Knowledge Economy Factors and the Development of Knowledge-based Economy

Dragomir Sundać
Faculty of Economics, University of Rijeka, Croatia
sundac@efri.hr

Irena Fatur Krmpotić
Faculty of Economics, University of Rijeka, Croatia
ifatur@efri.hr

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Abstract

The aim of this paper is to identify the various knowledge economy factors that have an impact on the achieved economic growth of national economies. This paper argues that there is no single scenario for building a knowledge-based economy. It utilizes variables of the knowledge economy, collected according to the Knowledge Assessment Methodology (KAM - benchmarking tool of the World Bank), on a sample of 118 countries. The countries are divided in three income groups according to GDP per capita PPP in 2006. Multivariate analysis is used. The analysis was conducted twice on data from KAM 2007 and KAM 2008 to avoid drawing wrong conclusions through using data limited to a single year. The results suggest that there are many significant factors and variables of knowledge economy that have an impact on the achieved development of the three income groups. Based on these results, proposals and measures for

enhancing sustainable development and building knowledge-based economies for the three income groups of countries are made.

Keywords: knowledge-based economy, knowledge assessment methodology, knowledge economy framework

JEL classification: O11, O47, O57

1 Introduction[1]

In the past decade much research has been conducted on productivity-led economic growth and its determinants. A major reason for this is the widespread belief that, due to rapid factor accumulation, economic growth is subject to diminishing returns and, hence, not sustainable. Recently, there has been growing interest in the contribution of knowledge to total factor productivity growth and, consequently, to sustainable long-term economic development.

Economic research on knowledge comes in various forms. For instance, there has been much research into the importance of human capital to economic growth (Barro, 1991; Hanushek and Kimko, 2000; Cohen and Soto, 2006) in the sense of education or achieved skills. Some research has also been conducted on innovations and R&D that lead to new technologies, ultimately resulting in increases in output per capita (Adams, 1990; Lederman and Maloney, 2003). Other research (Lee and Pilat, 2001; Stiroh, 2002) has focussed on the effects of information and communication technologies (ICT) on economic growth. The application of knowledge in areas such as entrepreneurship and innovation, R&D, software and product design, and in people's education and skill levels, is now being recognized as one of the key sources of growth in the global economy (Chen and Dahlman, 2005).

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In 1999 the World Bank Institute launched a project entitled "Knowledge for Development" (K4D). Its aims were to raise awareness among national policy-makers about the powerful growth effects of knowledge and to encourage economists to combine global and local knowledge in order to accentuate comparative advantages (World Bank, 2008).

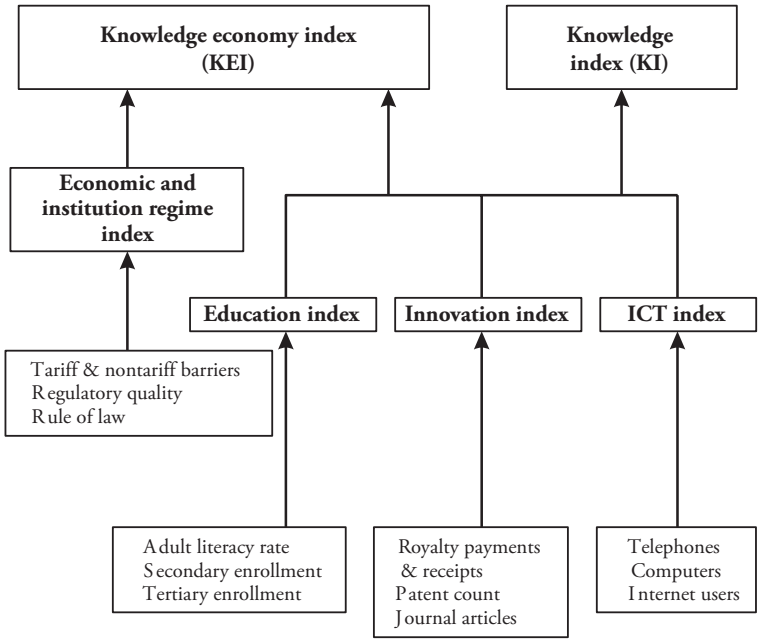
It has been determined that successful transition to the knowledge economy often includes four elements: long-term investments in education, the development of innovation capability, the modernization of the information infrastructure and the creation of a conducive economic environment. The World Bank has set these elements as the four pillars of the knowledge economy within the Knowledge Economy Framework. These pillars are (Chen and Dahlman, 2005):

- *an economic incentive and institutional regime* that provides good economic policies and institutions that permit efficient mobilization and allocation of resources and stimulate creativity and incentives for the efficient creation, dissemination and use of existing knowledge;
- *educated and skilled workers* who can continuously upgrade and adapt their skills to efficiently create and use knowledge;
- *an effective innovation system* of firms, research centers, universities, consultants and other organizations that can keep up with the knowledge revolution, tap into the growing stock of global knowledge and assimilate and adapt it to local needs;
- *a modern and adequate information infrastructure* that can facilitate the effective communication, dissemination and processing of information and knowledge.

The Knowledge Economy Framework postulates that the amount of knowledge and how it is used are key determinants of total factor productivity (TFP). Strengthening the four pillars of the knowledge economy will lead to an increase in the quantity and quality of the pool of knowledge available for economic

production in any country. This in turn will increase productivity and, thus, economic growth (Chen and Dahlman, 2004). The World Bank Institute has developed the Knowledge Economy Index (KEI), as well the Knowledge Index (KI), for ranking countries. Both are presented in Figure 1.

Figure 1: *KI and KEI Indices as a Benchmarking Tool*



Source: KAM (2009).

The KAM Knowledge Index measures a country's ability to generate, adopt and diffuse knowledge. This is an indication of the overall potential for knowledge development in a given country. Methodologically, the KI is the simple average of the normalized performance scores of a country or region on the key variables in three of the knowledge economy pillars – education and human resources, the innovation system and ICT. The Knowledge Economy Index takes into account whether the environment is conducive for knowledge to be used effectively for

economic development. It is an aggregate index that represents the overall level of development of a country or region in relation to the knowledge economy. Calculation of the KEI is based on the average of the normalized performance scores of a country or region on all four pillars of the knowledge economy - economic incentive and institutional regime, education and human resources, the innovation system and ICT (KAM, 2009). Figure 1 shows the four pillars of the knowledge economy with three key variables[2] representing each pillar. In calculating the KEI and KI indices, as well as the indices of the four pillars of the knowledge economy, the World Bank ranks countries according to a single model of building a knowledge-based economy which it applies to all countries.

However, each pillar consists of a large number of knowledge economy indicators (i.e., variables) collected according to the KAM. It would be financially unsustainable for the countries to invest in all of them. Governments in developing countries often have limited financial resources that must be rationalized. Therefore it would be very useful for governments to know which factor of the knowledge economy is the best investment for providing a significant contribution to its country's economic progress and moving it into a higher income group.

This paper provides evidence that knowledge economy factors differ between countries according to their levels of socio-economic development and, therefore, it can be argued that there is no single scenario for building a knowledge-based economy.

2 These 12 variables were selected in the Basic Scorecard because they were generally available over a longer time period and are regularly updated for the vast majority of the countries that are assessed by the KAM (Chen and Dahlman, 2005).

2 Knowledge Economy Factors According to the World Bank Project "Knowledge for Development"

The KAM is an interactive online benchmarking tool which allows countries to identify the problems and opportunities that they face in making the transition to the knowledge economy. The KAM represents a comprehensive tool for reviewing world development data aggregated and compiled from several reputable institutions (WB, UN, UNESCO, WEF, UNCTAD, USPTO, IES and ITU) (Malhotra, 2003). The KAM versions for 2007 and 2008, used in this study, consisted of a set of 83 structural and qualitative variables, of which 74 variables were used as proxies for the previously cited pillars of the knowledge economy in 140 countries. Sixty-six percent of the 74 knowledge economy variables were "hard data" and 34 percent "soft data".

