



**KNOWLEDGE SOCIETY AND TRANSITION ECONOMIES.
THE BULGARIAN CHALLENGE**

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Biographical notes

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Desislava Kolarova is a policy officer for the European Commission, Directorate General for Research. Her work involves coordination of research policy development in the European Research Area by applying the Open Method of Coordination (OMC). Her duties also consist in assessing RTD elements of the renewed Lisbon Strategy for Growth and Jobs in the EU Member States. Her expertise mainly lies in the development of the knowledge-based economy, in particular the services sector. Her work questions changes in transition economies towards a knowledge-based and services economy, with special emphasis on the development of business services, ICT services, and outsourcing. She holds a Ph.D degree from Pierre Mendès France University (Grenoble). She is a member of the European Association for Research on Services (RESER).

Abstract. This paper evaluates the Bulgarian positioning in the European knowledge-based economy. The analysis is mainly based on the Knowledge Assessment Methodology of the World Bank (2005). After an analytical framework, the analysis reveals an alarming situation for Bulgaria

resulting from several negative factors, which reinforce one another in a cumulative process. Finally, the conclusion underlines that a necessary condition for the Bulgarian economy to become knowledge-based, is to set up good rules of governance but also to be able to mobilize human capital and to coordinate the interactions within citizens and organizations.

Keywords: knowledge economy, knowledge triangle, Central and East European countries
JEL Classification: R11, R12, R23, P59

INTRODUCTION

Developed economies are undergoing a dramatic change, which makes them more and more knowledge-based. The development of the ICT, the rise of knowledge-based business services, as well as the growth of intangible factors such as education, knowledge, information, innovation and R&D are its significant components (Riddle, 1986; Rubalcaba- Bermejo, 1999). These knowledge-intensive economic activities play a leading part in the European economy, in the enterprises' competitiveness and in the process of regional development. They are the key factors for competitiveness and sustainable economic growth in a globalised world (*e.g.* Stare, 2005; de Bandt, 1995; Daniels, 1993).

The realization of the importance of knowledge led the European leaders to conceive the Lisbon strategy. Thus, in 2000, the main goal adopted by the European Council until 2010 is: "to become the most competitive and dynamic knowledge-based economy in the world, capable of sustainable economic growth, with more and better jobs and greater social cohesion, and respect for the environment" (European Commission, 2000, 2). The recent report, "facing the challenge. The Lisbon strategy for growth and employment" from the Kok group recalls the necessity of achieving the knowledge society in order to secure the long-term economic growth of Europe (Kok, 2004). It also emphasizes the needs for reconstituting a more focused and adequate agenda. Thus, the knowledge triangle (education, research and innovation) has to be reinforced. It requires the implementation of national policies in a European framework, the involvement from the social partners and the increase of private and public R&D expenditures. The revisited Lisbon strategy creates challenges and opportunities for Central and European Countries. To be competitive on the European market, these countries have to transform their productive structure towards a high value added production of goods and services, a high-skilled labor force and to increase the standard of living.

Thus, Bulgaria, after joining the European Union, faces a new challenge after those of the market economy. The country displays a catching-up process and underdevelopment of services, especially in high value added business services (Bourdeau-Lepage, 2005; Kolarova, 2005; Grigorova, 1999). However, as in most of CEECs, technological marginalization will affect Bulgaria if nothing is done in order to reorient the production of goods to high value added products (see Radosevic, 2002 for the diagnosis). Therefore, the promotion of a knowledge-based economy is a survival necessity for Bulgaria. This paper aims at evaluating the positioning of Bulgaria, in the process of transformation of its economic structure towards a knowledge-based economy. The analysis is conducted through the key factors in the knowledge-based economy identified by the World Bank (2005). The study has a comparative character. Thus, Bulgaria will be compared with 24 other European countries.

The paper is organized as follows. The first section lays down the analytical framework. The second one characterizes the Bulgaria's alarming positioning in European knowledge-based economy, achieved on the basis of selected indicators. The third aims at understanding the reasons for such a situation. Finally, the conclusion underlines some difficulties in promoting the knowledge economy in Bulgaria.

1. ANALYTICAL FRAMEWORK

1.1 The nature of the knowledge-based economy

The knowledge-based economy: first approach

The expression "knowledge-based economy" refers above all to the dramatic rise of *knowledge* as a primary factor of economic growth (Abramowitz and David, 1996; Foray and Lundvall, 1996; OCDE, 1996; OECD, 1999; Foray, 2000; Chen and Dahlman, 2004); the creation and massive diffusion of knowledge is permitted by the development of *information and communication technologies* (ICT); through the intensive use of knowledge, a knowledge-based economy is able to develop *high-technology industries*.

Beyond this broad definition, the terms refer to the historical process by which production uses more and more highly specialized intangible factors, so that the links between education, fundamental research, applied research, innovation, R&D, knowledge sharing and the production of service and goods become increasingly close. Thus, the knowledge economy might be defined as production intellectualization (Maunoury, 1972). It is *an economy, which creates, disseminates, and uses knowledge to enhance its growth and to increase its overall welfare*.

The seeming clarity of this definition hides conceptual difficulties, which arise as soon as we examine connected concepts.

Knowledge vs information

The concept of knowledge is inescapably and closely linked with that of information. It is concretely illustrated by the central role of ICT in the knowledge-based economy. Unfortunately, we can find nearly as many distinctions as authors between the two terms (*e.g.* Polanyi, 1967; Mayère, 1999; Foray, 2000; David & Foray, 2002; Epingard, 1999, Carrincazeaux, 1999). Moreover, the term knowledge may be used by a particular author with the same meaning as the term information employed by another one. The confusion is such that it is impossible to resume the debate.

Knowledge is frequently conceived as a stock while information is defined as the related flow of messages, the “raw material of knowledge” (Epingard, 1999). The stock of knowledge results from information flows and the diffusion of this knowledge induces new information flows (Mayère, 1990). After that conception, information would be the form taken by knowledge when it is diffused, transmitted or exchanged.

The distinction between knowledge and information could also be based on the tacit or codified (or codifiable) character of their contents. Polanyi (1967) separates codified and tacit knowledge. This distinction has been taken up and more or less adapted by a number of authors. Knowledge codification transforms knowledge into information. It translates knowledge in symbolic representations (David and Foray, 2002) so that it can be easily stored in physical media (books, software ...) and transmitted via ICT. Then information is nothing else codified knowledge. Conversely, tacit knowledge would remain embodied in individuals and organizations and, because of its complexity and its personalization, it could not be easily formalized by codes, and therefore could not be easily transferred by ICT. The best mode of transfer, which minimizes the loss of meaning, is direct contact, *ie.* face-to-face interaction (Leamer & Storper, 2001). But in that case, why is the flow created by the transmission of knowledge not called information?

Maybe the response lies in another distinction, between codified and tacit information. As far as information would refer to a transmission process, codified information is that which can be transmitted by ICT without any loss of meaning, while tacit information cannot. Tacit information is that which can only circulate informally during face-to-face contacts, giving to proximity a strategic role in the circulation of information. Between codified knowledge (or information) and tacit knowledge (or information), there is also a question of cost. The transmission of tacit knowledge is more costly than that of codified knowledge. For example, “cognitive capabilities are not easy to articulate explicitly or to transfer to others” (David & Foray, 2002, 4). In any case, transmission is more efficient and less costly (in terms of marginal costs) by means of ICT than by means of direct personal contacts (Bourdeau-Lepage & Huriot, 2005b).

Knowledge-based economy or information society?

The proximity and the complementarity between knowledge and information lead us to suspect a close link between knowledge-based economy and information society. Indeed, the two expressions describe the same reality. Manuel Castells (1996), writing on the information revolution and the primary role of information in production and consumption, deals implicitly with knowledge. Information and knowledge, if analyzed deeply, appear necessarily at the core of the primary contemporary change of economy and society, which results in the emergence of the post-industrial economy, in mutations of production organization and in a new production space. Actually, Bourdeau-Lepage & Huriot (2005a) have characterized the post-industrial economy as becoming more and more intangible, informational, personalized (through product differentiation) and global. Knowledge and information are the engine of growth, but even more the engine of the big transformation leading to the post-industrial era and its new global production landscape.

