

MINERVA 2.0 – Slovakia into the first league

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Abstract - The Minerva 2.0 strategy was drawn up by the Government of Slovakia's Plenipotentiary for Knowledge Economy in collaboration with the Ministry of Finance, Ministry of Education, Science and Sport and The Ministry of Economy. The goal of the strategy is to support the development of knowledge economy in Slovakia through 26 concrete and specific measures in three main areas – Development of Human Resources, Systematic support of Scientific and Innovative Research and the Reform of the Institutional and Legal Frameworks. The policies of the Minerva strategy will be implemented through close collaboration of the Government, educational and research establishment and business.

I. INTRODUCTION

The economic performance of the most important world economies for the year 2010 along with the 2011 forecasts suggest, that the global economic recession is over. Thanks to its strong competitive position, the Slovak economy can look forward to a period of economic growth. Economist forecast that just as before the crisis, Slovakia will once again be among the fastest growing EU member states.

The Slovak republic owes its current competitive position to two waves of successful reforms. In the early 90s of the last century, a post-socialist transformation took place in Slovakia, forming the basic market institutions, mechanisms and environment. IN the years 1999 to 2005, a second wave followed, forming the necessary conditions for long term economic growth.

However, competitiveness cannot be based on an endless series of cost cutting initiatives. IN order to make the best use of our current position and in order to ensure that the painful reforms of the past are not in vain, it is crucial to follow them up with a third wave of systemic, complex measures ensuring the continued competitiveness of the Slovak economy. Unlike past reforms though, we do not advocate further restrictive measures, on the contrary, today it is necessary to make good use of existing economic growth and invest in the creation of a modern innovation ecosystem.

It is generally known that from a long term perspective, it is not possible to keep raising living standards and at the same time base the competitiveness of the economy on low input costs. The key to long term competitiveness is therefore productivity growth, based on innovation. The purpose of a knowledge economy is to generate an environment, in which education, research and development and entrepreneurship sectors maximize their cooperation with a goal of not just generating new ideas, but also turning those ideas into new real world products or more effective processes.

The primary objective of the education system is therefore to train curious and creative young people capable of teamwork, able to process new information, and willing to undergo certain risks. The research and development sector must attract some of these people and create an environment in which they can dedicate themselves to cutting edge basic and applied research. Other educated people shall turn entrepreneur, and they need to be able to transfer the ideas generated in R&D into the real world and must be able to share the profits of such endeavors with the authors of the ideas and the institutions in which the ideas were generated. Yet another group of educated people shall find employment in existing firms, and use their skills to observe and improve existing processes, thus further increasing the productive potential of the Slovak economy.

In other words, the goal of building a knowledge economy is to create an environment, in which people with a high quality education work on cutting edge ideas in Slovakia, and their entrepreneurial colleagues use these ideas to generate new job opportunities and improve the living standards of their compatriots through innovative technological firms. Instead of serving as an assembly line reproducing the ideas of others, Slovakia will thus become a place where we will generate our own work processes and develop our own products to be assembled at home or in other, less developed countries.

In the past, the rate and scope of structural reforms was significantly better in Slovakia than among its neighbors. We need to keep the same ambition for the creation for a knowledge economy: take over the Czech Republic, catch up with Austria, and get Slovakia into the first league.

II. THE STATE OF KNOWLEDGE ECONOMY IN SLOVAKIA

The need to develop innovative potential and to create a knowledge economy is old news in Slovakia. The foundations for a knowledge economy were laid already in 2005 by the Minerva competitiveness strategy, the goal of which was to set the course for Slovakia for the following electoral periods. However, due to a large number of intended measures that were not coordinated and prioritized effectively, the momentum of Minerva was lost and the process of building a knowledge economy fragmented among a number of institutions and a number of various strategic plans.

The initiatives for supporting the development of a knowledge economy have then been incorporated into various strategic documents and governmental activities such as for example the Innovation strategy, the strategy Slovakia 21, the National Strategic Reference Framework and the National Program of Reforms.