This paper examines whether there is a statistically significant correlation between the individual pillars of the knowledge economy, consisting of knowledge economy variables, and the achieved economic development of national economies. The achieved level of economic development is measured by GDP per capita PPP in 2006 and 2007.[3]

3 Knowledge Economy Factors and Their Impact on the Economic Growth of National Economies

3.1 Methodology

The research started with 74 knowledge economy variables and a group of 140 countries. The total number of variables available was extremely large, so it was

3 GDP per capita in 2006 was the latest available data in the KAM 2007, with GDP per capita in 2007 being the latest in the KAM 2008.

necessary first to choose those which were most relevant,[4] and then to make a selection of the countries. For some countries, many data are missing. One approach for dealing with missing values is to omit entire records (for variables or countries) where there are "substantial missing data" (Freudenberg, 2003). Since a criterion for "substantial missing data" was not found in the literature, there was an arbitrary decision to omit the 22 countries with missing data in more than 15 variables. Ultimately the sample consisted of 118 countries, but still remained representative,[5] enabling the further application of inferential statistics.

The variables for which data were missing in a large number of countries were then determined. An arbitrary decision was taken to delete those variables with more than 25 percent of missing data (i.e., data were available in less than 88 countries).[6] The EM (Expectation-Maximization) algorithm and the MCMC (Markov Chain Monte Carlo) method were applied.

The next step was to divide the 118 countries into subgroups. The countries covered in this study differ in their achieved level of socio-economic development, and it would be wrong to put them together in the same empirical model. Durlauf and Johnson (1995), Temple (1999) and Osborne (2006) argue that it is not possible to integrate developing and developed countries into a single empirical framework. Durlauf and Johnson (1995) suggest that different countries have different output-labor ratios, different literacy rates and access to different aggregate technologies. Temple (1999) shows that countries differ widely in social, political and institutional characteristics. Osborne (2006) concludes that richer countries have more complex, diverse economies than the poor ones, so a single model of building a knowledge-based economy would not be appropriate.

4 Variables omitted from the study were: variables expressed in absolute terms, variables that measure the same phenomenon and variables with no data available for Croatia. After the elimination procedure, 63 variables remained (i.e., 11 variables were omitted). The results of the qualitative variable selection are available on request.

5 195 registered countries in 2006 realized a global GDP of 48,626,969 million US$. The 118 countries used in this study achieved a total GDP of 47,928,372 million or 98.6 percent of world's GDP. In 2006, 6.602 billion people lived on Earth and 95.5 percent of the world population lived in these 118 countries.

6 Four variables were excluded according to this criterion, so 59 variables remained.

Durlauf and Johnson (1995) suggest that heterogeneity can be reduced by sorting the economies into subgroups based upon some common characteristics.

Accordingly, the economies were divided into three groups depending on their achieved level of economic development. The World Economic Forum criteria were used (Lopez-Claros et al., 2006):

- low-income countries: GDP per capita PPP lower than US$ 4,000;
- middle-income countries: GDP per capita PPP between US$ 4,000 and US$ 17,000;
- high-income countries: GDP per capita PPP higher than US$ 17,000.

There were 30 low-income countries (LICs), 49 middle-income countries (MICs) and 39 high-income countries (HICs) according to their level of GDP per capita PPP in 2006. Among the HICs two were significantly atypical, Luxembourg and Qatar,[7] so they were omitted from the study.

The statistical tests performed on all the remaining variables in the three predefined income groups of countries were:

- Kolmogorov-Smirnov test. Variables which did not meet the criteria of normality were omitted from further analysis. These were:
  - 12 variables in the LICs: Interest Rate Spread; FDI Outflows as % of GDP; Royalty and License Fees Payments per Million Population; Royalty and License Fees Receipts per Million Population; Total Expenditure for R&D as % of GDP; University-Company Research Collaboration; Scientific and Technical Journal Articles per Million Population; Patent Applications Granted by the USPTO per Million People; Tertiary Enrollment (% gross); School Enrollment, Tertiary,

7 These two countries have a small population (Qatar had 885,358 inhabitants, which represented 0.013 percent of the world population in 2006; Luxembourg had 483,800 inhabitants, representing 0.007 percent of the world population) and a much higher GDP than other HICs. Qatar's development is based primarily on exports of oil and natural gas, and Luxembourg is the world's financial center. These two countries certainly do not represent the typical HIC.

Female (% gross); Computers per 1,000 Persons; International Internet Bandwidth;

- 8 variables in the MICs: Cost of Registering a Business; FDI Outflows as % of GDP; Royalty and License Fees Payments per Million Population; Royalty and License Fees Receipts per Million Population; Patent Applications Granted by the USPTO per Million People; High-Technology Exports as % of Manufactured Exports; Life Expectancy at Birth; TV Households with Television;
- 7 variables in the HICs: Tariff & Non-tariff Barriers; Interest Rate Spread; Cost of Registering a Business; Voice and Accountability; FDI Outflows as % of GDP; Royalty and License Fees Receipts per Million Population; Adult Literacy Rate.

- Bivariate Linear Regressions (BLR) as a procedure for reducing the number of variables in determining the level of significance of individual variables in the model. Variables that had insignificant beta coefficient or t-ratio explaining the relatively small percentage of variation criteria (GDP per capita PPP) were omitted from further analysis (the results of BLR are presented in Table A1 for the LICs, Table A2 for MICs and Table A3 for the HICs in Appendix).
- Variance Inflation Factor (VIF) as a method of detection of multicollinearity. A VIF greater than 5 was applied for the rejection of variables (3 variables in the LICs and MICs and 6 variables in the HICs). The variables omitted in the LICs were: Trade as % of GDP, Average Years of Schooling and Gender Development Index. Variables omitted in the MICs were: Government Effectiveness, Rule of Law and Voice and Accountability. Variables omitted in the HICs were: Rule of Law, Government Effectiveness, Control of Corruption, Private Sector Spending on R&D, Firm-Level Technology Absorption and Total Expenditure on R&D as % of GDP. The analysis was conducted separately for each income group of countries and for each pillar of the knowledge economy.

- Principal Component Analysis[8] (PCA) in order to transform correlated variables collected in pillars of the knowledge economy into a smaller number of uncorrelated variables called "principal components" or "knowledge economy factors". PCA was applied to the variables of four knowledge economy pillars and through the three income groups of countries. The Kaiser-Meyer-Olkin criterion 0.6 or higher, as recommended by OECD researchers (Nardo et al., 2005), was applied. The factors were given appropriate names according to the variables that remained in them. By using PCA, five factors were formed for the LICs, four factors for the MICs and five factors for the HICs (the results of PCA are available on request).
- Cronbach Alpha Coefficient as a measure of internal consistency of items in a model. C-alpha was applied to the variables that remained within given factors of knowledge economy. C-alpha results showed that the LICs in 2006 had two internally consistent factors: Education and ICT. The MICs in 2006 had four internally consistent factors: Law and Institutions, Potential for Innovation, Education and ICT. The HICs in 2006 had four internally consistent factors: Law and Institutions, Potential for Innovation, Labor-force Quality and ICT.[9]
- Heteroscedasticity was tested by using scatter diagrams and it did not seem to be a problem.

Thus, data were prepared for the further application of multivariate regression. All the statistical procedures which have been described were applied on updated variables for the second research[10] (due to the limited scope of this paper, the results of these procedures are available on request).