The preceding points suggest that the combination of information and human capital is a necessary condition for the emergence of the knowledge-based economy. But it is not sufficient. A third hidden factor must be added, which can be called social capital.

The apparent major factors: ICT and skilled labour combined

Technological progress is closely related to the access to more and more knowledge and information. Information and communication technologies have contributed to modify the nature of labor as it is becoming more knowledge-based. Consequently, more sophisticated knowledge and new skills are required. Therefore the competences needed for information processing, exploitation, interpretation and assimilation, which are scarce, are becoming strategic resources. This relates to the learning capacity (Epingard, 1999), but also to the competitive advantage of the firm, which depends not only on the disposal of some specific information, but also on the capacity of using it (Le Bas & Picard, 2003). Thus, *human capital, that is to say knowledge, skills, competences and attributes embodied in individuals, are central elements in knowledge-based economy*. The importance of acquisition of new knowledge and skills by learning is the foundation of the concept of the “learning economy” (Lundvall, 2000, 126), with reference to the labour force, but also to firms as “learning organizations, continuously adapting management, organization and skills to accommodate new technologies” (OCDE, 1996, 14). *Information infrastructure, that is to say ICT, telecommunication networks, information systems and policy and legal frameworks as well as skilled human resources needed to develop and use ICT, plays a significant part in the knowledge economy* because it facilitates, transforms and improves the modes of production, organization, consumption, learning, teaching, creation and diffusion of knowledge through new networks.

The hidden factors: Institutions, governance and social capital:

Knowledge contributes to economic growth only when incorporated into the production of goods and services (Fischer, 2004). The ability of organizations to learn, assimilate and use new or existing knowledge created elsewhere is essential and determines their level of innovation. The absorption capacity depends especially on the linkages between organizations like firms, universities and government agencies, and technology-transfer agencies. *The quality of interactions is crucial in the process of innovation and knowledge creation. These interactions are determined by the institutional context, the characters of governance and the quality of the social capital.* Institutions, governance and social capital are interrelated concepts. Indeed, institutions, understood as the set of formal or informal rules of the economic and social games (North, 1990) will condition the intensity and the quality of interactions, and consequently the creation and diffusion of knowledge and/or information. Governance, defined as “the sum of the ways through which individuals and institutions (public and private) plan and manage their common affairs” (UNCHS, 2001, 90), generates either conflicts or beneficial cooperation. It includes formal institutions and relates closely to social capital. The concept of social capital (initiated by Putman, 1993^{*}) refers to the collective dimension of all rules and norms, of the spontaneous social interactions permitting the coordination of actions and the cooperation within groups or between them, in order to reach social cohesion and the pursuit of common goals (see[†]). It depends on historical and cultural factors, on institutions as rules of the social game, but also on the governance structure, on its efficiency to mobilize and coordinate technological and human resources in order to build a knowledge-based economy.

The different characteristics of the knowledge-based economy analyzed in this section are the foundations of the main “pillars” we shall describe in section 2, in order to show the unfavourable situation of Bulgaria. But the last three factors, institutions, governance and social capital, because they condition the efficient running of the other ones, will be at the core of the explanation of the diagnosis in section 3. But first of all, we have to precise our methodological choices.

1.2 Measuring the knowledge economy

Because of the complex interweaving of factors and interactions as well as of feedback effects, the evaluation of a country’s position in the knowledge-based economy is not straightforward. Overall, the evaluation of the level of knowledge in an economy requires qualitative and quantitative indicators such as expenditures of R&D or data linked to the quality of the human resources, but

^{*} “Similar to the notions of physical and human capital, the term social capital refers to features of social organization - such as networks, norms, and trust that increase a society’s productive potential” (Putman, 1993).

[†] This definition is close to that of Baslé & Renault, 2004 (7) and Baslé, 2004 (220-221).

also indicators of knowledge diffusion (Dumont & Poutineau, 2004). In addition, the overall health of the economy and the quality of institutions, because they are important determinants of investment in education and ICT infrastructure as well as of accumulation of human capital, have to be appraised (Chen & Dahlman, 2004).

The European Commission proposes a set of 28 indicators with the European innovation scoreboard, which aims at reflecting the innovation capacity of a country. The indicators are divided into 4 categories: human resources, knowledge creation, diffusion and application of new knowledge, and innovation financing (European Commission, 2004a). None of these indicators is linked to the institutional context or to the social capital whereas these elements are crucial in the ongoing process of the knowledge economy. Actually, the economic situation (health of economy), the political and social context, but also the legal and organizational conditions, which determine the investment possibilities and the innovation capacities of organizations, are excluded from the European scoreboard. That may be because the aim of this analysis is to evaluate more the innovation system rather than the position of the country in the global knowledge economy. Consequently, it seems more appropriate to use a more extensive analysis for evaluating how Bulgaria embraces the knowledge economy in Europe.

The knowledge assessment methodology (KAM) developed by the World Bank is more exhaustive. It is based on 80 variables, which are divided into the seven following functional clusters: performance, economic incentive regime, governance, innovation systems, education and training, information infrastructure, and gender equity. These 80 structural and qualitative indicators are used as proxies to evaluate the performances of a country in the knowledge-based economy. According to the World Bank, a knowledge economy (KE) consists of four critical pillars: economic incentive and institutional regime, innovation, education and ICT. These four pillars are considered as the preconditions for a knowledge economy and their strengthening may lead to increase economic growth (Chen & Dahlman, 2004).

For our analysis, we have chosen one of the KAM modes, which enables a cross-country analysis and the creation of customized scorecards and comparators from the 80 variables. The KAM also proposes a “basic scoreboard” consisting of 12 variables that are based on the four pillars of the knowledge economy, plus two relating to performance. In essence, this scorecard, called knowledge economy index (KEI), attempts to capture a country's preparedness for the knowledge-based economy (World Bank, 2005). The KEI is the average of the performance scores of a country in all four knowledge economy pillars.

However, in the KAM methodology, the performance of each country is related to the performance of all the 128 countries of the sample. Because we focus on the situation of Bulgaria

relatively to other Eastern or Western European countries, we decided to limit the country sample to a set of 25 European countries (EC-25). Moreover, new KEI is created from a new combination of qualitative and quantitative variables, permitting a more relevant analysis in accordance with the specific interest of the paper. Therefore, 58 variables of the above mentioned 80 are normalized to the EC-25 (see the methodological note in appendix).

2. DIAGNOSIS: AN ALARMING SITUATION

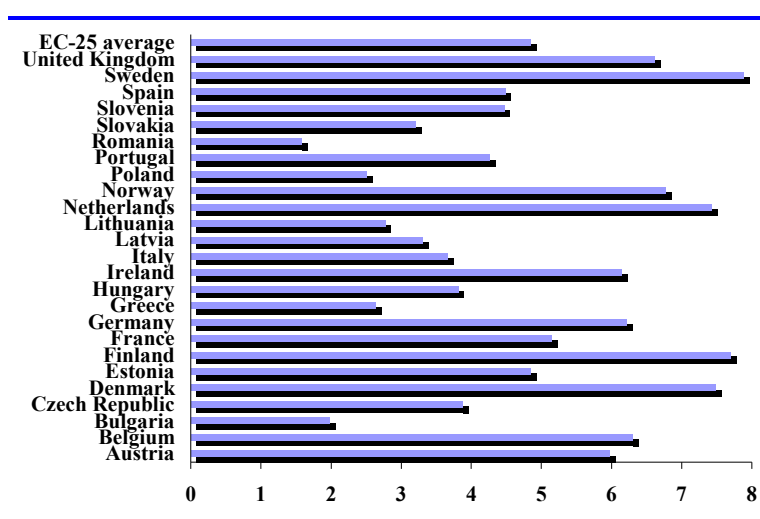
Among the 25 selected European countries, Bulgaria appears in a relatively unfavourable position. Such an alarming diagnosis results from adapting and processing the World Bank's data.