Despite all this, the state of knowledge economy in Slovakia remains pitiful. Slovakia lags behind not only the most advanced OECD countries, but also behind Poland, Hungary and the Czech Republic in a number of areas with critical importance for knowledge economy. We are the only Visegrad Four (V4) country with no University in any leading world ranking. We have the lowest share of innovative firms in the economy of all V4 countries. And in the ranking of top cited scientific articles we are lagging not only behind the V4, but also behind countries such as Brazil, Turkey or Mexico. Slovakia is far behind the leading performers in Europe and our long term position is deteriorating despite the fact that Slovakia is nowadays among the five fastest growing EU members.

Slovak investments into education, research and development rank among the lowest in OECD. The number of foreign students in Slovakia is negligible, while the flow of students out of Slovakia is among the highest in OECD. In the innovation rankings of EU countries, Slovakia fell from 18th to 23rd rank between 2009 and 2010. Even though a number of strategic documents refer to knowledge economy, high level political coordination and implementation support is entirely absent.

III. SPECIFIC MEASURES AIMED TO DEVELOP KNOWLEDGE ECONOMY IN SLOVAKIA

Knowledge economy represents a complex ecosystem, in which the sectors of education, research, development and entrepreneurship are delicately intertwined. Table 1. Shows the main areas and problems identified.

Area	Problem
Education	Low quality of education
Links between education and R&D	Lack of high quality professionals
	Weak functioning of key institutions
R&D	Ineffective and insufficient financing of R&D
Links between R&D and entrepreneurship	Weak technology transfer process
	Few and weak domestic technological firms
Entrepreneurship	Weak R&D activities of international firms
	Education cut off from industry
Links between entrepreneurship and education	Lack of entrepreneurial skills training
	Weak political coordination
Systemic failures	Administrative burdens
	Lacking support for international mobility

Table 1. An overview of problems in Slovak knowledge economy

A. Education

Problem: Low quality of education

A necessary condition for the development of knowledge economy is an educational system capable of training people to think independently and creatively. In the information age, it is crucial for the education system to teach young people to effectively receive, process, or generate new information, not to primarily force them to memorize existing information that rapidly becomes obsolete. The current educational system fails reflect the needs of the industry and many employers begin to complain about lack of preparation and independence of university graduates.

In the field of education, Slovak republic lags behind the rest of V4 and the average of OECD. While Poland and Hungary rank in OECD student rankings at least at average levels and their results are improving overtime, Slovak students have been consistently placing below the OECD average for the past six years. Slovak high school students reach the OECD average in mathematics and in the area of collecting information, but they fall short in sciences and in evaluating information. Our students thus perform worst in exactly those areas, that most require critical thinking and are most important for the development of a knowledge economy.

The need for a fundamental change in our approach to education is illustrated by the McKinsey study How do the best education systems keep improving: „the systems on the way from average to good, in general characterized by less well trained teachers, strictly control the educational process because the minimization of differences among classes and schools is a key performance driver at this stage. On the contrary, systems moving from good to excellent, characterized by more experienced teachers, offer only more general frameworks and syllabi, because the creativity of teachers, sharing of ideas and innovations within and among schools are a motor for further improvements.“ Slovakia has an ambition to create an excellent educational system, but it is trying to achieve these goals using tools more adequate to less developed systems.

Cause	Solution
Outdated educational methods	Partially resolved by syllabus reform and expansion of rights of school directors in the last educational reform. The effects must be given time to demonstrate, the process will be aided by best practices exchange
Low quality of teachers	Improvement of teacher education and best practice exchange
Conservative school management	Improvements in teacher quality will generate pressure on management for further improvements
Weak connection to world trends	Support for student and teacher mobility
Professional training weakly connected to industry	Lifelong learning system

Table 2. Causes and proposed solutions

B. Links between education, research and development

Problem: Lack of top practitioners

Best students leave to study abroad, and the top graduates move to the private sector. As a result, the universities are lacking a strong middle generation. To some extent, quality is maintained by aging professors, but they lack adequate support from driven middle aged successors. As a result, continuity is lost, and if the situation is not addressed soon, it could result in an irreversible decline of higher education, followed by the rest of the economy.