8 The main applications of factor analytic techniques are: (1) to reduce the number of variables and (2) to detect structure in the relationships between variables, that is to classify variables (StatSoft, 2011).

9 The results of C-alpha test are available on request.

10 The second survey had the same sample of 118 countries. Most of the variables of the knowledge economy had been updated in new data published in the KAM 2008. Any missing data were imputed with data from the previous year.

3.2 Results

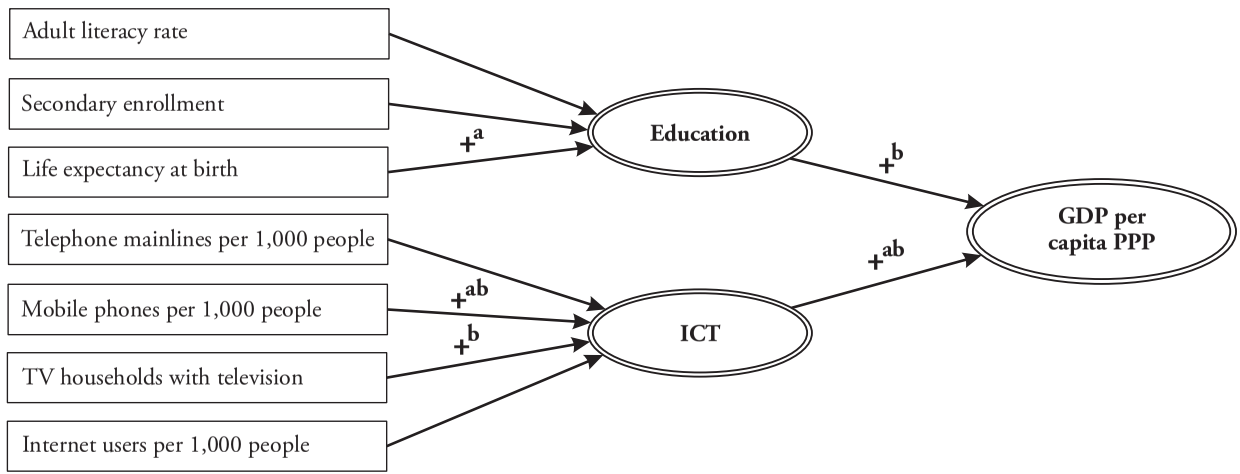
Multivariate regression was used to determine the relationship between all established factors and GDP per capita PPP.[11] The factors were then disaggregated, and the independent contribution of individual variables in explaining the variance of GDP per capita PPP was determined. Regression analysis was conducted for all the income-grouped countries and for the two observed years. The results of multivariate regression and semi-partial correlation are presented in Tables A4 and A5 for the LICs (Model 1), in Tables A6 and A7 for the MICs (Model 2) and in Tables A8 and A9 for the HICs (Model 3) in Appendix.

To help distinguish the research results for the different income-grouped countries and detect the similarities and differences within the results, the relevant knowledge economy factors with selected variables (which were detected as relevant in both analyses) are shown in the following diagrams. Model 1 is shown in Figure 2.

Figure 2 indicates that only two knowledge economy factors, Education and ICT, with their relevant variables, played an important role in the achieved socio-economic development of the LICs. Although the Education factor consisted of three variables, only Life Expectancy at Birth had a statistically significant independent contribution in explaining GDP per capita variance in 2006. While the ICT factor consisted of four variables, only Mobile Phones per 1,000 People made a statistically significant independent contribution in explaining GDP per capita variance in both analyses. Model 2 is shown in Figure 3.

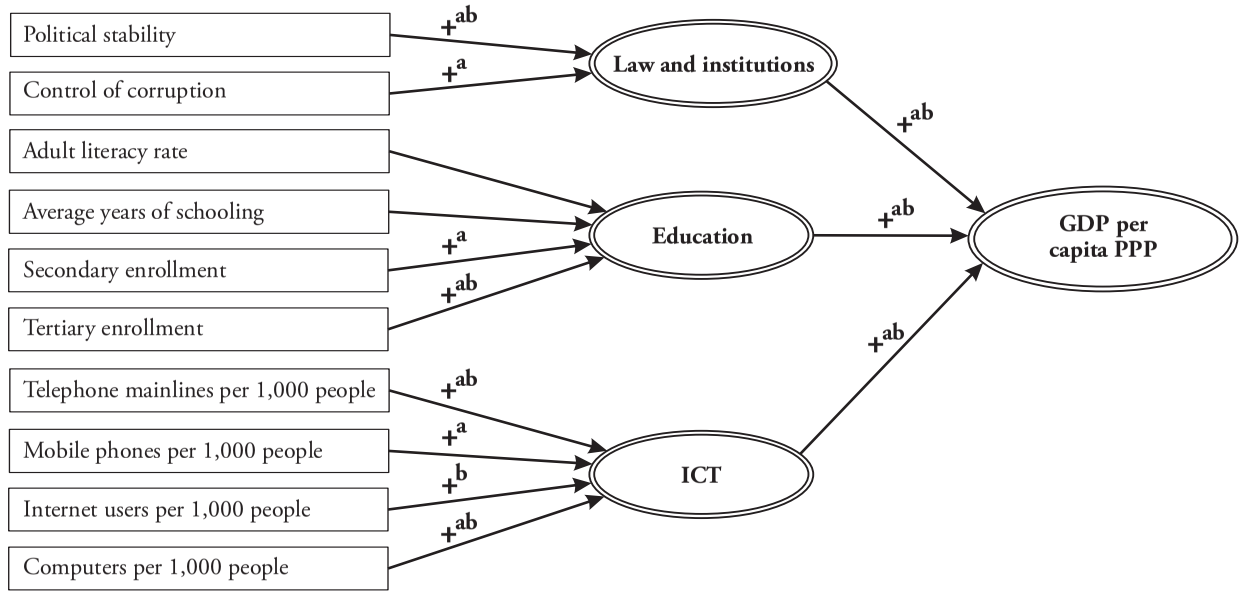
11 Regression diagnostics determine the quality of the model. Several techniques for assessing multiple regression models were used: the Durbin-Watson test, distribution of errors of regression coefficients and Cook's distances (the results for Models 1, 2 and 3 are available on request).

Figure 2: *Empirically Confirmed Impacts of Knowledge Economy Factors and Selected Variables on the Achieved Socio-economic Development of the LICs (GDP 2006 and 2007)*



Note: +a relationship confirmed in the KAM 2007; +b relationship confirmed in the KAM 2008; +ab relationship confirmed in both analyses.
Source: Authors' calculations based on Tables A4 and A5 in Appendix.

