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WHY HAVEN'T THE EU ACCESSION COUNTRIES YET ACCESSED KNOWLEDGE-BASED SOCIETY: WHAT CAN SOCIAL SCIENCES DO ABOUT IT? THE CASE OF CROATIA

INTRODUCTION: REALITY OR MYTH

In the countries of the developed West the concept of knowledge-based economy (KBE) has been recently (at the beginning of the third millennium) subjected to the critical examination prompted by the slowdown of information and communication technologies (ICT) and dot.com economy in the USA. The new economy has been proclaimed "in part an old story" (OECD, 2001; OECD, 2003), a myth and not a reality born by ICT and other new technologies that, by the end of the 1990s (OECD, 2001), were the drivers of the productivity growth. However, it can not be denied that a new pattern of economic growth has emerged bringing forth the new factors strongly influencing economic growth and catch-up processes between countries. While the developed as well as some of the fast growing small economies (e.g. Finland, Ireland) are already analyzing the consequences of the "knowledge based growth" they have experienced during the last quarter of the 20th century, in some of the EU candidate[1] and pre-accession countries[2] the knowledge based economy is far from being either the reality or a myth.

The reality of these countries, judging from the example of Croatia as a typical pre-accession country is torn by internal and external political interventions, "realpolitics" which has little to do with knowledge production, human and social capital, technology development, networking and other specific elements which constitute the new economy. Therefore, the knowledge-economy in these countries is neither a "negative" myth which should be reassessed and overcome nor a "positive" myth, a desirable goal, a better future worth aspiring to. Still, the typical dilemma that disturbs the policy makers all over the world, regardless of the scale and power of their economy is almost the same:

- in the **advanced countries** scholars are concerned with why have the USA and some smaller economies like Australia, Ireland, the Netherlands (OECD, 2003) or

Finland grown so fast while many big European countries like Germany or non-European countries like Japan have decreasing growth rates;

- Similarly, the **developing CEEC** countries scholars have concluded that "we have, on average, seen increasing divergence rather than convergence across Europe "while (...) "catching up has been restricted to just a few of restructuring CEE countries" (Gristock, 2003)
- The same question is relevant for **pre-accession** countries as well. Why, for example, hasn't Croatia joined the EU club together with Slovenia, Poland, and Hungary? In the 1970s it was one of the most advanced countries in the region. All of the necessary pre-requisites like technology base, scientific base, educated labor, openness to international markets and such did exist in Croatia. Nevertheless, taken together they haven't been a very successful combination.

The recent analysis of the growth performance of different countries corroborates the common belief that the divergence in growth can not be easily explained by investment in fixed assets (machinery, plants, equipment), or even by investments in the new technology and knowledge itself. (...) "Although they have pervasive effects on economy and society, they alone can not explain why some economies are growing while others are downsizing" (for more, see OECD, 2001; OECD, 2003). Much more important are the factors that put physical investments as well as investments in intangible assets to work.

Starting from this new assumption, we will try to demonstrate, using Croatia as an example, that the failure in economic growth in the developed and developing countries is deeply socially and politically rooted. The future of any country is produced by its historical heritage, business ethics, moral values, political attitudes. In the case of Croatia historical heritage has produced the state of semi-modernism which prevents the structural adjustment to the global changes and deters the knowledge-based economy. The Croatian society is a mixture of modern and traditional elements that create the state of semi-modernism, a term coined and defined by the famous Croatian sociologist Josip Županov (2001). Semi-modernism marked the last decade of the 20th century and is dominated by so-called de-industrializing political elite. These political elite dragged some aspects of social and economic life into the pre-industrial era which caused:

- basic failure to understand of the role of innovation, knowledge and technology capability in the knowledge based-economy including

- failure to implement the national innovation system (NIS) as a framework for connecting research and business facilitated by proper policy measures and environment needed for accelerating technology development.

Since the establishments of NIS and technology development are considered to be fundamentally social processes, the paper will explain how social sciences imbedded in the specific theory of Triple Helix (TH) can contribute to NIS, economic growth and entering knowledge-based economy.

WHAT DOES IT MEAN TO BECOME THE KNOWLEDGE-BASED SOCIETY?

The term knowledge based-economy was coined by OECD (1996) and defined as an economy which is directly based on the production, distribution and use of knowledge and information (Trewin, 2002). By analogy, the knowledge based society (KBS), could be defined, lacking the empirical analysis as well as theoretical reflections, as a new economic and social structure that is designed to support and stimulate technological change and innovation as well as R&D and education as its driving forces in all aspects of society: organizational, institutional, cultural, political, legal, ethical, etc.

Moving towards KBE is usually expressed in statistical indicators that measure or numerically express the strength of the selected factors or dimensions recognized as the most characteristic or influential for knowledge-based growth.

Some components such as knowledge investment, ICT, innovation and entrepreneurship, human capital and social capital are common for all indicators of entering KBE. The strength of these dimensions in a specific country is usually taken as a measure of moving towards KBE.

For example, by investing in knowledge, as one of the most important dimension of KBE,[3] Sweden, The USA, Korea and Finland became the four most knowledge-based economies, as their investment in knowledge amounts to 5.2 – 6.5% of GDP (OECD, 2001a). In addition, the majority of OECD countries, especially the Nordic countries, Ireland and Australia are moving towards knowledge-based economy because during the 1990s they invested more resources in the knowledge production (annual investments increase of 3.4%) than in gross fixed capital (annual investments increase of 2.2%).