There is no one to replace the departing students and professors, because the mobility into the Slovak republic is significantly restricted by visa policies, policies for residency of foreigners, as well as various administrative barriers by immigration officers, ministries and embassies. According to OECD data, in 2007 10,3% of Slovak students studied abroad (more than in Bulgaria, comparable with Uzbekistan and Morocco), but less than 1% of foreign students studied in Slovakia (one of the lowest values in OECD, comparable with Turkey or Poland, way below Hungary or Czech Republic).

To reverse this process, we need to support high quality researchers and scientists so that they do not need to emigrate or move to the private sector, and bring top foreign researchers to Slovakia, whether for a limited time or permanently.

The lack of high quality professionals is not tied only to teachers or researchers. It also applies to top managers and administrative personnel, who could bring foreign innovative approaches to Slovakia, improve the student experience, and support university professors and scientists in their work.

Slovak universities and science institutions regularly place at the tail end of OECD productivity rankings. No single Slovak institutions made its way to any of the leading world university rankings. Producing less than one scientific article per year per person in 2008, Slovakia belonged to the least productive countries in OECD. The situation is even worse among the 1% of top cited articles, where in the years 2006 to 2008 Slovak institutions represented less than 0.1%.

Cause	Solution
Lack of incentives to cooperate with private sector	Governance reform of universities
Lack of incentives to produce high quality outputs	Governance reform of universities, Reform of the Academy of science, New funding system for R&D
Legal barriers preventing the academy of science from cooperating with private sector	Reform of the Academy
Focus on quantity of students instead of quality	Governance reform of universities
Low quality management of academic institutions	Governance reform of universities and Reform of the Academy
Lack of high quality personnel	Measures 2 – 5

Table 4. Causes and proposed solutions

Cause	Solution
Low R&D budgets	Excellence initiative a new funding schemes
Infrastructure insufficient for cutting edge research	Some improvement due to structural funds, followed by world class infrastructure
Bad physical work environment	Building reconstruction program
Bad mental work environment	Excellence initiative and installation grants will improve the quality of work teams. Popularization programs will help attract more young talented students. Governance reform of universities and SAV will create more space for innovation.
Barriers for access of foreign students, researchers, teachers, and scientists	Migration policy (S.6)

Table 3. Causes and proposed solutions

C. Research and development

Problem: Weak functioning of key institutions

D. Links between R&D and entrepreneurship

Problem: Inefficient and insufficient financing of research and development

The volume and structure of private and public funding of R&D in Slovakia significantly lags behind the needs of a modern knowledge economy. Volume-wise, Slovakia is at the tail end of EU and OECD countries. Although the overall volume of public R&D funding is growing rapidly thanks to EU structural funds, the structuring and expenditure rules is absolutely wrong. Merely in the last three years, more than one billion euro was invested without any clear strategy (from the point of view of public expenditure and obligations). On the other hand, Slovakia lacks a number of key mechanisms for providing essential state support in particular stages of R&D, necessary due to standard market failures such as positive R&D externalities. In particular, there is no support for private research that leads to new technologies or solutions for specified economic or societal problems.

The decisions about the funding for education and R&D takes place on too many levels. The vast majority of public R&D expenditures outside the scope of EU structural funds In Slovakia take place in the form of non-competitive institutional financing. As much as 94% of all resources dedicated to academic research flows into generic funds, managed and allocated by the universities and the Academy. As much as 80% of these funds are

directed towards basic research, significantly more than the OECD average.