Figure 3: *Empirically Confirmed Impact of Knowledge Economy Factors and Selected Variables on the Achieved Socio-economic Development of the MICs (GDP 2006 and 2007)*



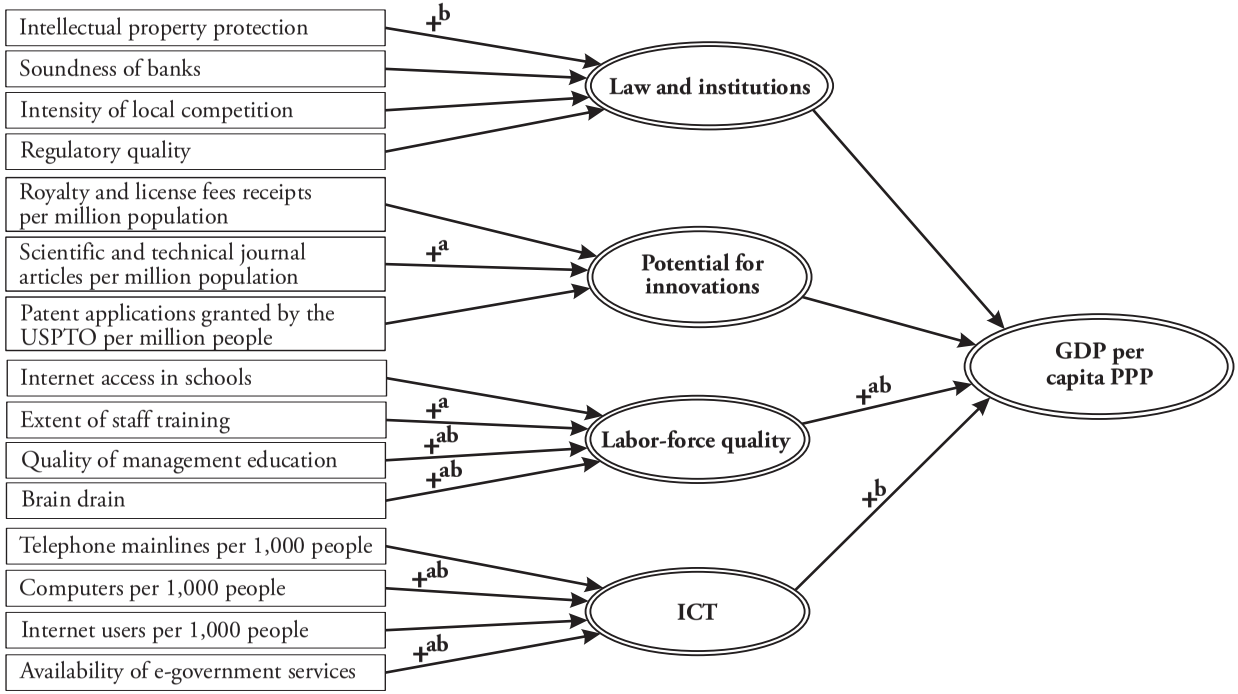
Note: +a relationship confirmed in the KAM 2007; +b relationship confirmed in the KAM 2008; +ab relationship confirmed in both analyses.
Source: Authors' calculations based on Tables A6 and A7 in Appendix.

Results for the MICs show that three factors of the knowledge economy (Law and Institutions, Education and ICT) were formed and made a positive impact on the socio-economic development of the group. The factor Potential for Innovation was not significantly associated with GDP per capita PPP in 2006, and in 2007 it did not even feature. The factor Law and Institutions consisted of three variables, but in both analyses only the Political Stability variable had a statistically significant independent contribution. Among the variables of Education, only Tertiary Enrollment showed a statistically significant independent contribution in both researches in explaining variance of GDP per capita PPP. The factor ICT consisted of four variables. In both the observed years, Telephone Mainlines per 1,000 People and Computers per 1,000 Persons had a statistically significant independent contribution in explaining the GDP per capita variance.

Results presented in Figure 4 show that four factors of the knowledge economy for the HICs were formed. Only Labor-force quality and ICT had a positive impact on the achieved development of the HICs. The factor Labor-force quality consisted of four variables among which Quality of Management Education and Brain Drain had a statistically significant independent contribution in explaining the dependent variable in both researches. Two variables of ICT that had a statistically significant independent contribution in both analyses were Computers per 1,000 Persons and Availability of e-Government Services.

Model 3 is illustrated in Figure 4.

Figure 4: *Empirically Confirmed Impact of Knowledge Economy Factors and Selected Variables on the Achieved Socio-economic Development of the HICs (GDP 2006 and 2007)*



Note: +a relationship confirmed in the KAM 2007; +b relationship confirmed in the KAM 2008; +ab relationship confirmed in both analyses.
Source: Authors' calculations based on Tables A8 and A9 in Appendix.

4 Discussion

The previous section has identified the knowledge economy factors that made a relevant contribution to the achieved economic development of a specific income group of countries.

The Knowledge Economy Framework with its four pillars was the starting point for exploring the relevant knowledge economy factors for three different income groups. After using statistical procedures and factor analysis, only two factors were formed for the low-income group of countries: Education and ICT. Other, theoretically set knowledge economy pillars did not gain empirical verification. Thus, the variables of Economic Incentives and Institutional Regime did not form a homogeneous construct (C-alpha was low). This can be explained by the following facts: the LICs have an unstable system of government due to wars and revolutions (this refers especially to countries in Africa), state institutions are lacking or not functioning properly, and there is widespread corruption (Transparency International, 2008).

Also, the variable of the Innovation System did not form a homogeneous construct (low C-alpha), which can be explained by the fact that the LICs have not yet built a system of intellectual property protection. These countries have a relatively low number of highly educated people and scientists, ongoing loss of skilled labor and poor investment in R&D. The overall social development of the LICs is so low that they have none of the elementary prerequisites for enabling innovation. Another reason for the lack of empirical confirmation of the two pillars (Economic Incentives and Institutional Regime and Innovation System) might be the large number of missing data or measurement errors.[12]

The study has shown a statistically significant relationship between the factors of Education and ICT and GDP per capita PPP, so the development of these two areas has to be made a priority in the development strategy of the LICs.

12 The LICs had the most missing data. The problem of accessing data for the LICs is often mentioned by other researchers (Erdil, Turkcan and Yetkiner, 2009: 8-9).

At the beginning of the 21st century, it is evident that the educational levels in a population strongly influence developmental inequality between different countries, in addition to influencing poverty and income inequalities within individual countries (Karaman-Aksentijević and Ježić, 2009: 17). The national governments of the LICs must become actively involved in increasing literacy rates and providing universal access to primary education, at the very least. But experts warn that the accumulation of human capital is not of itself sufficient for economic growth (Azariadis and Drazen, 1990). In fact, there is a certain threshold of accumulated human capital that has to be surpassed before one can expect concrete benefits from investment in human capital. This is vitally important for the LICs, which therefore must intensify their investment in education to ensure universal access to both primary and secondary education. Life expectancy at birth must also be improved. This will have a positive impact on the accumulation of human capital and social prosperity. These conclusions were confirmed by the results of the study, which showed that previous efforts for improved education and literacy have contributed to the achieved level of development of the LICs.

In recent years, there has been growing access in the LICs to new forms of ICT, such as mobile phones and the internet. There is a huge digital divide in the use of ICT between developed and developing countries.[13] However, the development of wireless technology has the potential to reduce this gap. The use of mobile phones has the highest growth rate of ICT use in the LICs.[14] By improving access to information and enabling communication, ICT could play an important role in eliminating extreme poverty, fighting disease and achieving universal primary education and gender equality (Parliamentary Office of Science and Technology,

13 Internet use in low- and lower-middle-income countries did not start until 1994, whereas in several HICs it started as early as 1990. In 2004, in the HICs, about 40 percent of the population enjoyed internet services, while the percentage was less than 3 percent in LICs. In other words, LICs will take more than 50 years to "close" that digital divide (Andrés et al., 2007: 7).

14 For instance, Africa lacks of investment-intensive infrastructure, such as landlines and fixed broadband. But in recent years, Africans increasingly use mobile telephony as a means of communication. So, mobile telephony has a higher coverage rate in that region. Cheaper infrastructure and larger regional penetration, cheaper handsets, competitive markets and business models are oriented to the needs of the poorer segments of the population (Avila, 2009: 2).

2006). However, the benefits of ICT are not fully realized in many LICs because of a lack of adequate infrastructure and human capital to support the application of ICT.

The results have shown that Law and Institutions, Education and ICT had a statistically significant impact on GDP per capita PPP for *middle-income countries* in both analyzed years.