However, the statistical evidence of strength of these selected components like knowledge investments does not explain why some countries are strong, or better yet: why

did they decide to become strong in these components, when others didn't.

WHY IS NIS IMPORTANT FOR BECOMING KBE

No matter how we put it, the essence is in the creation of an environment that stimulates the knowledge-driven factors. Contextual dimension incorporates a number of background elements such as economic, social, cultural, legal, political, environmental and global factors which act as preconditions for successful KBE (more in: Trewin, 2002).

In other words, economic growth and technological development could be accelerated by creating a socio-economic system which encourages the commercialization of knowledge through innovations and new technologies, namely by creating a national innovation system (NIS). Therefore, the concept of NIS could be defined as the integration of the science, educational, industrial, and technology policies into the new strategic policy of development as a model for achieving knowledge based growth.

For the development of small economies with scarce R&D and technology resources like Croatia, it is extremely important to understand that economic growth and technology development are complex social phenomena primarily based on the ability of a society to get organized in a way that stimulates technological change and innovations as the main driving forces of growth.

Still, in countries like Croatia innovation policy has never been a priority. Quite the contrary, it has always been marginal in comparison to the politically and socially accepted priorities like macro-economic stabilization, privatization, and the reconstruction of the regions devastated during the war, etc.

NIS as a national consensus on innovation hasn't been established and a technology policy has never become a national development priority. The fundamental question is why?

THE SOCIAL ASPECTS OF LEGGING BEHIND IN TECHNOLOGY DEVELOPMENT AND THE ABSENCE OF A PROPER NIS

The inability of Croatian ruling elites to recognize knowledge and innovation as the driving forces of growth and to comprehend that NIS is the environment that would put these forces to work is deeply rooted in socio-economic system and therefore depends on cultural values, historical heritage, political will-power and social recognition. The socio-economic system in Croatia is in a state of

"semi-modernism" (Županov, 2001) that marked the last decade of the 20th century. It is dominated by the so-called de-industrializing political elite which have brought some aspects of social life back to the pre-industrial era. Croatia is one of the countries which have been going through the 50 years long transition process, also described as the state of "Purgatory". The first phase of the process was the period of socialism as a transition between capitalism and communism, and the present, second phase is "political capitalism" as a transition from socialism to liberal democracy and market economy.

There are three main aspects of semi- modernism:

1. The first is **re-traditionalization** – the process of de-secularization and the so called "moral and social renewal" back to the ethical values of the 19th century. This social type of "Gemeinschaft" which was believed to have disappeared in migration and urbanization has raised surprisingly well as new normative integration. National homogenization which was very welcome during the war for independence has afterwards not been transformed into functional integration. Just the opposite, some kind of "Hobbesian incivility" and anomie have become quite visible because the old norms and values in business and politics were destroyed and the new ones have been based on a different process, the process of de-industrialization.

2. **De-industrialization** – is the process of devastation of industrial firms by the way of "the empty shell model". The model marks the process of the privatization of the previously state owned companies the substance of which was sucked out by the tycoons and corrupted or irresponsible managers. Privatization regularly ended with companies loosing their competencies in technology, skills, fixed assets, market competitiveness, etc. These companies were nothing but the empty shells dependent again on the state support. The wrong model of privatization entitled political "capitalism" lacking in fresh financial input and skilled managers, has had, instead of the healthy profit seekers, the rent-seekers, a new class of businessmen, who earned themselves the profits by selling the property accumulated by the previous generations.

3. The third process, **de-scientization,** a process of the marginalization of science and the creation of the atmosphere of anti- intellectualism, proves that the political elite just did not recognize science and education as necessary for development. The results were devastating and familiar: "brain drain", the migration of scientists, the financial starvation of research, the destruction of industrial R&D and the loss of technological competence.

These three processes are the social and political roots of legging behind in technology, slow growth and the lack of the structural adjustment to the knowledge-based economy.

THE STATE OF THE ART OF THE KEY NIS ELEMENTS IN CROATIA: ITS SHORTCOMINGS AND ITS SOCIAL ROOTS

The four main characteristics of the Croatian NIS are selected to illustrate the presented social and political roots of the failure in development. These are as follows:

A. Insufficient technological capabilities of companies
B. Inadequate structure of R&D sector
C. Unsatisfactory science- industry cooperation
D. Inappropriate environment

A. The Insufficient technological capabilities of companies

The technological capability of companies, which, by definition, comprises the ability to innovate and the ability for innovation diffusion (transfer, absorption, application, modification) is the factor of differentiation between technology leaders and technology followers, the so-called "technology changing" and "technology-using" countries (for more see: Bell & Pavitt, 1993).

The "technological capability" in contrast to the "production capability" has emerged as one of the major factors that are used to explain growth differences among the developed and the developing countries because it implies the ability to create and modify new technologies while the production capability incorporates the production and efficiency ***at a given*** level of inputs (technology, skills, equipment, etc.) (Bell & Pavitt, 1993).

The examples of Japan and Korea in the past and Finland or Ireland in the present are the evidence that technology accumulation enables the less developed countries to transform the low-technology and labor intensive sectors (textile, wood) into complex technology systems (food, chemical, automotive industries) and finally enter the knowledge intensive sectors (pharmacy, biotechnology, services). In practice it means that in the 1980s these countries made some structural adjustments to fit the new economy.