Cause	Solution
Low national investment into R&D	The implementation of the majority of the proposed measures generates room for more effective financing of R&D
Low private sector investment into R&D	Stimuli. support for innovative companies
Existing funding schemes take little account of quality and results	New grant scheme for science
Too many resources are directed towards generic institutional support	Governance reforms of the universities and the Academy
Undirected and uncoordinated use of research institutes ran by ministries	Grant system for applied research
Inefficient use of structural funds	World class infrastructure for top research
No financing from own resources	Will allow universities to profit from their own research activities and will make it possible to reinvest in R&D

Table 5. Causes and proposed solutions

Problem: Weak technology transfer system

Thanks to the adoption of the Bayh-Dole act in the USA in 1980, US universities were granted the right and responsibility to patent results of research financed from federal funds. The Universities have thus gained an ability to license the results of their research and profit from its commercialization. The Universities have responded by forming a well thought out professional system of specialized policies and offices, whose role is to protect the intellectual property of the universities and facilitate the transfer of knowledge and ideas to the commercial sector. In 2004, the income of universities from licensing rights exceeded 900 million USD in the USA, 80 million dollars in Australia, or 3 million euro in Switzerland .

The Slovak intellectual property law on the other hand provides only a weak protection for the ability of Slovak universities to claim a share in the inventions discovered on their premises. The law also fails to properly motivate the universities to actively assist its students, teachers and scientists to commercialize the results of their work.

The legal status of universities and research institutes and the rules governing their asset management create barriers for cooperation with entrepreneurs. Despite low equipment utilization rates, institutions are often not allowed to make this equipment available to entrepreneurs who are interested in using the equipment for applied R&D and are willing to let the institution share in the benefits of the research.

The result is an extremely low patent activity of the universities. Out of more than 4 thousand patent applications filed by the EU member states and over 16 thousand in all of OECD in the years 2004 - 2006, only two applications originated from Slovak universities, comparing to 13 Czech and 124 Austrian applications.

Cause	Solution
Lack of incentives	National technology transfer system
Lack of awareness about the benefits of commercialization among scientists	National technology transfer system
Problematic IP legislation	IP legislation and property management rules
Problematic legislation related to public asset management and management of assets financed by public or European funds	IP legislation and property management rules
Lacking infrastructure	World class infrastructure for top research
Lack of qualified personnel managing transfer	National system for technology transfer

Table 6. Causes and proposed solutions

E. Entrepreneurship

Problem: Few and weak domestic technological firms

Newly formed companies represent the main source of economic competitiveness and long term job creation. However, too few truly innovative firms are formed and flourish in Slovakia. According to the structure of the work environment, Slovak firms belong amongst the least innovative in all of OECD. The number of small and medium enterprises that introduce innovations in products or processes is deep below EU average and falling. At the same time, firm expenditure on R&D is declining as well, and the number of SMEs dedicated to or cooperating on innovation is falling.

Cause	Solution
Lack of an entrepreneurial spirit	International system of technology incubators
Lack of capital	JEREMIE and SBIR
Legislative barriers	IP legislation
Legislative barriers for foreign entrepreneurs	New migration policy (link later)
Weak technology transfer	National technology transfer system
Weak access to international knowledge and resources	International system of technology incubators

Table 7. Causes and proposed solutions

Problem: Weak R&D activities of international firms

Despite the presence of a large number of technologically advanced multinational corporations such as CISCO, IBM, Volkswagen, Kia and so forth, almost none of these corporations have significant development centers in Slovakia or invest heavily in R&D. On the contrary, the most inventive and capable employees are often transferred abroad. Industrial investment into R&D in Slovakia has fallen from 0.5 to 0.25% of GDP between 1998 and 2008, in stark contrast to EU average of 1%, OECD average of 1.5% or Austria, where industrial

investment in R&D grew in the same period from 1% to almost 2% of GDP .

