	0.364	59.87
IR	0.554	0.550	126.89
IU	0.760	0.758	426.88
I	0.708	0.705	219.49
PR	0.596	0.592	150.43
M	0.607	0.603	157.28

Table 1. The strength of the linear relationship between the components of the NRI and GDP per capita.

All the models are found to be statistically significant at $\alpha = 0.001$ level of significance (the value of the F statistic is quite large for all the cases analyzed). The results show that IU has the highest correlation with GDP. This makes sense since GDP reflects overall standard of living in a country. Thus, the higher is GDP per capita, the higher is the level of individual usage since availability of computers at home and access to Internet are considered as essential and vital components of everyday life in countries with relatively high GDP (many people can afford these commodities at home). The distribution of the IU scores versus GDP is shown in Fig. 1.

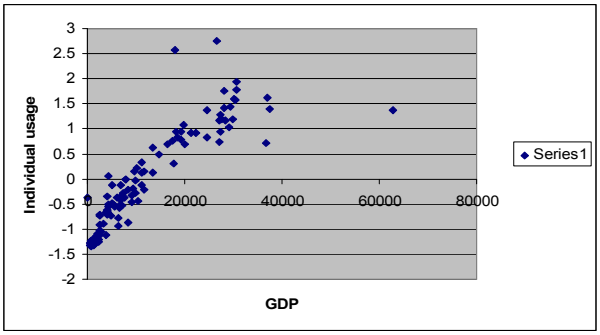

Fig. 1. IU versus GDP.

On the other hand, GR has the lowest correlation with GDP. This is an interesting observation since it reflects the fact that factors other than GDP per capita play an important role in government readiness to implement ICT.

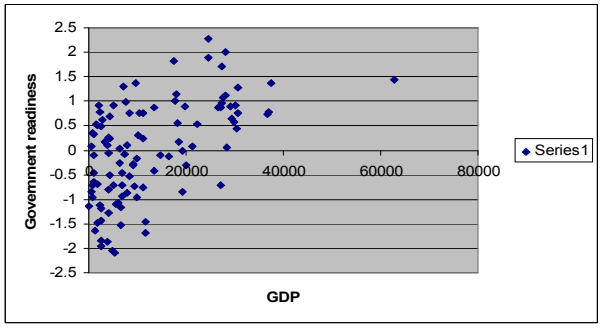

Fig. 2. GR versus GDP.

Let us compare the actual scores for Latvia with those predicted by the regression equations. The results are shown in Table 2.

Component	Actual score	Predicted score
BR	0.16	- 0.14
BU	0.13	- 0.16
GR	- 0.96	- 0.10
GU	- 0.73	- 0.13
IR	0.30	- 0.10
IU	- 0.04	- 0.20
I	- 0.12	- 0.20
PR	- 0.52	- 0.20
M	- 0.30	- 0.16

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Table 2. Comparison of the predicted and actual scores for Latvia.

As indicated earlier, some of the components of the NRI have rather low correlation with GDP (see Table 1). Therefore, we did not expect that the regression models would predict the scores well. Our main goal at this stage is to compare the actual scores and the predicted scores in order to identify the components of the NRI for Latvia which require special attention. As a result, a few conclusions can be drawn from Table 2. First, low actual scores on GR and GU are the major "contributors" to overall low rank for Latvia with respect to the NRI (Latvia was ranked 56th with the NRI of – 0.23). In addition, the predicted scores for GR and GU are much higher (– 0.10 and – 0.13, respectively). This fact was indicated earlier by the authors [11] and it means that the Latvian government can play an important role in ICT usage and adoption. All efforts should be made to increase the government readiness and usage in terms of ICT. Second, the regression models considerably underestimate the actual scores for BR, BU, IR and IU. This means that (a) other factors rather than GDP play an important role in the

adoption of ICT in Latvia and (b) the actual business readiness, business usage and individual readiness are well above the average score of zero. This is rather positive sign indicating that both businesses and individual users are ready for faster and more technically advanced adoption of ICT.