The importance of the technology capability for making the structural adjustments in accordance with the global changes is poorly understood in Croatia. Since the structural adjustments of economy have not been recognized as a priority goal of national development, neither

the state nor the private business have made any efforts to introduce new technology sectors or to modernize the exiting ones that would be worth mentioning.

It is, on the macro-economic level, illustrated by the fact that, for more than 25 years, the economy as well as the export has been dominated by the "traditional Croatian industries" like wood and textile industry, fishery, tobacco and shipbuilding (Jurlina-Alibegović, 2002). However, there is also some statistical evidence that the export of high-tech products is quite significant, amounting to 8% of the total exports of the manufacturing sector.

On the micro- level of companies, the technology capability is, again, rather low (Table 1). The comparison of some selected indicators like the number of patents, ISO standards 9000 and Internet hosts reveals that Croatia lags not only behind the developed countries, but also behind the European accession countries we like to compare to. For example, the number of patents is 6 times lower than in the Czech Republic and Poland and 26 times lower than in the EU countries.

The number of ISO 9000 is 7 times lower than in Slovenia and 16 times lower than in England, while the number of Internet hosts is 3 times lower than in Hungary, Poland, or Slovenia and 20 times lower than in Denmark.

As is the case with the technological capability, the innovation capacity and national competitiveness are rather low in comparison not only with the developed but also with the EU candidate countries we like to compare to (Table 2).

Table 1
Diffusion of Internet Hosts, ISO 9000 and patenting activities in 2000

		No. of Internet hosts per 10.000 inhabitants	No. of patents per Mio. inhabitants	No. of ISO 9000 per Mio inhabitants
Accession Countries	Cyprus	30		369
	Czech Republic	209	60	375
	Estonia	357		126
	Poland	127	60	54
	Slovenia	148		424
High Income Countries	Denmark	1.045		424
	Germany	294		396
	Netherlands	1.634		696
	UK	371		1.073
	EU 15		260	
	Croatia	47	10	65
	Hungary	168	70	469

Source: EPO 2003, OECD S&T Indicators, 200172, ITU 2002, World Bank 2001

It is obvious that in Croatia the management of the technological change and the accumulation of the technological capability of firms have, in reaction to the decades of the state planned economy, been being approached from the newly introduced neo-liberal point of view. When technology policy is considered, the power of market was obviously overestimated. However, the possibility for political and business elites to intervene to accelerate technology accumulation has been completely blocked from the fear of any kind of state interference.

B. The inadequate structure of R&D sector

Although the total investments in R&D (GERD) in Croatia are quite satisfactory (since it amounts to 1.2% of GDP in the year 2000) and Croatia is at the top of the list of theEuropean accession countries (still below Slovenia with 1.5% of GDP, but above Slovak Republic and Hungary with 0.68% of GDP, or Poland with 0.75% of GDP), the industrial R&D sector, the driving force of economic development, has almost disappeared during the transition period while the public R&D sector, the national pool of knowledge, has been seriously weakened. The general diagnosis would be that the problems are not so much in "inputs" but in "outputs" - the so called "Croatian research paradox"

Table 2
R&D and innovation indicators for selected countries in 1999 (Or the most recent available year)

Indicators	Croatia	EU	OECD	Finland	Nordic countries	Poland	Hungary	Slovenia
The Global Competitiveness report								
- Rank of GDP per capita (2001)	44			14		38	30	25
- Rank of national competitiveness	58			2		51	29	28
- Rank of technology index	58			3		36	21	25
- Rank of innovation capacity	42			3		35	28	25
GERD	1,19	1,85	2,21	3,19	--	0,75	0,68	1,51
% of GERD performed by business	44,4	65,6	72,4	70,0	69,2	41,4	45,4	55,0
% of GERD performed HE and public labs	51,2	34,4	27,6	26,0	30,8	58,6	54,6	45,0
% of GERD financed by business	44,5	54,7	63,2	65,0	62,8	38,1	38,5	56,9
% of GERD financed by the State	52,7	36,0	29,8	30,0	30,0	58,5	53,2	56,9
BERD	0,43	1,20	1,54	2,18	-	0,31	0,28	0,84
Public expenditures on R&D as % of GDP (GOV+HE)	0,55	0,64	0,61	0,99	-	0,44	0,37	-
R&D expenditures per capita (USD)	70	415	500	-	690	60	90	220
Researcher is business sector (%)	17,3	49,8	64,9	-	50,5	18,3	25,9	18,3
Researchers in public sector (%)	82,7	50,2	35,1		49,5	81,7	74,1	63,6
Researchers per 1000 labor force	3,2	5,2	6,1		8,1	3,3	2,9	4,6
PhD in science and technology (aged 25-34)	0,17	0,55	0,47 (USA)	0,97	-	-	-	-

Source: Radas 2003; Strategy of Development, "Croatia in 21st century – Science", (Official Gazette, 108/2003), The Global Competitiveness Report, 2002-2003, Annual Competitiveness Report of Croatia, 2002, NVK, 2003

This paradox is rooted in the inadequate structure of R&D sector which is not harmonized with the requirements of the modern research system for "catching up" and adjusting to knowledge-based economy. In the developed countries industry dominates the science system since it funds nearly 63% and conducts about 72% of the total R&D. It employs the majority of researchers and scientists – from 50% in the EU to 65% in OECD countries.