Law and Institutions had a positive impact on the achieved economic development of MICs because effective rule of law and the protection of every citizen's rights and interests invariably play an important role in the economic progress of any country. Among the variables of Law and Institutions, only Political Stability had a statistically significant correlation with GDP per capita. Similar results can be found in the panel research (Alesina et al., 1992) on 113 countries during 1950-1982 which showed that political instability and economic growth are jointly determined. These researchers concluded that, in countries and time periods with a high rate of government collapse, growth was significantly lower than otherwise.

The factor of Education for the MICs consisted of variables that measure the quantity of education.[15] Human capital, particularly human capital achieved through education, is an important determinant of economic growth. The higher the level of education, the higher the worker skills and productivity, leading ultimately to increased production of goods and services. The level of absorption of advanced technologies from more developed countries depends on the skills of well-educated people. The results of the study indicate that the MICs should encourage their citizens to finish secondary and higher education to gain stronger human capital, with an increase in the average number of years of schooling, and improvement in the quantity of education. These achievements will certainly lead to greater economic development.

15 It is necessary to distinguish between quantity and quality of education. The years of schooling and enrollment rates are indicators of quantity of education. Knowledge and skills, i.e., cognitive abilities, which can be developed through formal education but also in the family, with peers and from the prevailing culture represent the quality of education (Hanushek and Wößmann, 2007).

The research conducted for this study has shown a statistically significant relationship between ICT and achieved economic development in the MICs. Investment in ICT infrastructure and skills helps to diversify economies from dependence on their natural-resource endowments and offsets some of the location disadvantages of landlocked and geographically remote countries. This can attract more FDI - particularly investments in non-traditional sectors - an effect enhanced if democratization encourages economic reforms and other policy measures that improve the investment climate (Addison and Heshmati, 2003: 2).

The variables of the Innovation System formed a homogeneous construct only in 2006. The formation of an efficient national Innovation System takes many years. In addition, huge investments in supporting institutions, as well as strong connections between government, universities and industries are needed.

High-income countries base their economies to a large extent on knowledge, or if not they are on their way to do so. Regression results showed statistically significant correlation between Labor-force Quality and GDP per capita PPP in both observed years. This means that, apart from formal education, staff training and education for the quality of management were important factors in gaining skilled workers in the HICs. As the variables that formed Labor-force Quality represent qualitative measures of education, their goal was to determine workers' cognitive skills.

At first, a statistically significant positive correlation between the indicator of Brain Drain[16] and the achieved economic growth of the HICs seemed surprising. After reviewing studies that have dealt with the brain drain phenomenon, it is possible to determine the logical reasons for such a significant correlation. Docquier and Marfouk (2004) estimated skilled workers' emigration rates for about 190 countries in 2000 and 170 countries in 1990 and determined that

16 The variable of Brain Drain is based on the statistical score on a 1-7 scale of a large sample group in a particular country asked to rate whether the country's talented people normally leave to pursue opportunities in other countries (1), or almost always remain in the country (7). So, high Brain Drain values mean that fewer highly educated people are leaving the country.

the U.S. had the greatest benefit from skilled immigration (53 percent of the total number of immigrants in 2000), followed by the EU (16.3 percent) and Canada (13.9 percent). In the period 1990-2000, the percentage of professional immigrants from the LICs (India, China, Vietnam, Pakistan, Indonesia) coming to OECD countries increased significantly. In absolute terms, countries most affected by brain drain were the Philippines, India, China, Mexico and Vietnam, but also Great Britain, Germany, Canada and Italy. Recently conducted research by Schiff and Wang (2008) has shown that the impact of human capital (measured by the average number of years of education for the population aged 25 and above) on TFP and the interactive effect of TFP on human capital, foreign trade and R&D were significantly stronger in small countries than in large. That means that small countries are particularly affected by TFP reduction through brain drain. It can be concluded that very few developed countries have benefits from the brain gain, while others record losses. Small states are more sensitive to changes in brain drain. In addition, the sample of the HICs used in this study consisted of a larger number of small, rather than big countries, so that the status of small and big countries in the sample was the same, which logically resulted in a stronger statistical significance of brain drain.

In the second study of GDP per capita in 2007, ICT was statistically significantly correlated with the achieved economic growth of the HICs. This relationship, therefore, should be interpreted with caution. However, OECD (2004) found that ICT had a beneficial effect on productivity, which probably played a leading role in stimulating growth. The impact of ICT on national indicators was less rapid than expected, because ICT works in synergy with other complementary factors, such as the political and legal environment and the availability of human capital. Among the variables of the ICT factor, the Availability of e-Government Services had a statistically significant independent contribution in explaining the GDP per capita PPP variance in both observed years. Such results are not surprising since ICT is increasingly used in the public sector. Developed countries are introducing e-government, e-learning, e-health and e-business.

The factor Law and Institutions showed no statistically significant relationship to the dependent variable in either of the observed years. This is probably because the system of law and institutions was already functioning successfully in this group of countries.

An interesting result of multiple regressions showed that there was no statistically significant relationship between Potential for Innovation and GDP per capita PPP. This could be explained by the fact that the HICs are currently in different stages of building national innovation systems, some of which have probably been completed in a few developed countries, such as Sweden and Finland. These innovative societies can thank their National Innovation System for a large part of their economic growth. In other HICs, the creation of National Innovation Systems is yet to come.

5 Conclusion

Building a knowledge-based economy is a long process involving radical and far-reaching changes. The transformations that a particular country should make depend primarily on its achieved level of economic development. Scenarios for building a knowledge-based economy cannot be common to all countries. If we divide the process of building a knowledge-based economy into three phases, we can argue that the LICs belong to *the first stage* of that process.

According to our results, the priorities for the LICs in this first phase are:

- More intensive application of ICT, primarily by increasing the use of mobile phones and increasing the number of households with television. A unit increase in the number of mobile phones per 1,000 people would on average increase GDP per capita by 5.6 US$ in the LICs. Similarly, a unit increase in the share of households with television would on average increase GDP per capita by 19.39 US$. The development of ICT, especially wireless technology, could lessen the digital divide that exists between

developing and developed countries, and reduce extreme poverty. Greater use of ICT would help in fighting diseases and in educating people.

- Improvement in the educational structure of the population, especially by increasing literacy, and extending life expectancy at birth.

Although the research results show that the LICs are still far from being fully-fledged knowledge-based economies, through these changes they would create the minimal basis needed for the greater use and dissemination of knowledge, and prepare their economies for the *second phase* of their transformation towards knowledge-based economy.

The MICs, which include Croatia, are in the *second phase* of transformation towards knowledge-based economy. The priorities in the second phase are:

- More intensive application of ICT, especially by increasing telephone mainlines, and the number of computers and internet users in the population. A unit increase in the relevant ICT variables would on average significantly increase GDP per capita. For instance, a unit increase in telephone mainlines per 1,000 persons would on average have increased GDP per capita by 7.82 US$ in 2006 and 16.65 US$ in 2007. A unit increase in Internet users would on average increase GDP per capita from 14.97 to 19.05 US$.

- Quantitative improvement of education by increasing secondary and tertiary enrollment rates (a unit increase in the share of tertiary enrollment would on average increase GDP per capita from 95.81 to 145.98 US$).

- Improvement of Law and Institutions, in particular by exerting greater control, combating corruption and strengthening political stability. Improving certain aspects of Law and Institutions is arguably the most complex task facing national governments, but its realization would lead to a significant increase in GDP per capita. A one point increase in the

index for political stability in the MICs would increase GDP per capita from 1,913.19 to 2,166.88 US$.

The HICs are currently in *the third phase* of transformation of their economies toward knowledge-based economy. The priorities of the third phase are:

- Improvement of the quality of the labor force, especially through better management education and by controlling and reducing the brain drain. For instance, a one point increase in the quality of management education index would change GDP per capita from 3,230.50 to 3,810.50 US$. Similarly, a one point increase in the brain drain index (meaning that fewer highly educated people leave the country) would boost GDP per capita in the HICs from 3,880 to 6,875 US$.