In order to evaluate the relative position of Bulgaria in the European knowledge economy, a synthetic scorecard is built. This new KEI is based on the knowledge assessment methodology defined by the World Bank. The five following pillars compose this new KEI: Economic Incentive and Institutional Regime, Education and Training, Innovation System, Information Infrastructure and the "governance" pillar. Thus, 50 variables are used in the analysis (see table 3 in appendix for the composition of each pillar). The new KEI is the average of the performances of a country in all five pillars. Each pillar score is derived by averaging the normalized scores of each pillar's variables (see the methodological note in appendix for detailed information).

2.1 A first glance

Bulgaria compares badly to the rest of Europe. Indeed, on the basis of the new KEI, Bulgaria holds the 24th position just before Romania, with a score of 2.0 (see bar graph 1). Thus, Bulgaria is at the bottom of the European distribution in the knowledge-based economy with Romania, Poland, Greece and Lithuania while Sweden, Finland, Denmark and Netherlands not surprisingly occupy the top of the distribution with score up to 7.4. The Bulgarian positioning results from a weak score in all pillars of the knowledge economy and especially from a bad rank in that of governance (see bar graph 2).

BAR GRAPH N°1 - New KEI of 25 European Countries



Source: calculated from World Bank Data (2005) with authors' methodology.

2.2 Ambiguous economic environment: Favourable trade openness but inefficient financial system

Tariff & non-tariff barriers to trade, such as import bans and quotas as well as strict labelling and licensing requirements are lower in Bulgaria than in the other members of the EU. Thus, among the 25 countries under consideration, Bulgaria and Romania were the most open to trade in 2004, probably because they had not yet integrated into the EU. In fact, the European Union seems to entail trade restrictions. The Bulgarian exports of goods and services amount to 53.7% of GDP in 2003. Therefore, the country occupies a good rank with a score of 6.3 compared with the EC-25 average of 4.6. However, it is unsurprisingly ranked after Belgium, Netherlands – well-known as open countries – and after Slovakia, Hungary, Czech Republic, Slovenia and Lithuania. The trade liberalization with the industrial crisis at the beginning of the transition leads to an increasing specialization in intensive labor goods (as observed by Spiridonova, 2002). The Bulgarian trade liberalization perhaps contributes to enhance the efficiency in resources allocation according comparative advantage and to induce an annual GDP growth higher than in the other countries between 1999 and 2003. However, its long run effects are still uncertain especially because the lack of FDI impedes technological and knowledge diffusion from abroad and could have a lock-in effect for Bulgaria in an immediate future.

According to the other variables, the Bulgarian financial system is not efficient compared with Denmark, Ireland, United Kingdom and Netherlands. The soundness of banks and financial resources provided to private sector in percentages of GDP are very limited (with respectively a score of 0.8 and 0.8 against an EC-25 average of 4.5 and 5.0). Moreover the protection of

intellectual property is the weakest of the 25 countries. It is not surprising because of the weak regulatory framework subsequently analyzed.

2.3 Deficient governance

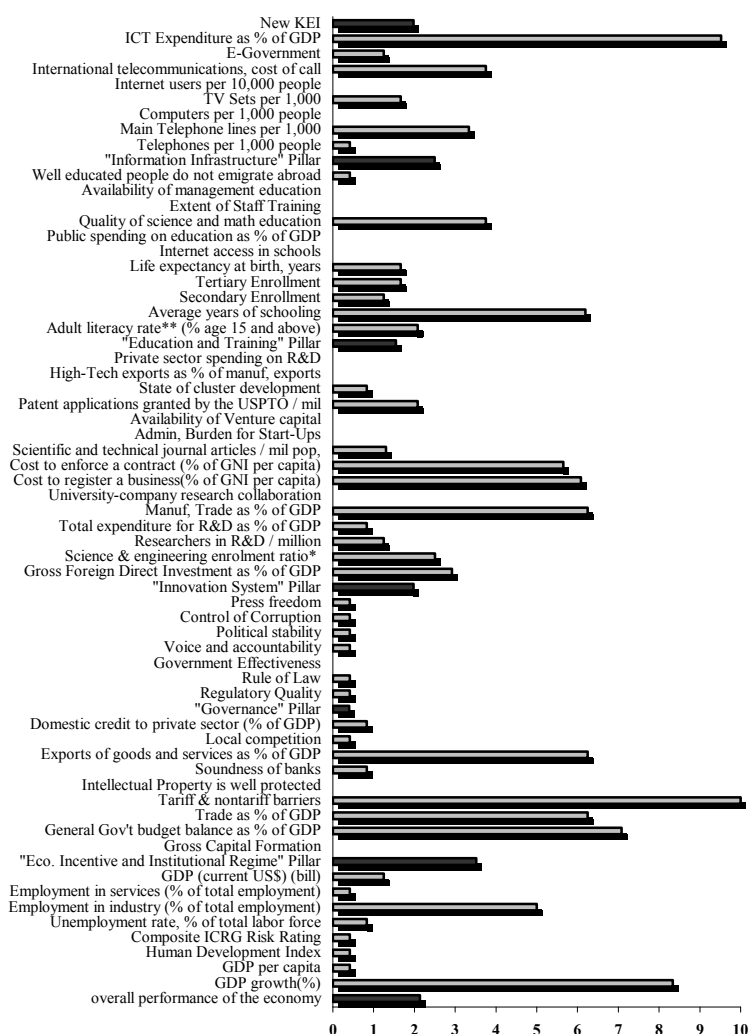
The examination of that pillar, which combines seven variables, shows the unfavourable position of Bulgaria (0.4). Only Romania displays an inferior position with a score of 0.1.

Corruption is higher than in the other countries. It is observed at all institutional levels by national and international reports of institutions (EC, 2004b; OSI, 2002; TI, 2004 and Annual Report of Coalition 2000, 2005). This is a serious obstacle to economically developing the country because corruption especially discourages entrepreneurship and impedes foreign direct investments. Therefore it deprives the country of technological transfers.

In addition, the Bulgarian government effectiveness is the weakest in Europe (score equals to 0.0). Perceptions of the quality of public service provision, the quality of the bureaucracy, the competence of civil servants, the independence of the civil service from political pressures, and the credibility of the government's commitment to policies are negative in Bulgaria while it is better in other Eastern countries as in Slovenia (5.0) or in Hungary (6.3) (see table 3 in appendix). Thus, the quality of bureaucracy is deficient and a lack of procedural clarity and technical competences is observed. The bad score of Bulgaria in this variable results from those of the variables “rules of law” and “regulatory quality”. The absence of impartial state enforcement limits the number of economic transactions that could otherwise occur. In addition to the above aspects, the degree of press freedom and the ability of the population to participate in the selection of government are weak.

In this context, social capital can hardly develop in Bulgaria. The population cannot be mobilized towards social cohesion or common goals, particularly because the government is not perceived by the population as reliable and because the legal rules and the norms which organize the social life and the co-operation among individuals are not clear and consequently they reinforce cheating behaviours.

BAR GRAPH N°2 - The 5 Pillars of knowledge Economy and Bulgaria



Note: the missing bar means that Bulgaria scores 0.0 and holds the last rank among EC-25 in the corresponding variable.

Source: calculated from World Bank Data (2005) with authors' methodology.

According to these two first pillars, the legal framework and the financial system do not encourage the knowledge-based economy development, while the trade openness does not entail obvious results.

2.4 Uncertain human capital

High levels of education and great skill are fundamental in a knowledge economy and in economic growth (see for example, Becker, 1975; Schulz, 1971; Barro & Sala-I-Martin, 1995; Krueger & Lindhal, 2001; Baslé & Renault, 2004; OECD, 2002; World Bank 2005; EC 2004b). As for this

pillar, Bulgaria is ranked last with a synthetic score of 1.5, ahead of Romania, Slovakia & Lithuania, compared with a EC-25 average of 4.8 (see table 3 in appendix).

Bulgaria occupies a good position for only one of the indicators, which make up this pillar. It concerns the average duration of schooling that is used as an aggregate measure of the educational stock in a country. In fact, the Bulgarian score is 6.2 compared with 5.2 for the EC-25 average score. However, other countries like Poland, Romania and Czech Republic display better scores, respectively of 8.1, 7.1 and of 6.7. Consequently, Bulgaria seems to be endowed with a basically well-educated population. Nevertheless the analysis of the adult literacy rate, which is conventionally defined as the ability to read and write with understanding (Azariadis & Drazen, 1990), shades the interpretation because the country does not occupy as good a ranking for this indicator. Therefore, the quality of the educational system is probably low in Bulgaria. In any case, science and math education is of poor quality. Bulgaria effectively displays a low score (3.8), less than the EC-25 average of 4.9 and lower than most of the transition countries. In addition the secondary and tertiary enrolments (number of students in the secondary and tertiary level in 2001) are very low and hence it could be expected that numerous low skilled workers will enter the labour market in the future.