But Croatian R&D system is still dominated by the public sector since the state funds about 53% of R&D and employs about 83% of researchers (53% at universities and 30% in the public labs).

Business sector finances about 44% of total R&D and employs only 17% of researchers. It is obvious that the vast majority of R&D potentials heavily depends on the scarce budget resources, which amount to only 0.55% of GDP.

In addition, the total investment of business sector in R&D is extremely low and amounts to 0.43% of GDP while in the developed countries business sectors invests more than 1% of GDP and in the fast growing countries like Finland more then 2% of GDP.

Both the government and the industry in Croatia have a very good reason for alarm. Therefore, the urgent task of NIS in Croatia is to strengthen the industrial R&D sector towards its domination of R&D system.

The devastation of industrial production and industrial R&D sector is a most severe shortcoming of the Croatian innovation system, as insofar both the major supply and the strong demand for R&D and technological development have disappeared.

Thus, to build up and support R&D and innovative activities in the business sector should be a common goal both for the government policy and the business sector.

At the moment, the institutional and policy environment is neither conductive nor encouraging for entrepreneurial activities and technology development. It, also, isn't attractive for international / export oriented economic activities.

The prerequisite for such change in R&D system would be a social and political recognition of the business sector as the place of commercialization of research through innovations and new technologies. However, during the transition period, the political and business elites applied the "shock" therapy (Radošević, 1996) on industrial R&D sector driven by the neo-liberal belief in the perfect market. The business philosophy of the new business elite was driven by "rent-seeking" through privatization

and not by "profit-seeking" through industrialization and technology accumulation.

C. The unsatisfactory science-industry cooperation

The strengthening of the industrial R&D sector largely depends on the science industry cooperation, a mechanism which is widely used in the developed countries for the translation of R&D potentials into new marketable technologies.

In Croatia is the cooperation between public R&D organizations and business sector quite unsatisfactory. The research institutes earn only about 10% and the universities earn meager 6% of their revenues from the contracts with the industry (Švarc et al., 1996). There is no market for scientific research and services, since the Croatian industry has, in time, lost the need for R&D services, and the research institutions traditionally play a passive role in this interaction. The close cooperation exists only between the large industrial companies in technology intensive fields and their corporate institutes established for the purposes of the in-house research (e.g. "Tesla – Ericsson" (telecommunication), "Pliva" (pharmacy)).

For the science-industry cooperation to develop it is necessary to understand that the linear model of innovation has never proven its worth in practice because the large investments and the top scientific achievements do not automatically create profit. That's why, during the 1970s, when the innovation based competitiveness emerged, many countries substituted the linear model of innovation with the interactive model. The linear model presumes the automatic translation of scientific results to the business sector use and encourages the independence of science from the industry.

By contrast, the integrative model is based on the interaction of science and the industry. This interaction is a mechanism of the commercialization of research and of the building of the technology capacity of firms. Therefore, some distinguished scholars pointed out that, in modern countries, the science-industry cooperation emerge as an important political issue (Dosi, 1988). Still, that were not the case in Croatia.

D. The inappropriate environment

The importance of the technology accumulation, industrial research and the science-industry cooperation for the long-term economic growth is poorly perceived and understood in Croatia. Correspondingly, the creation of proper

environment that would encourage these new factors of economic growth was very much neglected.

To illustrate: Croatia lacks:

- domestic venture capital industry – a special financial institution for supporting new technologies or technology based business like seed capital or risk capital
- system of encouraging the protection of intellectual property in research by patenting, licensing or by other method of the commercialization of innovation and research results
- large infrastructural institutions for technology transfer like technology or science parks
- technology foresight programs as an exercise in self-analysis of technology limits we are facing
- significant efforts in developing competence is generic technologies like biotechnology, nano-technology, new materials or even computer technologies which play today the same role that the electricity played in the past.

The shortcomings of the exiting NIS show how cultural values, historical heritage, political will and social recognition form the mentality and the paradigm of semi-modernism, both of them obstacles to the modern way of thinking about the development (Table 3).[4]

Table 3
Differences in modern and traditional approach to some elements of NSI

NSI elements	Traditional approach	Croatian specifities	Modern approach
Technology capabilities of companies (TC)	• Implicitly assumed as immanent to companies • New technology is exogenous process • Technology can be bought on the free market • Market is perfect	• TC is irrelevant sine rent seekers and tycoons dominate in the management structures • Privatization according to the empty shells model	• Technology is endogenous process • TC is continuously improved by learning and accumulation • State intervenes to amortize market imperfections
Structure of R&D sector	• Domination of the academic science funded by the state	• Domination of the academic science funded by the state • Descientization, anti-intellectualism	• Domination of industrial private sector in investing and performing R&D
Weak science-industry cooperation	• Linear model of innovation	• Science and universities are "ivory tower"	• Interactive model of innovation • Science-industry cooperation is decisive factor of economic development • Networking • Public-private-partnership
Proper environment	• Neo-liberal approach • Market perfection • No need for deliberate social action or state intervention	• Not recognized as a factor of development	• Depends on intentional social activities, self-organization and self-management • State support is indispensable

Still, parts of the government administration did try to set up a proper environment by creating different support programs. The most important efforts are those of the **Ministry of crafts and small and medium sized companies** which has launched a range of different programs for upgrading firms' technology capabilities and export[5]. Also, the Croatian Program for Innovative Technological Development (HITRA) launched in 2001 by the Ministry of science and Technology (MoST) aimed at encouraging the science-industry cooperation via technology projects and the support of the knowledge-based companies. These endeavors should be taken as the foundations of the Croatian NIS, but without the national consensus on the technology development they have limited and short-term effects.