- Intensive application of ICT, especially through increasing the number of computers in the population and providing greater availability of e-government and other e-services. A unit increase in the number of computers per 1,000 persons would on average increase GDP per capita from 12.26 to 16.45 US$. A one point increase in the availability of e-government services would on average lift GDP per capita in the HICs from 3,106.16 to 3,555.41 US$.

Depending on their achieved economic development, all national economies should systematically manage the relevant factors of the knowledge economy to ensure that their economies are based increasingly on knowledge, in order to achieve higher rates of economic growth and sustainable development. The consistent and effective use of knowledge over time would certainly pay off.

Appendix

Table A1: *Results of BLR in the LICs (GDP per capita PPP in 2006 as Dependent Variable)*

	Variable	t-ratio	Adjusted R^2	β
1	Gross Capital Formation as % of GDP (average 1995 – 2004)	3.14	0.23	0.510
2	Trade as % of GDP, 2005	2.53	0.16	0.431
3	**Tariff & Nontariff Barriers, 2006**	**-0.53**	–	**-0.100**
4	**Intellectual Property Protection, 2006**	**0.30**	–	**0.056**
5	**Soundness of Banks, 2006**	**-0.32**	–	**-0.060**
6	Exports of Goods and Services as % of GDP, 2005	0.42	0.15	2.440
7	**Intensity of Local Competition, 2006**	**0.24**	**0.02**	**1.275**
8	Domestic Credit to Private Sector (% of GDP), 2005	3.08	0.23	0.503
9	**Cost to Register a Business (% of GNI per capita), 2006**	**-0.38**	–	**-0.070**
10	**Days Required to Start a Business, 2006**	**0.70**	–	**0.131**
11	Cost to Enforce a Contract (% of debt), 2006	-2.38	0.14	-0.411
12	**Regulatory Quality, 2005**	**0.44**	–	**0.082**
13	**Rule of Law, 2005**	**0.51**	–	**0.097**
14	**Government Effectiveness, 2005**	**0.28**	**0.04**	**1.520**
15	**Voice and Accountability, 2005**	**0.02**	–	**0.096**
16	**Political Stability, 2005**	**0.06**	–	**0.012**
17	**Control of Corruption, 2005**	**0.76**	–	**0.143**
18	**Press Freedom, 2006**	**-0.10**	–	**-0.019**
19	FDI Outflows as % of GDP (average 2001-2005)	2.12	0.11	0.372
20	Researchers in R&D, 2004	2.16	0.11	0.380
21	**Manufacturing Trade as Percentage of GDP, 2005**	**0.28**	**0.04**	**1.516**
22	**Availability of Venture Capital, 2006**	**1.64**	**0.05**	**0.295**
23	**High-Technology Exports as % of Manufactured Exports, 2005**	**0.45**	–	**0.084**
24	**Private Sector Spending on R&D, 2006**	**-0.67**	–	**-0.125**
25	**Firm-Level Technology Absorption, 2006**	**0.34**	–	**0.064**
26	Value Chain Presence, 2006	2.30	0.13	0.399
27	Adult Literacy Rate, 2004	2.38	0.14	0.410
28	Average Years of Schooling, 2000	3.21	0.24	0.519
29	Secondary Enrollment, 2005	3.30	0.25	0.529
30	Life Expectancy at Birth, 2005	0.49	0.21	2.960
31	Internet Access in Schools, 2006	2.54	0.16	0.438
32	**Public Spending on Education as % of GDP, 2005**	**1.06**	**0.04**	**0.196**
33	**Quality of Science and Math Education, 2006**	**1.66**	**0.06**	**0.299**
34	Extent of Staff Training, 2006	1.87	0.08	0.332
35	**Quality of Management Education, 2006**	**0.45**	–	**0.084**
36	**Brain Drain, 2006**	**1.12**	**0.01**	**0.207**
37	Gender Development Index, 2004	4.76	0.43	0.67

38	Females in Labor Force (% of total labor force), 2005	-1.99	0.09	-0.35
39	**Seats in Parliament Held by Women (as % of total), 2005**	**-0.01**	–	**-0.002**
40	School Enrollment, Secondary, Female (% gross), 2005	3.59	0.29	0.561
41	Telephone Mainlines per 1,000 People, 2005	3.46	0.28	0.55
42	Mobile Phones per 1,000 People, 2005	4.01	0.34	0.604
43	TV Households with Television, 2005	3.25	0.25	0.524
44	Internet Users per 1,000 People, 2005	2.67	0.17	0.450
45	Price Basket for Internet, US$ per Month, 2005	-2.90	0.20	-0.481
46	**Availability of e-Government Services, 2006**	**0.10**	–	**0.018**
47	**Extent of Business Internet Use, 2006**	**0.77**	–	**0.144**

Note: Variables marked in bold are omitted from further analysis because of the low t-ratios and beta coefficients.
Source: Authors' calculations.

Table A2: *Results of BLR in MICs (GDP per capita PPP in 2006 as Dependent Variable)*

	Variable	t-ratio	Adjusted R^2	β
1	**Gross Capital Formation as % of GDP (average 1995 – 2004)**	**-0.39**	–	**-0.057**
2	**Trade as % of GDP, 2005**	**0.38**	–	**0.056**
3	Tariff & Nontariff Barriers, 2006	2.64	0.11	0.359
4	Intellectual Property Protection, 2006	2.16	0.07	0.300
5	**Soundness of Banks, 2006**	**1.01**	**0.00**	**0.146**
6	**Exports of Goods and Services as % of GDP, 2005**	**1.18**	**0.01**	**0.170**
7	**Interest Rate Spread, 2005.**	**-0.80**	–	**-0.116**
8	**Intensity of Local Competition, 2006**	**0.91**	–	**0.132**
9	**Domestic Credit to Private Sector (% of GDP), 2005**	**1.35**	**0.04**	**0.194**
10	**Days Required to Start a Business, 2006**	**-0.53**	–	**-0.078**
11	Cost to Enforce a Contract (% of debt), 2006	-2.61	0.11	-0.356
12	Regulatory Quality, 2005	4.89	0.32	0.581
13	Rule of Law, 2005	4.84	0.32	0.576
14	Government Effectiveness, 2005	6.81	0.49	0.7052
15	Voice and Accountability, 2005	4.06	0.25	0.510
16	Political Stability, 2005	5.60	0.39	0.633
17	Control of Corruption, 2005	5.27	0.36	0.609
18	Press Freedom, 2006	-2.77	0.12	-0.375
19	**FDI Inflows as % of GDP (average 2001-2005)**	**-0.21**	–	**-0.031**
20	Researchers in R&D, 2004	3.40	0.18	0.444
21	**Total Expenditure for R&D as % of GDP, 2004**	**1.82**	**0.05**	**0.257**
22	**Manufacturing Trade as Percentage of GDP, 2005**	**1.36**	**0.02**	**0.195**
23	University-Company Research Collaboration, 2006	3.25	0.17	0.428
24	Scientific and Technical Journal Articles per Million Population, 2003	6.36	0.45	0.680