In the education and training investment, the Bulgarian position is alarming. Public spending on education measured, as a percentage of GDP and the extent of staff training are the lowest in Bulgaria among the 25 European Countries. Bulgaria stands behind Romania while a country like Slovenia displays a score above EC-25 average. In addition to this difficult situation, highly-educated Bulgarians tend to emigrate abroad. This phenomenon affects more Romania (0.0), Bulgaria (0.4), and Lithuania (0.8) than countries like Czech Republic (4.6), Slovenia (5.0) or than the EC-25 average (5.0).

Thus, the quality level of the Bulgarian stock of human capital is insufficient and lifelong learning and human development has unsound foundations. Moreover, Bulgarian investments in education and training are very low, like those devoted to innovation.

2.5 Unproductive innovation system

Overall, the Bulgarian innovation system is less effective than those of all other European countries, except Romania, which occupies the 24th rank. The score is 2.0 compared with 4.9 for the EC-25 average. It is notable that for all new EU members this score is smaller than the European average (but its value in some countries is close to this average one).

The Bulgarian innovation system is characterized by few technological and knowledge transfers stemmed from FDI. In fact, FDI, evaluated by the average percentage of the gross FDI relative to

GDP for the period 1993-2002, are low in Bulgaria. Even if the country shows a higher score (2.9) than those of Greece (0.0), Italy (0.4), Slovenia (0.8), Romania (0.8), Lithuania (2.1), and Slovakia (2.1), the Bulgarian score is less than the EC-25 average of 4.9 and faraway of the best result of Sweden (8.3). Consequently, Bulgaria does not benefit from one of the important channels of knowledge transfers.

The functioning of an innovation system requires the capacity of experts of different organizations to cooperate and communicate with one another (Fischer, 2004). In Bulgaria, the collaboration and interactions among R&D institutes, firms and universities are relatively absent. Indeed, the country occupies last rank with a score of 0.0 compared with the EC-25 average of 4.9 and with the top-three, respectively 10.0, 9.6 and 9.2 for Finland, Sweden and France.

In addition, Bulgaria does not encourage innovation. The administrative burden for starting a new business is greater than in other countries. The availability of venture capital and the total expenditures for R&D in percentage of GDP are among the lowest in Europe (see bar graph 2 and table 3 in appendix). Moreover, clusters are few in Bulgaria while in Finland, Italy, France, Ireland, or Sweden their development is common. Consequently, the country does not enjoy clustering advantages, namely enhancing of competitive advantages, collective and localized learning process, innovation and sharing of knowledge (Keeble & Nachumt, 2001; Maillat *et alii*, 1993; Courlet, 2001; Maignan *et alii*, 2003).

As a consequence, the Bulgarian innovation system is one of the less productive in Europe. Thus, the level of domestic innovation measured by scientific and engineering articles published in physics, biology, chemistry, mathematics, clinical medicine, biomedical research, engineering and technology, and earth and space sciences, places Bulgaria in 22nd position among European countries, ahead of Romania, Lithuania and Latvia, as expected, Bulgaria does not export R&D intensive products, such as scientific instruments or electrical machinery. Its share of high-technology manufactured exports expressed in percentage of manufactured exports is one of the weakest. Along with Poland (0.0), Romania (0.0) and Slovakia (0.0), Bulgaria displays the lowest score (0.0) for an EC-25 average of 4.8 and compared with a Hungarian score of 8.8.

2.6 Underdeveloped information infrastructure

The Bulgarian position in the pillar, which is considered as the backbone of the knowledge economy, is not favourable (score of 2.5), though it is higher than in Romania (1.8) and Lithuania (1.7). Overall, the available stock of ICTs in the Bulgarian economy is not sufficient.

Thus, the number of telephones per 1,000 people in Bulgaria (telephone mainlines and mobile phones per 1000 people in 2003) is one of the lowest in Europe with that of Romania and Poland.

That is an outstanding feature of Eastern countries except Czech Republic. The numbers of computers per 1,000 people and of Internet users per 10,000 people relegate Bulgaria to the last rank faraway from countries like Slovenia (the sole Eastern country whose score is higher than the EC-25 average) or Sweden.

Whereas telephone penetration, computer use and Internet access still lag, *ICT Expenditure as percentage of GDP* is the highest after those of Czech Republic in Europe. In this field, Bulgaria follows a different way from that of Romania. However, the investment seems to be insufficient in the e-government. The web presence in the various branches of Bulgarian government puts Bulgaria at the 23rd rank.

2.7 Taking stock

The analysis reveals some obstacles to the development of knowledge-based economy in Bulgaria.

The main one is relative to the institutional structure in charge of leading the economy, that is to say governance and economic and institutional regime, the foundation pillars on which hinge all economic and social policies. In Bulgaria, the governance is not efficient enough. The political instability, corruption, organizational conditions and the lack of adequate property rights as well as legal rules and procedures do not favour entrepreneurship and above all, the development of social capital or the establishment of common goals within the population.

The other obstacles relate to the quality of human capital and to the level of investment in innovation and education. Thus, Bulgaria lacks well-educated and skilled workers. The country does not really encourage lifelong learning, human development or innovation. Therefore innovation activity is low and sufficient R&D is lacking. In addition, the development of ICTs infrastructure is lagging.

Few elements conducive to knowledge-based economy development are found in Bulgaria. Such a situation calls for some explanation.

3. THE TRANSITION IN QUESTION

Under the planned economic system, the Bulgarian economy was strongly orientated towards the economies of COMECON. More than 80% of the foreign trade was directed to these countries. Following the priority of the socialist system, the economy experienced fast industrialization. Some industrial branches such as electronics, machines' construction and chemical industry were developed as a priority. Bulgaria also was specialized in high technologies and more precisely in five fields - the generation mainframes, high-speed matrix processors and parallel systems, software development, system hardware, digital and analogue PC design areas (ICT development Agency,

2002). Regarding this specialization in high-tech and ICT products, Bulgaria even was called “Silicon Valley of Eastern Europe”. These activities benefited from a large amount of investments and led to the emergence of a tradition in computer-sciences education, engineering and mathematics. The transition affected negatively the Bulgarian specialization in high technologies. Numerous factors contributed to this situation. Among them, a deep recession combined with political instability, a deteriorated social context and a late awareness that knowledge is a key factor in the development.

3.1 Durable slowdown and political instability

The collapse of the socialist system put Bulgaria in the face of numerous economic and social problems. The transition towards a market economy can be divided in two main stages, before 1997 and after 1997.

Thus, early transition was characterized by a major economic stagnation, the loss of external markets, strong inflation, the delay of economic reforms, high unemployment, a serious industrial crisis and a large foreign debt. A range of negative factors, such as financial problems, the lack of competitiveness of industrial production on the world market, the obsolete infrastructure, the absence of entrepreneurial skills and culture as well and the lack of political stability, hampered the transition progress. As a result, the flow of FDI was insufficient. Numerous state-owned enterprises experienced serious difficulties (also in electronic industry) and many of them collapsed.

The chaotic structural reforms were not able to manage the deep industrial crisis. Bulgaria underwent a strong de-industrialization process. In 1996, the economy experienced a deep financial crisis accompanied by hyperinflation, which led the collapse of many banks and to the total disappointment of the economic reforms. These problems were mostly due to the chaotic reforms and to the inability of the governmental policy to generate favourable environment for economic growth.

As a result in the end of 1996, a strict program of structural reforms and the setting-up of the Currency Board were introduced under the supervision of the IMF and the World Bank. After 1997, the second stage of transition was marked by macroeconomic stabilization, acceleration of privatization, FDI and by the process of integration of the country to the EU. In 1998, the industry recovered its growth, but stayed below the results recorded before the beginning of the transition in 1990. After 1998, a recovery of the Bulgarian economy is clearly observed, with increased rates of real growth: 2.3% in 1999, 5.4% in 2000, 4.1% in 2001, 4.9% in 2002 and 4.3% in 2003 and 5.5% in 2004 (See the table 2).