HOW TO BECOME KNOWLEDGE-BASED ECONOMY/SOCIETY?

The formula for becoming KBE/S is quite simple and can be expressed as follows:

KBE/S = (science + education) × innovation + technology.[6]

However, to implement the formula a level of social and political modernism that would allow the comprehension of the following ideas is required that:

- driving force of KBE is knowledge (and education) embodied in the technological change which consists of the technological capability to create and absorb innovations
- managing the technology change (innovations) is located primarily in companies (industry) and is the result of the accumulation of technology and learning
- technological change is biased towards knowledge-based innovations and that the knowledge flow from science to industry and back is the key concept of modern development
- technological change and learning are essentially social processes which can be accelerated by proper social and political actions targeted primarily at the science-industry cooperation
- intentional social and political action to facilitate knowledge flow is also known as NIS, so building up an efficient NIS with the emphasis on the technological capability of companies by means of the science-industry – government cooperation is a key to achieve KBE.

The social and political acceptance of the aforementioned ideas calls for:

- the radical change in the traditional economic doctrine, a shift from the classical growth theories to the new growth theory (Table 4)
- the change in the mentality dominated by the belief in a perfect market towards the belief in the creation the national innovation system as an intentional social and political activity of planning and managing national R&D resources, if necessary even by the state intervention.

The shift from the classical growth theories to the new growth theory also asked for the shift from the exogenous to the endogenous growth model. In contrast to the traditional economy which acknowledges only tangible investments in capital and labor (machinery, plants, buildings and worker's wages) as the main production and growth factors, the growth of the new economy is based on the accumulation and investments into the intangible capital, primarily knowledge and human capital. Basing economic development in R&D, technology and learning is, in comparison to the traditional economy, quite a radical approach and some countries were not able to comprehend it. The shift from the traditional cost-based competitiveness of firms to the competitiveness based on innovation requires the substitution of the classical science and industrial policy with the innovation policy as the strategic integration of both science and technology into the new policy of economic development.

The neo-classical exogenous growth theory formulated by Solow in the early 1960s (Solow, 1957) was the needed breakthrough in the economic theory. The theory states that the largest part of the economic growth Šone half (OECD, 1992:168) or even 3/4 (Solow, 1957) cannot be explained by the traditional economic factors of labor and capital (conventional capital). It can be explained by another, the third production factor, the so-called technological change[7]. However, it has been treated as an exogenous factor, "manna from heaven" (Petit, 1995) making, in an incomprehensible way, the production factors more productive. It was seen as unrelated to the pace of economic growth and therefore not capable of explaining it.

Table 4
The shift in economic theory

KNOWLEDGE-BASED CONOMY	TRADITIONAL ECONOMY
1. BACKGROUND: new growth theory – endogenous growth model	1. BACKGROUND: neo-classical growth theory – exogenous growth model
2. PRODUCTION FACTORS: knowledge as endogenous to economy and society transformed into the innovation	2. PRODUCTION FACTORS: capital, labor, technology as exogenous to economy and society
3. INVESTMENTS: intangible capital, R&D, learning, products & process improving	3. INVESTMENTS: tangible capital, machinery, plants, buildings and labor in terms of wages
4. COMPETITIVNESS based on innovation	4. COMPETITIVNESS cost-based

The neoclassical theoretical framework, which was not able to explain the nature of economic growth and technology change, assumed that:

1. all social and economic processes, including the emergence of technology, are regulated by the perfect market and by the competition,
2. new technologies appear as the market demands them (demand-pull model),
3. they are freely available under the same conditions for all, they do not cost anything nor do they require any special knowledge
4. according to the linear model of innovation technologies appear at the last phase of research and are embodied in machinery.

Contrary to this approach, according to the new growth theory formulated by P. Romer as the "endogenous growth model" (Romer, 1989, 1990) the driving force of economic growth is knowledge or idea. Knowledge is completely new kind of production factor which, when imbedded in new technology, innovation, machinery, process or similar, has the effects of externalities and spill-over and therefore creates continuous returns on investment and continuous economic growth.

Due to externalities and spill-over, knowledge has the permanent positive effects on economic and social development. Therefore, technology as materialized knowledge is not a factor exogenous to economic and social processes but is endogenous to society and economy. The new growth theory has overcome the neo-classical approach of diminishing returns to investments. It has also overcome the theorem of economic stagnation.

To accept the new growth model means to accept the knowledge and education as the new production factors and accept all the rules imposed by the "knowledge econ-

omy" including the new business culture, new mental concepts as well as the new ways of behavior.

WHAT CAN SOCIAL SCIENCES DO?

The endogenization of R&D is just the first and more simple part of the "how to become knowledge-economy" equation. The second part is about "social change" and the shift in mentality necessary for the acceptance of the first steps towards the new economy – the materialization and the commercialization of science and education through innovation and new technologies.