25	Availability of Venture Capital, 2006	3.21	0.16	0.424
26	Private Sector Spending on R&D, 2006	2.39	0.09	0.329
27	**Firm-Level Technology Absorption, 2006**	**1.29**	**0.01**	**0.186**
28	Value Chain Presence, 2006	2.25	0.08	0.313
29	Adult Literacy Rate, 2004	2.91	0.13	0.391
30	Average Years of Schooling, 2000	3.96	0.23	0.500
31	Secondary Enrollment, 2005	3.64	0.20	0.469
32	Tertiary Enrollment (% gross), 2005	4.70	0.31	0.565
33	Internet Access in Schools, 2006	4.30	0.28	0.531
34	Public Spending on Education as % of GDP, 2005	2.60	0.11	0.354
35	Quality of Science and Math Education, 2006	2.28	0.08	0.316
36	Extent of Staff Training, 2006	2.80	0.13	0.379
37	Quality of Management Education, 2006	2.47	0.10	0.339
38	Brain Drain, 2006	2.14	0.07	0.298
39	Gender Development Index, 2004	4.56	0.29	0.554
40	Females in Labor Force (% of total labor force), 2005	2.32	0.08	0.320
41	Seats in Parliament Held by Women (as % of total), 2005	2.77	0.12	0.375
42	School Enrollment, Secondary, Female (% gross), 2005	3.51	0.19	0.456
43	School Enrollment, Tertiary, Female (% gross), 2005	4.95	0.33	0.585
44	Telephone Mainlines per 1,000 People, 2005	5.62	0.39	0.633
45	Mobile Phones per 1,000 People, 2005	5.30	0.36	0.611
46	Computers per 1,000 People, 2005	6.23	0.44	0.672
47	Internet Users per 1,000 People, 2005	4.56	0.29	0.553
48	**Price Basket for Internet, US$ per Month, 2005**	**-0.95**	–	**-0.138**
49	Availability of e-Government Services, 2006	2.43	0.09	0.334
50	Extent of Business Internet Use, 2006	2.72	0.12	0.369

Note: Variables marked in bold are omitted from further analysis because of the low t-ratios and beta coefficients.
Source: Authors' calculations.

Table A3: *Results of BLR in the HICs (GDP per capita PPP in 2006 as Dependent Variable)*

	Variable	t-ratio	Adjusted R^2	β
1	**Gross Capital Formation as % of GDP (average 1995 – 2004)**	**-1.93**	**0.07**	**-0.310**
2	**Trade as % of GDP, 2005**	**-0.32**	–	**-0.053**
3	Intellectual Property Protection, 2006	6.84	0.56	0.765
4	Soundness of Banks, 2006	3.42	0.23	0.501
5	**Exports of Goods and Services as % of GDP, 2005**	**-0.16**	–	**-0.028**
6	Intensity of Local Competition, 2006	4.88	0.39	0.636
7	Domestic Credit to Private Sector (% of GDP), 2005	3.65	0.26	0.525
8	**Days Required to Start a Business, 2006**	**-1.86**	**0.06**	**-0.300**
9	**Cost to Enforce a Contract (% of debt), 2006**	**-0.63**	–	**-0.106**
10	Regulatory Quality, 2005	4.89	0.39	0.637
11	Rule of Law, 2005	7.93	0.63	0.801
12	Government Effectiveness, 2005	6.81	0.56	0.755
13	Political Stability, 2005	2.22	0.10	0.351
14	Control of Corruption, 2005	7.10	0.58	0.768
15	**Press Freedom, 2006**	**-1.71**	**0.05**	**-0.278**
16	**FDI Inflows as % of GDP (average 2001-2005)**	**-0.45**	–	**-0.076**
17	Royalty and License Fees Receipts (US$ millions) per Million Population, 2005	4.17	0.31	0.576
18	Researchers in R&D, 2004	4.63	0.36	0.616
19	Total Expenditure for R&D as % of GDP, 2004	3.73	0.26	0.533
20	**Manufacturing Trade as Percentage of GDP, 2005**	**0.27**	–	**0.046**
21	University-Company Research Collaboration, 2006	5.30	0.43	0.667
22	Scientific and Technical Journal Articles per Million Population, 2003	5.48	0.45	0.680
23	Availability of Venture Capital, 2006	6.38	0.52	0.733
24	Patent Applications Granted by the USPTO Per Million People, average for 2001-2005	4.51	0.35	0.606
25	High-Technology Exports as % of Manufactured Exports, 2005	2.41	0.12	0.377
26	Private Sector Spending on R&D, 2006	5.20	0.42	0.660
27	Firm-Level Technology Absorption, 2006	3.09	0.19	0.463
28	Value Chain Presence, 2006	3.45	0.23	0.503
29	Average Years of Schooling, 2000	2.62	0.14	0.406
30	Secondary Enrollment (% gross), 2005	2.08	0.09	0.332
31	Tertiary Enrollment (% gross), 2005	2.56	0.13	0.397
32	Life Expectancy at Birth, 2005	5.83	0.48	0.702
33	Internet Access in Schools, 2006	3.97	0.29	0.557
34	**Public Spending on Education as % of GDP, 2005**	**1.30**	**0.02**	**0.216**
35	**Quality of Science and Math Education, 2006**	**1.25**	**0.02**	**0.208**
36	Extent of Staff Training, 2006	6.89	0.56	0.759
37	Quality of Management Education, 2006	5.33	0.43	0.669
38	Brain Drain, 2006	5.73	0.46	0.695

39	Gender Development Index, 2004	7.81	0.63	0.7972
40	**Females in Labor Force (% of total labor force), 2005**	**1.52**	**0.04**	**0.249**
41	Seats in Parliament Held by Women (as % of total), 2005	3.154	0.20	0.470
42	**School Enrollment, Secondary, Female (% gross), 2005**	**2.00**	**0.08**	**0.320**
43	School Enrollment, Tertiary, Female (% gross), 2005	2.66	0.15	0.410
44	Telephone Mainlines per 1,000 People, 2005	4.72	0.37	0.624
45	**Mobile Phones per 1,000 People, 2005**	**0.48**	–	**0.081**
46	Computers per 1,000 People, 2005	5.83	0.48	0.702
47	**TV Households with Television, 2005**	**1.99**	**0.08**	**0.318**
48	International Internet Bandwidth, 2005	3.49	0.24	0.508
49	Internet Users per 1,000 People, 2005	3.32	0.22	0.489
50	**Price Basket for Internet, US$ per Month, 2005**	**0.34**	–	**0.058**
51	Availability of e-Government Services, 2006	4.67	0.37	0.620
52	Extent of Business Internet Use, 2006	3.97	0.29	0.558

Note: Variables marked in bold are omitted from further analysis because of the low t-ratios and beta coefficients.
Source: Authors' calculations.

Model 1

Table A4: *Factors of Knowledge Economy Related to GDP per capita PPP in 2006 and 2007 in the LICs*

Factors of Knowledge Economy	***Dependent Variable: GDP per capita PPP in 2006***			***Dependent Variable: GDP per capita PPP in 2007***		
	B	**Standard Error B**	**β**	**B**	**Standard Error B**	**β**
Education	83.59	229.82	0.10	410.64	203.62	0.39*
ICT	537.31	228.86	0.63**	479.42	202.22	0.46**
Adjusted R^2		0.52			0.63	
F for R^2		13.29***			24.58***	
Number of countries		28			29	

Notes: *, ** and *** denote significance at the 90, 95 and 99 percent confidence level, respectively. The beta coefficients are the regression coefficients obtained if all variables are standardized to a mean of 0 and a standard deviation of 1. B coefficients are not standardized.
Source: Authors' calculations.