However, the GDP per capita remains inferior to that of the new member states of the EU (see Bourdeau-Lepage, 2005). The positive results of economic reforms encouraged the penetration of FDI; nevertheless their level and their structure did not enhance economic growth (according to the IMF, 2001, p. 20). Apart from the low stock of FDI per capita, compared with the other candidate countries, their structure shows that the FDI in the industry are concentrated in labour-intensive branches and not in the knowledge-intensive branches. The FDI in the ICTs, business services and other knowledge-intensive industries, which are favourable to knowledge transfers, constitute only a small share of total investments.

Together with industrial sector, the sectors of education and R&D are facing major difficulties. During the transition, more firms closed their research laboratories. Academia, universities, research institutes and schools experienced serious problems because of strict budget restrictions. The level of public subsidies severely diminished and hampered the renovation of obsolete scientific infrastructures. Even many high-skilled persons (scientists, engineers, professors and teachers) lost their jobs and hope to achieve their professional ambitions. Consequently, the education system, the innovation system and R&D activity have been strongly affected during the transition.

TABLE N°1 - Bulgarian macroeconomic review

Year	GDP in US\$, current prices	GDP growth in %	GDP per capita in US\$	Inflation in %	Unemployment rate in %	FDI inflows by year in millions US\$	from privatization in %*
1991	8,137.1	-8.4	942.6	473.6	11.0	-	-
1992	8,605.0	-7.3	1,007.6	79.5	15.1	34.4	-
1993	10,812.1	-1.5	1,276.2	63.8	16.4	102.4	21.5
1994	9,484.2	1.8	1,123.2	122.0	12.8	210.9	63.6
1995	13,055.1	2.9	1,553.1	32.7	11.1	162.6	16.0
1996	10,368.00	-9.4	1,239.80	311.6	12.5	256.4	29.8
1997	10,198.30	-5.6	1,226.90	547.7	13.7	636.2	66.2
1998	12,734.60	4	1,542.30	1.6	12.2	620.0	34.8
1999	12,945.80	2.3	1,576.70	7	16	818.9	27.7
2000	12,596.70	5.4	1,541.80	11.3	17.9	1001.5	36.5
2001	13,599.20	4.1	1,705.50	4.8	17.3	812.9	2.4
2002	15,650.80	4.9	1,994.80	3.8	16.3	904.7	15.0
2003	19,860.20	4.3	2,545.80	5.6	13.52	2096.9	16.9
2004	-	-	-	-	-	2487.5	47.8

* Greenfield and expansion are the other sources of Foreign Direct Investment.

Sources: Bulgarian National Bank, 2005.

In these early years of transition, the measures taken by the government were mainly directed to macroeconomic stabilization policies and to the implementation of the structural reform, aiming at reducing macroeconomic problems of post-socialist recession. However, the lack of political, legal and institutional stability from the beginning of the transition and the resulting high level of corruption have limited the effects of such an economic policy, have delayed some strategic reforms

and consequently the development of the knowledge economy. That can be illustrated by the postponement of the privatization of the Bulgarian Telecommunication Company (BTC), which has hampered the investments in new modern information and communication infrastructure. One result of the monopolistic position of BTC was the slow down of ICT development and hampering the concurrence in this field.

3.2 The adverse social climate and its consequences

Bulgaria underwent strong problems in development of its human capital, owing to high unemployment, increased poverty, the poor access to education, and the change in the social security system during the first decade of the transition. Overall, the social and economic reforms have worsened the quality of live. That affects negatively the knowledge economy development. Two main effects are observed.

First, pushed by the aggravation in the socio-economic environment, many young and highly educated Bulgarian specialists looked for career development abroad, attracted by the immigration programs for highly skilled of some developed countries (USA, Australia and Canada). This alarming situation is clearly shown by the US immigration statistics. A continuing large inflow of highly qualified specialists from Bulgaria is observed. Thus, almost 1,000 people with professional specialty and technical occupation have migrated from 1998 to 2000 to the United States of America. Poland and Romania are also affected by the phenomenon in a greater scale (respectively more than 1,200 people in 1999 and 1,100 in 2000 for Romania).

Second, the low-income level has a negative effect on the demand for ICT products and services and it explains the under-equipment of households in ICT. In addition, the low business culture of Bulgarian managers contributes to the low penetration of ICT in enterprises (Chobanova, 2002). Consequently, many of the Bulgarian IT firms actually work for foreign corporate and institution clients (ICT Development Agency, 2002, p. 13). But the fall of the iron curtain faces Bulgaria with a serious concurrence of countries like India, China and some Eastern European countries like the Czech Republic, Hungary and Poland, mostly in terms of outsourcing projects (Kearney, 2004). These countries enjoy large enterprises, which permit to conduct big project. In Bulgaria, the ICT firms are small and the critical size is not reached. Thus, Bulgaria is hampered by this problem. This may partially explain its position in IT activities (see Bulgarian Association of Software Companies, 2005).

Additional negative factors for the development of ICT have played during the transition, such as the late awareness of the strategic nature of knowledge.

3.3 A late awareness of the strategic nature of knowledge

As previously underlined, the delay in development of coherent policies and strategies in the fields of ICTs, R&D and innovation explains partly the current position of Bulgaria in Knowledge Europe. The realization that knowledge is a key factor in the development arose with the perspective of the country's accession to the European Union. Thus, the elaboration and implementation of policies, strategies or reforms in order to promote the development of the knowledge-based economy started only during the advanced stage of transition, after 1999, period of the economic recovery.

The elaboration of the *National Strategy for Development of High Technologies* initialized the process unsuccessfully because it was not carried out by the Parliament. However, the *National Strategy for the Development of Information Society* was adopted in 1999. It is the base of the *National Program for the Development of Information Society*, accepted in 1999 and revised in 2001. But the watershed in economic policy took actually place in 2004.

Recently, in the context of Bulgaria's accession to the EU, the Bulgarian government has attached high priority to the enhancement of innovation, according to the targets outlined in the Strategy of Lisbon (see for additional information CED, 2001 and 2005; UNECE, 2002; Report of the President of the Republic of Bulgaria, 2005; WEF, 2004 and 2005). Thus, in September 2004, the *Innovation strategy of the Republic of Bulgaria* was adopted. This strategy aims mainly at:

- Supporting R&D and encouraging the cooperation between research, universities and enterprises;
- Improving the funding of innovations; encouraging the introduction of new technologies and increasing the innovation efficiency of enterprises;
- Encouraging the formation of clusters in traditional sectors.

A few months later, the initiative for *ICT Cluster* was officially established by 13 non-government organizations, among which the Telecommunications Association, the Bulgarian Association of Software Companies, the Bulgarian Association of Information Technologies, the Bulgarian International Business Association, and Business Park Sofia. The aim of the cluster is to create a favourable environment for the development of IT industry. With the *ICT Competitiveness Strategy*, some governmental measures like the promotion of Bulgarian IT industry on the international market or the attraction of FDI in the IT sector and the development of education in IT, were also introduced. Again in 1999, the Ministry of Economy created a *National Innovation Fund* to support technology and innovation projects. In addition, the first *National Innovation Forum* was organized by the Applied Research Communications' Fund. Its goal is to provide a platform for cooperation between business and research organizations and to combine the local experience with the best

European and international practices (see ARC fund, 2005). In the context of the implementation of action plan “e-Europe 2005”, a *National Strategy for introducing the ICT in the Bulgarian Schools* was accepted.