In spite of the externalities and the spill-over effects of knowledge (implying that investments in all kinds of knowledge are effective), it must be commercialized to become economically valuable. Starting from the basic definition of technological innovation as "the first application of science end technology in a new way, with commercial successes (OECD, 1992)" the capitalization of knowledge is realized by being translated to innovation, which leads us to the technological capability of companies, managing technological change (innovations) and technology accumulation. In other words, it leads us to the concept of the national innovation system (see Freeman, C., 1988a; Lundvall, B. A., 1988; Niosi, J. at al., 1993), the concept the origins of which go back to the early 1980s when the business philosophy of companies was best illustrated by the slogan "innovate or liquidate" (Grayson, 1996:18).

In contrast to science policy, national innovation system stresses the commercial utilization of innovation as well as the commercial application of research results with the purpose of achieving economic growth and competitiveness.

Emphasizing the need to interconnect all the institutions and subjects relevant for the production and diffusion of innovation it goes far beyond science planning and coordination. It has gradually been replacing standard R&D policies.

Some of the more technologically advanced industrializing countries like Japan and Korea in the past and Finland or Ireland today, are the proof that a proper innovation system enables even the less developed countries to accumulate technology, which results in a more complex production sector and, eventually, in entering the knowledge-based economy[8].

The advancement of these countries supports the well-known conclusion that economic progress and tech-

nology development are primarily social processes (OECD, 1992) meaning that achieving KBE depends on the social ability of self-organization and on the self-management system which encourages the commercialization of knowledge through innovations and new technologies. NSI is socially rooted and depends on historical heritage, culture, ethics, political attitudes, etc. That's why the national innovation systems differ so significantly across the countries and regions.

Social sciences could, therefore, help construct the national innovation system and enhance economic growth. Today, the theory of Triple Helix (TH) emerges as the most useful theoretic platform, analytical framework and normative approach for social research and social action in building NIS and enhancing economic growth.

"The Triple Helix is intended to be a sociological expression of what has become an increasingly knowledge-based social order" (Shinn, 2002). As Leydersdorff and Etzkowitz (2003) pointed out "(...) it can be considered as an epistemological tool that helps us to explain current transitions towards knowledge-based economy. Three helices are sufficiently complex to help us understand the social reproduction of the dynamics of innovation (...)".

In our opinion, this status of TH as a high-level theory on social structures and their dynamics within knowledge-based socio-economic system is based on the same assumptions that make NIS one of the most popular theories of economic development.

NIS is by definition "the network of institutions in the public and private sectors whose activities and interactions initiate, import, modify and diffuse new technologies" (Freeman, 1988). In a narrow since it involves only the institutions that are directly concerned with scientific and technical activities[9].

For the small and the less developed countries with scarce R&D and technology resources the concept of NIS is extremely important since it is based on the assumption that the competitiveness of a nation does not only depend on the scale of R&D but also "upon the way in which the available resources are managed and organized, both at the enterprise and at the national level". Proper NIS may enable a country with rather limited resources to make very rapid progress while inappropriate NIS can cause the waste of the abundant resources (OECD, 1992).

If we translate this massage from NIS to social sciences, it would mean that economic growth and technology development are complex social phenomena primarily

based on the ability of a society to organize itself to stimulate technology change and innovations as the main driving forces of growth. TH model of evolutionary convergence of the three key players/helices towards economic growth is very close to the idea of self-organization of society towards economic growth and social welfare. The Triple Helix emerges as a new theoretical and analytical framework for studying sociology of science in the knowledge-based society resembling NIS which is used to describe the necessary transformation of economy towards innovation base competition and knowledge intensive production. The role of TH in social sciences is virtually equal to the role of NIS in economic sciences.

TH and NIS share some basic constitutive elements: the basic theoretical premise of socio-economic system as a constructive element, the same evolutionary approach of constructing the socio -economic system[10] as well as the same goals and functioning principles (Table 5). However, there are also some differences between these two concepts, for example the limitations of NIS to national borders vs. the European or wider perspectives of TH (Leydesdorff, 2002). The most important difference is the analytical approach, which, in turn, is the most criticized aspect of TH theory (Etzkowitz & Leydesdorff, 2000). While NIS analyses growth from the perspective of an industrial company which is seen as central to economic development and perceives innovation as the main driving force, TH analyses growth from the position of the equal importance of each of the three helices and their spontaneous convergence towards growth.

Table 5
A tentative list if similarities and differences between TH and NIS

Elements	Theory of TH	Theory of NSI
Goals	Knowledge based society	Knowledge based economy
Theoretical premises	Economic growth is result of socio-economic construction	Economic growth is result of socio-economic construction
Driving forces	Knowledge flow	Innovation flow
Central institutions	Equal role of science, industry, government	Industrial company
Main constitutional elements	Science, industry, government (S-I-G)	Research/science institutions in the industrial and public sectors; government as facilitator of cooperation; other sectors that influence producing innovation
Principle of development	Evolution of helices	Evolution of innovation
Principle of functioning	S-I-G cooperation	Pubic-private partnership (networking)

This is, probably, the main reason why NIS is, in economics, commonly accepted as a model used to explain the innovation-based national competitiveness and to respond to the imperialism of other countries, while TH is heavily attacked by a number of scholars.