Table A5: *Independent Contribution of Manifest Knowledge Economy Variables to the Explanation of the GDP per capita PPP Variance in the LICs in 2006 and 2007*

Factors of Knowledge Economy	*Manifest Variables*	*Dependent Variable: GDP per capita PPP in 2006*		*Dependent Variable: GDP per capita PPP in 2007*	
		Independent contribution (%)	**B**	**Independent contribution (%)**	**B**
Education	Adult Literacy Rate, 2004 (2007)[a]	1.37	6.52	2.30	11.23
	Secondary Enrollment, 2006 (2006)	0.15	2.52	2.55	13.73
	Life Expectancy at Birth, 2005 (2005)	10.62	40.38**	3.53	27.65
ICT	Telephone Mainlines per 1,000 People, 2005 (2006)	0.04	0.65	0.47	-2.51
	Mobile Phones per 1000 People, 2005 (2006)	13.66	4.85***	20.10	5.60***
	TV Households with Television, 2005 (2005)	3.76	10.52	10.04	19.39***
	Internet Users per 1000 people, 2005 (2006)	0.12	1.24	0.41	2.43

Notes: *, ** and *** denote significance at the 90, 95 and 99 percent confidence level, respectively. [a] The year in brackets denotes when the data for that indicator were collected. Those data were included in the second study (multivariate regressions with the dependent variable, GDP per capita PPP in 2007).
Source: Authors' calculations.

Model 2

Table A6: *Factors of Knowledge Economy Related to GDP per capita PPP in 2006 and 2007 in the MICs*

Factors of Knowledge Economy	*Dependent Variable: GDP per capita PPP in 2006*			*Dependent Variable: GDP per capita PPP in 2007*		
	B	**Standard Error B**	**β**	**B**	**Standard Error B**	**β**
Law and institutions	922.54	260.15	0.28***	734.79	396.48	0.17*
Potential for innovations	137.83	238.98	0.04	–	–	–
Education	759.08	233.62	0.23***	981.17	367.42	0.24***
ICT	1922.89	278.77	0.59***	2433.52	426.08	0.60***
Adjusted R^2	0.85			0.73		
F for R^2	64.67***			42.92***		
Number of countries	46			47		

Notes: *, ** and *** denote significance at the 90, 95 and 99 percent confidence level, respectively. The beta coefficients are the regression coefficients obtained if all variables are standardized to a mean of 0 and a standard deviation of 1. B coefficients are not standardized.
Source: Authors' calculations.

Table A7: *Independent Contribution of Manifest Knowledge Economy Variables to the Explanation of the GDP per capita PPP Variance in the MICs in 2006 and 2007*

Factors of Knowledge Economy	***Manifest Variables***	***Dependent Variable: GDP per capita PPP 2006***		***Dependent Variable: GDP per capita PPP 2007***	
		Independent contribution (%)	**B**	**Independent contribution (%)**	**B**
Law and institutions	Intellectual Property Protection, 2006 (2006)[a]	0.60	-454.29	–	–
	Political Stability, 2005 (2006)	8.85	1913.19***	6.15	2166.88**
	Control of Corruption, 2005 (2006)	6.80	2694.11**	0.30	733.70
	Voice and Accountability (2006)	–	–	1.36	912.07
	Regulatory Quality (2006)	–	–	0.41	782.01
Potential for innovations	University-Company Research Collaboration, 2006	6.13	2752.94*	–	–
	Availability of Venture Capital, 2006	1.94	1028.27	–	–
	Private Sector Spending on R&D, 2006	1.12	-1398.54	–	–
	Value Chain Presence, 2006	1.55	695.31	–	–
Education	Adult Literacy Rate, 2004 (2007)	0.04	9.76	1.00	69.34
	Average Years of Schooling, 2000 (2000)	0.39	-230.74	0.85	-422.57
	Secondary Enrollment, 2005 (2006)	7.52	84.53**	1.98	53.02
	Tertiary Enrollment, 2005 (2006)	9.51	95.81**	15.57	145.98***
ICT	Telephone Mainlines per 1,000 People, 2005 (2006)	2.95	7.82**	9.65	16.65***
	Mobile Phones per 1,000 People, 2005	8.54	5.45***	–	–
	Computers per 1,000 People, 2005 (2005)	5.07	14.97***	5.27	19.05***
	Internet Users per 1,000 People (2006)	–	–	4.98	10.70**

Notes: *, ** and *** denote significance at the 90, 95 and 99 percent confidence level, respectively. [a] The year in brackets denotes when the data for that indicator were collected. Those data were included in the second study (multivariate regressions with the dependent variable, GDP per capita PPP in 2007).
Source: Authors' calculations.

Model 3

Table A8: *Factors of Knowledge Economy Related to GDP per capita PPP in 2006 and 2007 in the HICs*

Factors of Knowledge Economy	*Dependent Variable: GDP per capita PPP in 2006*			*Dependent Variable: GDP per capita PPP in 2007*		
	B	**Standard Error B**	**β**	**B**	**Standard Error B**	**β**
Law and institutions	2004.11	1215.09	0.26	2481.93	1877.88	0.31
Potential for innovations	-763.47	1179.06	-0.10	1182.82	1687.08	0.15
Labor-force quality	5436.93	1507.95	0.70***	5590.95	2354.20	0.70**
ICT	409.11	1333.64	0.05	3639.55	2100.17	0.45*
Adjusted R^2		0.75			0.53	
F for R^2		26.93***			8.79***	
Number of countries		35			36	

Notes: *, ** and *** denote significance at the 90, 95 and 99 percent confidence level, respectively. The beta coefficients are the regression coefficients obtained if all variables are standardized to a mean of 0 and a standard deviation of 1. B coefficients are not standardized.
Source: Authors' calculations.

Table A9: *Independent Contribution of Manifest Knowledge Economy Variables to the Explanation of the GDP per capita PPP Variance in the HICs in 2006 and 2007*

Factors of Knowledge Economy	*Manifest Variables*	*Dependent Variable: GDP per capita PPP in 2006*		*Dependent Variable: GDP per capita PPP in 2007*	
		Independent contribution (%)	**B**	**Independent contribution (%)**	**B**
Law and institutions	Intellectual Property Protection, 2006 (2007)[a]	2.33	2735.50	6.31	4155.51*
	Soundness of Banks, 2006 (2007)	2.48	3353.40	0.67	1755.99
	Intensity of Local Competition, 2006 (2007)	3.11	5557.00	0.00	80.09
	Regulatory Quality, 2005 (2006)	0.58	2764.50	1.03	3326.37
	Political Stability, 2005	0.00	5.40	–	–

Potential for innovations	Royalty and License Fees Receipts (US$ millions) per Million Population, 2005 (2006)	0.01	1.39	0.09	3.69
	Scientific and Technical Journal Articles per Million Population, 2003 (2005)	8.66	11.09**	3.44	7.74
	Patent Applications Granted by the USPTO per Million People, average for 2001-2005 (2002-2006)	4.29	26.64	4.73	29.71
Labor-force quality	Internet Access in Schools, 2006 (2007)	0.82	-1431.70	1.54	-1854.70
	Extent of Staff Training, 2006 (2007)	7.56	4698.20***	0.86	1877.60
	Quality of Management Education, 2006 (2007)	6.79	3810.50***	3.66	3230.50*
	Brain Drain, 2006 (2007)	11.15	3880.00***	29.48	6875.00***
ICT	Telephone Mainlines per 1,000 People, 2005 (2006)	1.39	9.13	1.06	8.76
	Computers per 1,000 People, 2005 (2006)	4.82	12.26**	10.87	16.45**
	Internet Users per 1,000 People, 2005 (2006)	0.26	-2.95	0.02	0.84
	Availability of e-Government Services, 2006 (2006)	7.50	3106.16**	9.54	3555.41**
	Extent of Business Internet Use (2006)	–	–	6.60	5213.73*

Notes: *, ** and *** denote significance at the 90, 95 and 99 percent confidence level, respectively. [a] The year in brackets denotes when the data for that indicator were collected. Those data were included in the second study (multivariate regressions with the dependent variable, GDP per capita PPP in 2007).
Source: Authors' calculations.

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