TABLE N°2 - Main Measures in favor of the knowledge Economy in Bulgaria

Year	Measures
1999	Elaboration of the National Strategy for Development of High Technologies Adoption of National Strategy for the Development of Information Society
2001	Adoption of National Strategy for Scientific Research Revision of National Strategy for the Development of Information Society Adoption of Innovation strategy of the Republic of Bulgaria (September) Adoption of National Strategy for Introducing the ICT in the Bulgarian Schools
2004	Establishment of National Innovation Fund Establishment of the initiative for ICT Cluster (December) Adoption of ICT competitiveness Strategy
2004 and 2005	Organization of National Innovation Forum (October)

The bad health of the Bulgarian economy during the transition combined with the management difficulties of the public domain (governance problems, corruption, political instability, bad legal and organizational conditions) are the keys for understanding the current bad performance in the knowledge economy of the country. In such a transition context, the investment possibilities and the innovation capacities of organizations were reduced to zero and the strategic role of knowledge in the development was neglected. Consequently, the transition process affected all 5 pillars of the knowledge economy.

4. BY WAY OF CONCLUSION

Our analysis shows a bad positioning of Bulgaria in the European knowledge-based economy. The alarming situation results from several unfavourable factors, which reinforce one another in a cumulative process. Bulgaria has to break this vicious circle.

During last few years, the government took measures in order to achieve Lisbon goals towards a knowledge-based economy. Thus, the Bulgarian government acted in many different policy domains. We are not able to evaluate ex-ante or ex-post Bulgarian strategy and policy. That could be the aim of a future paper. Here, the discussion is focused on some questions or remarks derived from the conducted analysis.

A good quality of the institutional environment is a pre-requisite for the implementation of any strategy or policy (see sections 1 and 2). It means that even an adequate piecemeal strategy and policy aiming at promoting economic development may not produce desired effects. Thus, lack of administrative clarity, burdensome administrative environment, corruption, low coordination among organizations, people and institutions and bad legal framework could constrain the full achievement of the goals of different strategies conducted by any government. As mentioned, for Bulgaria, the

pillars “Governance” and “Economic incentive and institutional regime” are very weak. Therefore, if the present government wants to get effective results from its numerous involved policy or reforms policy, first of all, the improvement of institutional regime and governance must be given top priority.

From 2001, many NGOs and the government took different measures to fight against corruption. For example, National Anti-Corruption Strategy, Program of Implementation of National Anti-Corruption Strategy and Action Plan 2003-2005 were successively adopted. One can mention the setting up of the Anti-corruption Committee followed by the Anti-corruption Coordination Commission (see Annual Report of Coalition 2000, 2005) and the adoption of Codes of Conduct for Civil Servants and of Conduct for Public Administration Officials. Thus, the Bulgarian government focuses its efforts on the improvement of the regulatory framework: simplifying bureaucratic procedures, strengthening the monitoring mechanisms and governance. Nevertheless, it seems that despite the progress achieved during last five years, changes are not sufficient and need more time. In fact, the country still lacks an effective institution to tackle and prevent corruption (IT, 2004). It results from our analysis that a profound change of servants’ and citizens’ mentality is required. Indeed, it is not sufficient enough to lay down new regulations to win the fight against corruption and to improve governance. It is a long and complex process, related to the social culture, behaviours, mentality, which is often due to an adverse social context. The effective strengthening of state administration requires behavioural changes and above all an involvement of population and government.

Thus, a necessary condition for the Bulgarian economy to become knowledge-based is to set up good rules of governance but also to be able to mobilize human capital and to coordinate the interactions within citizens and organizations. Consequently, understanding how the social capital is created, will permit better implementation of policies and reforms in Bulgaria and will strengthen their effects.

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APPENDIX

Methodological Note - The Knowledge Assessment Methodology

The analysis is based on the World Bank's Methodology. Thus, here the Knowledge Assessment Methodology (KAM) used, consists of data for 25 countries for 58 variables, describing our five pillars of the knowledge economy (Economic Incentive and Institutional Regime, Governance, Education and Training, Innovation System and Information Infrastructure: 50 variables) and economic and social performance (8 variables).

The normalization procedure used in the KAM is as follows:

First, the raw data (u) is collected from World Bank datasets and international literature for 58 variables and 25 countries.

Secondly, ranks are allocated to countries according to based on the absolute values (raw data) that describe each and every one of the 58 variables (rank u). Countries with the same performance are allocated the same rank. Therefore, the rank equals 1 for a country that performs the best among the 25 countries in our sample on a particular variable (that is, it has the highest score), the rank equals to 2 for a country that performs second best, and so on.

Thirdly, the number of countries with worse rank (N_w) is calculated for each country.

Fourthly, the following formula is used in order to normalize the scores for every country on every variable according to their ranking and in relation to the total number of countries in the sample (N_c) with available data:

$$\text{Normalized } (u) = 10 * (N_w / N_c)$$

Fifthly, the above formula allocates a normalized score from 0-10 for each of the 25 countries with available data on the 58 variables. 10 is the top score for the top performers and 0 the worst for the laggards. The top 10% of performers gets a normalized score between 9 and 10, the second best 10% gets allocated normalized scores between 8 and 9 and so on. As mentioned, more than one country may be allocated either the top or worst of normalized scores. The 0-10 scale describes the performance of each country on each variable, relatively to the performance of the rest of the country sample.

TABLE N°3 – The five Knowledge economy pillars and the new KEI (25 European Countries)