Actually, the concept of Triple Helix (TH) has, from the very start, been controversial: while some scholars perceive it as a "narrative fantasy (O'Malley, McOuat, Doolittle, 2002), and a possible threat to academic freedom (Viale & Campodall'Orto, 2002), others treat TH as "a serious research school" (Shinn, 2002) and accept it as a natural framework for studying the science-industry interaction. However, both sides agree that TH enjoys great popularity, particularly among the developing countries and is still of growing interest to sociologists, economists and science policy makers.

Putting aside the objection that universities should abandon the "third mission" of direct contribution to industry and should return to research and teaching (Etzkowitz & Leydesdorff, 2000), there is a serious criticism that TH is rhetorically powerful but in practice a very vague model (O'Malley, McOuat, Doolittle, 2002; Viale & Campodall'Orto, 2000; Jensen & Tragardh, 2002). It might be a problem to implement it, especially in the underdeveloped regions because it will not make the underdeveloped regions less underdeveloped, since these regions lack the basic prerequisites for the implementation of TH, e.g. competence, education, research etc. (Jensen & Tragardh, 2002).

This really is bad news for the developing countries which perceive TH as the theoretical background and the practical model using which the economically underdeveloped areas can recover relying on their national knowledge resources. Are we, the developing countries, delusional about TH? Do we advocate for a concept which can be applied only in the advanced countries?

Indeed, the famous theory of technological accumulation convincingly explains that the technological capability for managing innovations (technological change) (Bell and Pavitt, 1993) is gradually built up from productive skills to technological (innovation changing) abilities. There is a long way to go accumulating technology, before one can come from production capabilities to the knowledge intensive sectors. It may be reasonable to accept that the industry-science interaction is relevant only at these complex levels of knowledge-intensive productions while on the lower levels it is irrelevant. Indeed, building technological capabilities at the lower levels includes a lot of

training in management and marketing, quality certification, technology and business audits. The dominant process of economic development is working and reworking – a creative imitation of the existing innovations in which the research is not necessarily involved because companies do not absorb much R&D. The industrial company and the innovation as the driving force are central to NIS. In TH none of the three helices has the central role because economic growth is seen as the result of the knowledge flow based on the interaction and the spontaneous convergence of the three helices towards growth. One can only assume that the spontaneous convergence will be directed towards innovation.

Both, TH and NIS are based on the knowledge flow between science and industry, private companies and universities/research institutes.[11]

The since industry- links differ across countries and the most intensive (measured by the patent citations) are in the most developed OECD countries; the USA, Canada, the United Kingdom and Australia. Such links are less developed in France, Germany and Japan which is explained by the initiatives for the technology transfer from the public sector to private industry as regards patent protection, operative research and such (OECD, 2001).

However, the serious doubts about the "prime mover" still remain – what came first: a certain level of industrial complexity that generates the demand for cooperation with industry or was it the other way around, that the cooperation between industry and science generates faster economic development. In other words: do the developing countries and their governments need to stimulate S-I links or should they take care only that technological capabilities of companies reach the level of absorption of R&D? Is today possible to develop technological capabilities without R&D?

Some analyses speak in favor of S-I links being pre-requisites for technology development and economic growth.

The **first argument** is the history of the grant- land universities in the USA and the emergence of the chemical and electrical engineering as the fist knowledge-based industries (also in the USA and, in a lesser degree, in Germany) revealed that S-I links have a long tradition and they were established much before knowledge-based economy. The **second** is that certain comprehensive analysis' of the relationship of science and education to industrial performance revealed that although industrial performance is rarely directly linked either to research or educa-

tion there is a strong relationship between the economic development and the interaction between industry and scientific research (Shinn, 1998).

The **third** and the most important argument for the developing countries has to do with NIS and its fundamental transition from science to innovation that generates the shift of focus from R&D **in public institutes and universities** to R&D, innovative activities and technology capabilities **in companies**. NIS appeared as the reaction to the linear model of technology development (technology as the last phase of research) pushing forward the technology policy and industrial performance and giving science and research the supporting roles. Indeed, countries like Finland or Ireland, which substituted classical R&D policies with innovation policies succeeded in transforming into knowledge-based economies. Did that destroy science in those countries? It seems that it has not happened. The dominance of innovation over scientific research does not mean the weakening of public R&D. Just the opposite: The developing countries are, same as the developed countries, forced to catch-up with the more advanced countries and even with the technology leaders in spite of their scarce R&D resources.[12] The catching up process involves three basic capabilities (see Andersen and Lundvall, 1988):

- the capability to use (not necessarily to create) radical innovations and generic technologies (e.g. nano-technology, biotechnology, etc.)
- the capability for incremental innovations – adopting and modifying foreign technologies, re-engineering
- the capability for producing the small high technology products for entering market niches.

The development of these catching-up capabilities demands almost the same level of technological capability and accumulation as does the creation of the new technologies since the copying of innovation is today almost as expensive and complex process as is creating radical innovations. It is estimated that the imitation cost amounts to 50% or even 75% of the creation of innovation (Bell and Pavitt, 1993; Nelson, 1990:201). The modern innovation is much more intensive with research; therefore both, the private and the public research systems should be properly developed.