One cannot underestimate the role of technology diffusion at this stage. Presently (especially after the crisis in Russia in 1998) many Latvian companies have trading partners from the EU. In addition, there are many "solid players" from the West in Latvian banking sector, finance, insurance industry. These companies bring new technology and communication services to Latvia. As a result, local businesses may need less time for ICT adoption and, therefore, there is an opportunity to elevate the current differences between Latvia and developed countries with respect to ICT. From the analysis point of view it may be worthwhile to include other factors than GDP in the regression model (for example, data reflecting major trading partners of a particular country). We are planning to develop such a model in the near future.

4 Analysis of the Factors Affecting the ICT Progress in Latvia

In this section a comparative analysis of the issues related to the ICT adoption in the Republic of Ireland and Latvia is made. The objective is to identify perceived similarities and differences between businesses in the two countries in order to use this information to stimulate faster transition to higher ICT adoption levels in Latvia. All the variables that are analyzed are categorical (nominal measurement scale with only two categories). Therefore, the test for the difference between two proportions [12] is used to identify statistically significant differences between proportions of respondents who answered positively to the formulated question.

We start with the first category – Environmental Influence. Statistically significant differences (at less than 0.01 level) are found between responses to the questions "Do you gain or share technology advice (a) with suppliers, (b) with customers and (c) from media/journals/books?" The percentage of positive responses was 20%, 24% and 11% for Latvia versus 50%, 57% and 48% for the ROI, respectively.

Substantial difference exists between Latvia and the ROI in terms of the percentage of businesses that have e-mail interaction with government (49% for Latvia versus 16% for the ROI, Z score = 11.17). In fact, relatively low level of e-mail interaction with government is typical for many developed countries and is not related to a decline in the sophistication of ICT adoption. If government is making information more accessible online then the number of e-mail enquiries is certainly reducing. The high percentage of e-mail interaction of businesses in Latvia with government is consistent with findings in Section 2 where low level of government readiness and government usage in Latvia is found.

Businesses in both countries rate competitors as major driver for ICT implementation at a similar level (42% in Latvia versus 40% in the ROI, Z score = 0.65, no statistical difference at 0.1 level). Similarly, there is no statistical difference between businesses feeling constrained by regulation in adopting ICT (7% in Latvia versus 9% in the ROI, Z score = – 1.17).

Let us consider the second category – Awareness and People. It is interesting to note that percentage of businesses with positive attitudes towards ICT is 90% in both countries. Similarly, percentage of staff with positive reaction to new ICT is similar: 83% in Latvia and 79% in the ROI. Thus, Latvia follows the general trend indicated in [10] that there is a strong correlation between positive attitudes of businesses and positive staff response to ICT. Statistically significant differences at 0.01 level are found between proportions of businesses perceiving cost as a barrier (Z scores for set-up costs and running costs are – 4.49 and – 3.17, respectively).

People-related implementation barriers are viewed similarly in both countries. More precisely, the percentage of businesses in Latvia which view lack of skills, reluctance of staff and lack of knowledge as a barrier are 10, 3 and 5, respectively, versus 12, 6 and 5 in the ROI (Z scores are – 1.01, – 2.3 and 0, respectively). The proportion of businesses in Latvia with written business plan is significantly smaller (56%) in comparison with the ROI (71%), Z score = – 4.94. Considerable difference exists in the way businesses in the two countries assess their employees' IT skills. Only 40% of the businesses in Latvia are mostly satisfied with their employees' IT skills versus 57% in the ROI (Z score = – 5.39).

Essential differences exist between the measurement indicators in the third category – Technology and Adoption. Despite the fact that the proportion of businesses with Internet access is similar in both countries (more than 90%), only 33% of micro businesses and 34% of small businesses in Latvia have a website versus 63% and 73%,

respectively, in the ROI. Adoption of videoconferencing is very low in Latvia – 2.5% versus 21% in the ROI.