Variables	Austria	Belgium	Bulgaria	Czech Republic	Denmark	Estonia	Finland	France	Germany	Greece	Hungary	Ireland	Italy	Latvia	Lithuania	Netherlands	Norway	Poland	Portugal	Romania	Slovakia	Slovenia	Spain	Sweden	U. Kingdom	EC-25 average
Overall performance of the economy	6.3	6.8	2.1	2.8	6.7	3.0	6.2	6.6	5.5	5.0	3.7	7.4	4.7	3.4	3.1	7.6	8.2	2.8	3.6	2.5	2.1	3.6	4.9	7.8	7.2	4.9
Average Annual GDP growth 1999-2003 (%)	1.3	2.5	8.3	3.8	2.5	9.2	4.6	3.3	0.0	7.9	7.5	10.0	0.4	9.6	8.8	1.3	0.8	6.7	2.1	6.3	5.8	6.7	5.4	5.0	3.8	4.9
GDP per capita, 2003	8.8	7.9	0.4	3.3	9.2	2.1	6.7	7.1	7.5	4.6	2.9	9.6	5.8	0.8	1.3	8.3	10.0	1.7	3.8	0.0	2.5	4.2	5.0	5.4	6.3	5.0
Human Development Index, 2002	5.8	7.5	0.4	3.3	5.8	2.5	7.5	5.8	5.8	3.8	2.5	7.5	5.0	0.8	1.3	7.5	10.0	2.5	3.8	0.0	1.3	3.8	5.0	9.6	7.5	4.7
Composite ICRG Risk Rating, dec. 2003	8.3	7.5	0.4	3.3	7.9	1.7	9.2	4.6	6.3	2.1	2.5	9.6	5.4	3.8	2.5	7.1	10.0	1.3	4.2	0.0	0.8	5.0	5.4	8.8	6.7	5.0
Unemployment rate (% of total labor force), 2000-2004	9.2	5.8	0.8	3.3	7.1	2.1	4.2	4.6	5.4	2.9	6.7	8.8	3.8	1.3	2.5	10.0	9.6	0.0	7.5	5.0	0.4	6.3	1.7	8.3	7.9	5.0
Employment in industry (% of total employment), 2001	4.2	7.9	5.0	0.0	7.1	2.1	5.8	8.3	2.5	9.2	1.3	4.6	2.9	6.7	5.0	10.0	9.6	3.8	1.7	6.3	0.8	0.4	3.3	8.8	7.5	5.0
Employment in services (% of total employment), 2001	6.3	7.5	0.4	2.1	7.9	4.2	7.1	10.0	6.7	4.6	3.3	5.8	5.4	3.8	2.5	8.3	9.2	0.8	1.7	0.0	2.9	1.3	5.0	9.6	8.3	5.0
GDP (current US\$ bill.), 2003	6.7	7.5	1.3	3.3	5.8	0.0	4.6	9.2	10.0	5.0	2.9	3.8	8.8	0.4	0.8	7.9	6.3	5.4	4.2	2.5	2.1	1.7	8.3	7.1	9.6	5.0
“Economic Incentive & Institutional Regime” Pillar	5.5	6.9	3.5	4.7	6.3	6.2	4.8	3.6	4.2	2.4	4.6	6.3	3.0	3.7	3.6	6.7	5.0	2.2	4.4	3.3	5.0	5.0	5.4	4.6	4.6	4.6
Gross Capital Formation as % of GDP (av. 1993-2002)	7.5	2.9	0.0	10.0	2.5	9.2	1.3	1.7	4.2	3.8	8.3	3.3	2.1	6.7	5.4	4.2	5.4	5.0	8.8	6.3	9.6	7.9	7.1	0.8	0.4	5.0
General Government Budget Balance as % of GDP, 2003	7.1	8.8	7.1	1.3	9.6	8.3	7.1	1.7	2.1	3.3	0.0	6.7	4.2	4.2	5.4	5.8	10.0	0.4	2.5	6.3	0.8	3.8	9.2	4.6	2.9	4.9
Trade as % of GDP, 2002	5.8	9.2	6.3	8.3	5.0	9.6	2.9	0.4	2.5	0.0	7.9	10.0	0.8	5.4	6.7	7.5	3.3	2.1	3.8	4.2	8.8	7.1	1.7	4.6	1.3	5.0
Tariff & nontariff barriers, 2004	0.4	0.4	10.0	7.5	0.4	0.0	0.4	0.4	0.4	0.4	7.5	0.4	0.4	0.4	0.4	0.4	0.4	7.5	0.4	9.6	7.5	7.5	0.4	0.4	0.4	2.6
Intellectual Property is well protected	6.7	10.0	0.0	1.7	9.6	3.8	8.3	7.1	8.3	2.9	3.3	5.0	3.8	2.5	0.8	7.5	6.3	1.3	5.0	0.4	2.1	3.8	5.0	7.9	8.3	4.9
Soundness of banks	5.4	6.7	0.8	0.0	7.9	6.7	7.9	5.8	2.1	2.9	0.8	7.9	2.9	2.9	2.9	7.9	5.4	0.8	5.0	0.0	4.6	2.1	7.5	7.1	7.9	4.5
Exports of goods and services as % of GDP, 2003	5.8	9.2	6.3	7.9	5.0	9.6	3.8	1.7	3.3	0.0	8.3	10.0	1.3	5.4	6.7	7.5	4.2	0.4	2.5	2.9	8.8	7.1	2.1	4.6	0.8	5.0
Intensity of Local Competition	3.3	9.2	0.4	3.3	7.5	5.8	6.7	6.7	7.5	3.3	1.7	5.4	5.8	2.5	3.3	9.2	3.3	1.3	2.5	0.0	0.8	1.7	7.5	7.5	10.0	4.7
Domestic credit to private sector (% of GDP), 2003	7.1	5.4	0.8	2.1	8.8	2.5	4.6	6.7	7.5	5.0	3.3	8.3	5.8	2.9	0.4	10.0	6.3	1.3	9.2	0.0	1.7	4.2	7.9	3.8	9.6	5.0
“Governance” Pillar	6.6	6.5	0.4	2.6	9.0	4.0	9.6	4.6	6.9	2.9	4.0	6.8	3.2	2.3	2.4	8.7	8.3	2.1	6.3	0.1	2.0	4.0	4.7	8.8	6.7	4.9
Regulatory Quality, 2002	7.9	5.4	0.4	2.9	8.8	5.0	10.0	4.6	7.1	3.3	4.2	7.5	3.8	2.1	2.5	9.6	6.7	0.8	6.3	0.0	1.3	1.7	5.8	8.3	9.2	5.0
Rule of Law, 2002	8.3	6.3	0.4	2.5	9.6	3.3	10.0	5.8	7.1	2.9	4.2	6.7	3.8	1.3	1.7	7.9	9.2	2.1	5.4	0.0	0.8	4.6	5.0	8.8	7.5	5.0
Government Effectiveness, 2002	7.1	8.3	0.0	2.5	8.8	3.3	9.2	6.3	6.7	3.8	2.9	5.8	4.6	2.1	1.3	10.0	7.5	1.3	5.0	0.4	0.8	4.2	5.4	7.5	9.6	5.0
Voice and accountability, 2002	6.3	7.1	0.4	1.3	10.0	2.5	9.6	5.4	7.9	2.5	4.6	6.7	3.8	1.7	0.8	8.3	8.8	3.8	5.8	0.0	2.1	3.3	5.0	9.2	7.5	5.0
Political stability, 2002	7.5	4.2	0.4	5.4	7.1	4.6	10.0	1.3	5.8	3.3	6.3	7.9	1.7	2.5	3.8	8.3	9.6	0.8	8.8	0.0	5.0	6.7	2.5	8.8	1.7	5.0
Control of Corruption, 2002	7.5	6.3	0.4	2.1	9.6	3.8	10.0	5.4	7.1	2.9	3.3	6.7	4.2	0.8	1.3	8.8	8.3	2.5	5.0	0.0	1.7	4.6	5.8	9.2	7.9	5.0
Press freedom, 2004	1.7	8.3	0.4	1.7	9.6	5.8	8.3	3.3	6.7	1.3	2.9	6.7	0.8	5.8	5.4	7.9	8.3	3.3	7.5	0.0	2.5	3.3	3.3	9.6	3.3	4.7
“Innovation System” Pillar	5.8	6.6	2.0	3.6	7.4	4.3	8.5	6.5	7.1	2.3	4.0	7.0	4.0	3.3	3.2	7.7	5.8	2.2	3.5	1.1	3.1	4.1	4.0	8.2	7.8	4.9
Gross Foreign Direct Investment as % of GDP,	1.7	6.7	2.9	5.8	7.5	6.7	8.8	6.3	3.8	0.0	4.2	10.0	0.4	4.6	2.1	9.6	5.0	2.9	7.9	0.8	2.1	0.8	5.4	8.3	9.2	4.9
Science & engineering enrolment ratio % of tertiary	6.3	9.6	2.5	3.3	0.8	2.5	8.8	7.5	10.0	1.3	5.8	4.6	4.2	0.4	4.6	8.3	1.3	3.3	7.1	0.0	9.2	1.3	4.6	7.9	6.7	4.9
Researchers in R&D per million population	6.3	7.9	1.3	2.5	8.8	4.2	10.0	7.5	8.3	1.7	2.1	5.0	0.8	0.4	5.8	6.7	9.2	2.9	3.3	0.0	3.8	5.4	4.6	9.6	7.1	5.0
Total expenditure for R&D as % of GDP	7.1	7.9	0.8	5.4	8.3	2.1	9.6	8.8	9.2	2.9	3.8	5.0	4.6	0.0	1.7	7.5	6.3	2.5	3.3	0.0	1.3	5.8	4.2	10.0	6.7	5.0
Manufacture Trade as % of GDP, 2002	6.7	10.0	6.3	8.3	3.3	9.6	4.2	2.1	3.8	0.0	7.9	8.8	1.7	5.0	5.8	7.5	0.4	2.5	2.9	5.4	9.2	7.1	1.3	4.6	0.8	5.0