The technology transfer was, not so long ago, considered to be a relatively cost-free and automatic process performed via free knowledge dissemination or via buying the machinery. It has been recognized since, that the technology transfer depends on the national intellectual and research potentials (Fageberg, 1988; Unger, 1988). "The

successful exploitation of imported technology is strongly connected to the ability of adaptation and improvement of this technology by own R&D" (Freeman, 1991). The research intensity, educated labor, technology accumulation as well as science-industry cooperation are therefore the key-concepts for both the developed and the less developed countries.

Finally, innovation has today been shifted not only from individual to institutionally organized activity but to network activity. The traditional science-industry cooperation from the 1970s based on the individual and the small-scale institutional cooperation has grown into the concept of the Public-Private-Partnership – PPP[13] especially when the strategic or generic technologies are concerned (OECD, 1998).

In fact, the stress on innovation as the capitalization of science together with network activity make the concept of science- industry cooperation strongest than ever. The need for innovation as research intensified activity is being generated both in the developed and the less developed countries.

There is the need for cooperation between individuals and companies, industry and universities. The knowledge production today is closely connected to its market exploitation and therefore the science-industry cooperation is a key-concept of the modern development.

CONCLUSION

Croatia is an example of the well known fact that "technology development and economic growth are fundamentally social processes. Croatia, as many other transition countries, has demonstrated a social inability to absorb global changes that have driven the country to stagnation which has finally turned into collapse" (Družić, 1994).

This social inability has roots in the Croatian society which is a mixture of the traditional and modern elements. The nation in general and the political and business elites in particular are unable to reach the breaking-point in understanding and accepting the innovation as a new driving force and the science-industry-government cooperation as a tool for activating this driving force. The national innovation policy, technological capability, human capital, science-industry cooperation, etc. have been swapped out by the traditional values of national homogenization and by the business ethic imposed on by tycoons and irresponsible managers.

Therefore, the development of NIS as a social and political consensus on technology and innovation as national development priorities has never had a chance to emerge. The domination of the traditional science policy over the innovation policy is a quite natural outcome Croatian semi-modern society. The social climate of traditionalism and the lack of open-minded elites hindered the reorganization of the new knowledge-based factors of growth and ended in failure in the adjustment of the institutions and the government policies to global changes and requirements of the knowledge-based economy.

The establishment of NIS as a system of the management of innovation requires a certain level of social capital and modernity, particularly in terms of democratization in setting national development priorities. The science-industry-government cooperation as communication between the three constitutive elements of the knowledge-base society creates, if nothing else, a democratic forum for establishing the national priorities. Therefore, the TH concept is a valid and useful concept for the developing countries.

FOOTNOTES

[1] EU candidate countries are: Bulgaria, Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia, Slovenia, Turkey.

[2] For the purposes of this paper the term pre-accession countries refers to the countries from the same geographic region as the candidate countries, which, unlike the candidate countries, have not yet applied for the EU membership, naimely: Albania, Bosnia and Herzegovina, Croatia, Serbia and Montenegro and F.Y.R. of Macedonia.

[3] Measured in a narrow sense which would include public and private spending on higher education R&D and software, while a broader sense would include all levels of education.

[4] To illustrate: the HITRA programme for supporting the science-industry cooperation launched in 2001 by MoST was heavily criticized by both sides; by the scientists who saw it as an attack on the academic freedom and by the industry which percieved it as an incompetent and too complicated attempt to assist industry on the part of the administration.

[5] There are different programs like "Snowball" and "Entrepreneur" involving 66 regional and local self government units and 18 commercial banks, aimed at the provision of credits for export-import, development and application of the new technologies (mainly the computerization and automatisation of business operations). In addition, the Ministry provides grants for innovators and grants for the introduction of the ISO quality standards and environmental protection.

[6] Inspired by the formula (KNB = (research + education) × science + technology) devised by Romeo Ilie, Research and European Integration Programmes, Head of Office, during the CIPRE seminar: *Role of different actors in the policy and decision-making process,* 18-25 September 2003, Bucharest.

[7] According to the standard interpretation, "technical change" is the result of introducing new production procedures or of organising business in a new way (technological and organisational *innovations)* which generates "technical progress" usually manifested as the increase in productivity and the decrease in the unit costs at given input levels.

[8] The concept of the National system of innovation was, in 1990, adopted by the Science and technology Council of Finland as the description of the orientation towards knowledge intensive technology. Christopher Freeman was one of the authorities of this evolutionary economics by which Finnish Technology was directed (Särkikoski, 1994.) It has become known as the Finnish model of the technology transfer.

[9] Says Olatunji Adeoti (2002).

[10] TH is an evolutionary model based on the evolution of helices in the sense of the spontaneous convergence of the industry, the academia and the government through the processes of communication of all the actors involved (Leydersdorff, 2002).

[11] The success of NIS depends on knowledge flow, too. Some of the analysis identify in OECD countries four types of knowledge flow: technology alliances, science-industry cooperation, technology embodied in machinery and intermediate products, the mobility of experts and educated labour (OECD, 1997).

[12] It is estimated that, today, the 90% of total resources for R&D and technological development is provided by the 10 most developed countries which, naturally, perform the largest part of scientific and technological activities. For example, so-called G7 countries (world's seven larges economies) publish around 70 per cent of world's science (May, 1977).

[13] In the area of technology policy the term public/private partnership can be defined as any innovation based relationship whereby public and private actors jointly contribute financial, research, human and infrastructure resources, either directly or in kind" (Cervantes, 1998).

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