Process and Deployment category is analyzed to assess the extent to which ICT are used by businesses. Essential differences exist also in this category. For example, the proportions of businesses that provide information about products and services for customers online is much smaller in Latvia – 35% versus 69% in the ROI (Z score = – 10.77). Similarly, 17% of businesses in Latvia provide information about product availability for customers online versus 40% in the ROI (Z score = – 9.18). Only 26% of businesses in Latvia provide information about pricing, terms and conditions for customers online versus 34% in the ROI (Z score = – 2.73). It is interesting to note that percentage of businesses in Latvia that pay for goods and services online (45%) is not statistically significant from the proportion of businesses in the ROI (43%). Similarly, 22% of businesses in Latvia allow customers to pay for goods and services online versus 26% in the ROI (Z score = – 1.79), the difference is not statistically significant at 0.05 level. Significant differences exist in the proportion of businesses that use online banking (3% in Latvia versus 71% in the ROI, Z score = – 22.37) and in the proportion of businesses that use online technology (6% in Latvia versus 31% in the ROI, Z score = –10.05). However, the proportion of businesses with integrated internal systems is similar in both countries. For example, in Latvia 25% of businesses have already integrated internal systems, 10% are currently integrating and 18% have specific plans in place. The corresponding percentage of responses in the ROI was 28%, 14% and 17%, respectively (Z scores are –1.08, –1.95 and 0.42, respectively, so that in all the cases the differences are not statistically significant at 0.05 level of significance).

Perceived Impact category refers to the extent to which the adoption of ICT changes the way businesses do business. Some interesting observations are made by comparing data from Latvia with that from the ROI. For example, the average percentage of total sales (by value) made online by businesses selling online is 32% for Latvia and 18% for the ROI (the difference is statistically significant at 0.01 level). Similarly, the average percentage of total purchases (by value) made online by businesses which place orders online is 29% for Latvia and 25% for the ROI. About 47% of businesses in the ROI systematically measure the cost of technology versus 65% in Latvia (the difference is statistically significant at 0.01 level of significance).

5 Conclusion

Beginning with the premises that there is strong evidence that there is a relationship between ICT and productivity growth and evidence indicating that the European Union has not reached its ”potential’, in terms of ICT-related productivity growth, we have examined how Latvia compares to a number of EU countries and the rest of the world. Using the Global Information Technology Report 2004-2005 and the Business in the Information Age: The International Benchmarking Study 2004 along with an original questionnaire for Latvia based on the latter report, we have made a detailed comparison of Latvia and the Republic of Ireland. We found that there are many similarities between the two nations. For example, businesses in both countries rate competitors as major driver for ICT implementation; overall reaction to new ICT is viewed similarly in both Latvia and the Republic of Ireland as well as people-related implementation barriers.

Essential differences exist in the way businesses in the two countries assess their employees’ IT skills: the proportion of the businesses in Latvia that are mostly satisfied with their employees’ IT skills is much lower than in the ROI. In addition, relatively small proportion of businesses in Latvia uses online services to inform customers about product availability, prices and conditions. Only 3% of businesses in Latvia use online banking versus 71% in the ROI.

We conclude that in terms of understanding of the benefits of ICT the differences between Latvia and developed countries are not so large. However, much work needs to be done in terms of the technical realization and implementation of ICT in Latvia.

The role of GDP as one of the factors that affects the extent to which a nation can use and benefit from ICT developments is analyzed. Our findings have several government policy implications. The results show that the Latvian government plays a role in the potential adoption of ICT in the country. In order to promote faster diffusion growth of ICT in Latvia, policy makers should promote open market conditions, leading to foreign investment. i.e., multi-national corporations (MNCs), which in turn lead to IT-based business practices and IT systems [13]. They should also focus on liberalizing telecommunications [14], promoting e-commerce

and ICT [15], and passing specific legislation on e-commerce and IT [16]-[17] For example, regarding the latter, in the United States, legislation was passed in 2001, recognizing electronic signatures, but e-signatures are still not catching on [18]. The same holds true in Latvia [19].

In summary, all of the above factors should to be addressed by the Latvian government and would help increase ICT diffusion and hence the productivity of the Latvian economy.

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