University-company research collaboration	5.8	7.5	0.0	4.2	7.5	2.5	10.0	6.3	9.2	3.3	0.8	8.3	5.4	4.2	1.3	7.1	6.7	2.1	1.3	0.4	2.5	4.2	3.3	9.6	8.8	4.9
Cost to register a business (% of GNI per capita), 2002	6.5	4.8	6.1	4.3	10.0	n/a	8.3	8.7	7.4	0.0	0.4	5.2	0.9	2.6	7.0	3.0	7.8	1.3	3.5	3.9	5.7	2.2	1.7	9.6	9.1	5.0
Cost to enforce a contract (% of GNI per capita), 2003	9.1	3.9	5.7	0.0	7.8	n/a	0.4	7.8	6.1	4.3	6.5	5.2	7.4	4.8	1.7	9.6	3.0	2.2	7.0	1.3	0.9	8.7	3.5	2.6	9.6	5.0
Scientific and technical articles per million people, 1999	6.3	7.5	1.3	3.8	9.2	2.9	9.6	7.1	6.7	4.2	3.3	5.8	4.6	0.8	0.4	8.3	7.9	1.7	2.1	0.0	2.5	5.0	5.4	10.0	8.8	5.0
Administrative burden for Startups	5.8	3.8	0.0	2.1	7.1	10.0	9.6	0.8	5.4	1.7	8.8	7.1	2.1	6.3	2.1	7.9	6.3	3.3	1.3	0.4	3.8	5.0	3.8	8.3	9.2	4.9
Availability of Venture capital	1.7	6.3	0.0	2.9	7.5	5.0	10.0	6.7	4.2	3.3	2.1	8.3	4.6	6.7	5.4	9.2	7.9	2.1	3.8	0.4	0.8	0.8	5.4	8.8	9.6	4.9
Patent Applications granted by the USPTO per million	7.9	7.5	2.1	3.8	8.8	3.3	9.6	7.1	9.2	2.9	4.2	5.8	5.4	2.5	0.0	8.3	6.3	0.8	1.7	0.4	1.3	5.0	4.6	10.0	6.7	5.0
State of cluster development	5.8	4.6	0.8	0.0	8.8	0.0	10.0	5.8	7.5	2.1	0.8	9.2	9.6	4.6	3.8	5.8	5.8	2.9	3.8	2.9	2.5	1.7	5.4	7.9	7.9	4.8
High-tech exports as % of manufactured exports, 2002	5.8	4.6	0.0	5.4	7.5	5.0	8.3	7.1	6.7	4.2	8.8	10.0	3.8	1.7	2.1	9.2	7.5	0.0	2.9	0.0	0.0	2.1	2.9	6.3	9.6	4.9
Private Sector Spending on R&D	4.6	7.1	0.0	2.5	8.8	2.5	10.0	8.3	9.2	2.1	0.8	6.7	4.2	5.4	3.8	7.5	5.8	2.5	1.3	0.4	1.7	6.3	4.6	9.6	7.9	4.9
“Education & Training” Pillar	5.9	7.1	1.5	3.5	6.9	5.4	8.4	5.8	5.1	2.8	3.2	4.7	3.1	4.1	3.1	6.2	7.2	3.5	3.4	1.6	2.7	4.8	4.6	8.6	6.3	4.8
Adult literacy rate (% age 15 and above), 2002	4.6	4.6	2.1	4.6	4.6	3.8	4.6	4.6	4.6	0.8	2.5	4.6	1.7	3.8	2.9	4.6	4.6	4.6	0.0	0.4	4.6	2.9	1.3	4.6	4.6	3.5
Average years of schooling (% age 15 and above), 2000	2.4	4.3	6.2	6.7	7.6	n/a	8.6	1.9	9.0	2.9	3.3	5.2	1.0	n/a	n/a	4.8	10.0	8.1	0.0	7.1	3.8	0.5	1.4	9.5	5.7	5.2
Secondary Enrollment, 2001	3.8	9.6	1.3	1.7	8.8	6.3	8.3	5.4	4.2	2.1	2.9	5.8	2.5	0.8	3.3	7.9	7.5	4.6	6.7	0.0	0.4	5.0	7.1	9.2	10.0	5.0
Tertiary Enrollment, 2001	5.4	5.8	1.7	0.4	6.3	7.5	10.0	3.8	2.1	8.3	1.3	2.5	2.9	8.8	7.1	4.2	9.2	4.6	3.3	0.0	0.8	7.9	5.0	9.6	6.7	5.0
Life expectancy at birth, years, 2002	8.8	8.3	1.7	3.3	4.6	0.8	7.1	9.6	5.8	6.7	1.3	5.0	7.9	0.4	2.1	6.3	9.2	2.9	4.2	0.0	2.5	3.8	7.5	10.0	5.4	5.0
Internet access in schools	8.3	5.8	0.0	3.3	9.2	8.3	10.0	3.3	6.3	0.4	5.0	2.5	1.3	4.6	2.5	7.5	6.7	1.7	5.0	0.4	1.7	7.1	3.3	9.6	7.9	4.9
Public spending on education as % of GDP, 2001/2	5.8	7.5	0.0	2.1	10.0	9.2	7.5	5.8	2.9	0.8	4.6	1.7	3.8	7.5	5.4	4.2	8.8	5.0	5.8	0.4	1.3	5.8	2.9	9.6	2.1	4.8
Quality of science and math education	8.3	9.6	3.8	6.7	4.2	6.7	8.8	9.6	0.8	1.7	7.9	5.4	1.7	2.9	4.6	4.6	0.4	2.5	0.0	8.8	7.5	5.4	2.9	5.4	1.3	4.9
Extent of Staff Training	6.7	7.9	0.0	2.5	10.0	3.3	8.8	6.7	9.2	2.9	1.3	5.8	4.6	4.2	0.8	7.9	5.8	1.7	1.7	0.4	3.8	5.4	4.6	9.6	7.5	4.9
Availability of management education in 1 st -class Business	5.4	6.7	0.0	2.5	5.4	4.6	8.8	10.0	6.3	0.8	2.9	6.7	5.0	3.8	1.7	6.7	7.9	0.8	3.3	0.4	1.7	4.2	7.9	8.8	9.6	4.9
Well-educated people do not emigrate abroad	5.8	7.5	0.4	4.6	5.8	3.8	10.0	3.3	5.4	2.9	2.1	6.7	1.7	4.2	0.8	9.2	9.6	2.5	7.9	0.0	1.3	5.0	6.7	8.8	8.3	5.0
“Information Infrastructure” Pillar	6.1	4.5	2.5	5.0	7.8	4.3	7.3	5.3	7.8	2.9	3.3	5.8	5.1	3.2	1.7	7.9	7.6	2.5	3.7	1.8	3.3	4.4	3.7	9.3	7.7	5.0
Telephones per 1,000 people, 2003	6.7	4.6	0.4	5.4	9.2	2.5	7.5	3.8	8.3	3.3	2.9	5.8	8.8	1.3	1.7	7.1	10.0	0.8	5.0	0.0	2.1	4.2	6.3	9.6	7.9	5.0
Main Telephone lines per 1,000 people, 2003	5.4	7.1	3.3	2.5	9.2	2.1	6.7	7.5	8.8	5.0	2.9	6.3	5.8	1.3	0.8	8.3	9.6	1.7	4.2	0.0	0.4	3.8	4.6	10.0	7.9	5.0
Computers per 1,000 people, 2003	6.7	5.4	0.0	3.3	9.6	4.6	8.3	6.3	7.9	0.4	1.7	7.5	5.0	2.9	2.1	8.8	9.2	1.3	2.5	0.8	3.8	5.8	4.2	10.0	7.1	5.0
TV Sets per 1,000 people, 2002	5.8	4.6	1.7	4.2	8.8	3.3	7.1	5.4	6.7	3.8	2.1	7.5	2.9	8.3	2.5	6.3	9.2	1.3	0.8	7.9	0.4	0.0	5.0	10.0	9.6	5.0
Internet users per 10,000 people, 2003	7.5	5.0	0.0	3.8	9.2	4.6	8.8	5.8	7.9	0.4	0.8	4.2	5.4	6.7	2.1	9.6	8.3	2.5	1.7	1.3	3.3	6.3	2.9	10.0	7.1	5.0
International telecommunications, cost of	2.9	1.3	3.8	5.8	3.3	7.1	5.0	0.0	9.2	7.9	6.7	7.5	4.2	0.8	0.4	8.3	10.0	2.5	5.4	2.1	6.3	8.8	1.7	9.6	4.6	5.0
E-Government	8.8	2.5	1.3	5.0	6.7	5.8	7.5	9.6	10.0	0.0	0.4	7.9	7.1	0.8	2.1	8.3	3.8	5.4	2.9	1.7	4.6	3.8	3.3	6.3	9.2	5.0
ICT Expenditure as % of GDP, 2002	4.8	5.2	9.5	10.0	6.2	n/a	7.6	3.8	3.3	2.4	8.6	0.0	1.4	n/a	n/a	6.7	0.5	4.3	7.1	1.0	5.7	2.9	1.9	9.0	8.1	4.8
New Knowledge Economic Index (new KEI)	6.0	6.3	2.0	3.9	7.5	4.8	7.7	5.2	6.2	2.6	3.8	6.1	3.7	3.3	2.8	7.4	6.8	2.5	4.3	1.6	3.2	4.5	4.5	7.9	6.6	4.9

Source: calculated from World Bank Data, 2005 with authors' methodology.