In contrast to Bratislava, a significant number of large corporations have established R&D centers in Brno. R&D centers of large corporations play a vital role in the economy not only because they provide additional employment, but also because they help to anchor the related manufacturing processes. While the assembly line can in principle be moved fairly easily, it is much more difficult to relocate major R&D centers, because the number of suitable locations is much more restricted.

There is almost no direct or indirect governmental support for industrial R&D. While Austria, the Czech republic, and Hungary invest between 0.1 and 0.2% of GDP into government support for industrial R&D and as many as 22 EU member states offer fiscal stimuli for this reason, in Slovakia the financing of industrial R&D flounders around 0.025% GDP.

Cause	Solution
Lack of incentives	World class research infrastructure will generate an environment attractive for private research centers, Stimuli for industrial R&D will provide additional funding
Administrative barriers	Debyrocratisation of EU funds, Public procurement

Table 7. Causes and proposed solutions

F. Links between entrepreneurship and education

Problem: Education cut off from industrial needs

The supply of existing professional training does not adequately match the industrial demand. Even though a strategy for lifelong learning was adopted in 2007 in Slovakia and even though it was followed by an act on lifelong learning, neither has been thoroughly implemented, especially concerning the acceptance of informal training of professionals.

The growth of a knowledge economy does not depend only on high tech innovation. The diffusion of existing technologies and processes throughout the economy plays an equally important role. A large number of productivity improving innovations can be well known in the country or within the sector, and yet they may be new and innovative for most individual firms. The lack of lifelong education programmes slows down such diffusion of innovative practices.

Cause	Solution
Conservative school management	Lifelong education system will generate incentives for schools to cooperate with industry
Administrative barriers preventing firms from offering courses on proprietary technology	Lifelong education system

Table 8. Causes and proposed solutions

Problem: Lack of entrepreneurial skills training

Even though proficient scientists and researchers are very important for the economy, innovative enterprises are needed to develop their ideas and bring them to practical use. But such companies need well trained managers as much or more than proficient researchers. However, educational programmes focusing on the development of an entrepreneurial spirit (as opposed to a purely academic study of management or accounting) are largely absent in Slovakia.

Cause	Solution
Outdated educational methods	best practice exchange and support for practical entrepreneurship training
Low quality of teachers	best practice exchange

Table 9. Causes and proposed solutions

G. Systemic failures

Problem: Lack of political coordination

Even though a number of strategies were formulated in Slovakia to build an innovation system or a knowledge economy, none were implemented successfully so far. To preserve the momentum of the reforms and overcome the natural institutional resistance, it is crucial to ensure that the reform process receives sufficient attention and support from the top political leadership and to coordinate and drive all initiatives not only at the time when the action plans are written, but also throughout the entire implementation process.

Cause	Solution
Lack of top level political coordination	Government innovation council
Lack of mechanisms for the collection and evaluation of information concerning the implementation of planned measures the actual impact of those measures	Action plans formulated based on this strategy will contain specific objectives, the Government innovation council shall monitor progress towards reaching those objectives

Table 10. Causes and proposed solutions

Problem: Administrative burden and administrative barriers

Whether we examine the system of school inspection, the organizations managing EU structural funds, or the public procurement act, we will discover a common trait in the rules involved: suspicion of the citizen and a desire not only to evaluate the outputs of her activities, but also to control and manage in detail the entire process used to achieve such outputs.

In the name of fighting corruption, managing quality or ensuring efficiency in the use of public funds, the state attempts to create the strictest rules possible to limit the powers of the bureaucrats, and to dictate in as much detail as possible how the public officials but also the citizens or firms should act.

The results are counterproductive. The resulting net of rules has two basic effects: fear or corruption. The vast

array of rules creates a disincentive for public employees to make decisions, because they risk being penalized for violations. As a result, many officials hide behind the rules and request endless series of explanations, confirmations and proofs to avoid having to make hard decisions. On the other hand, the interplay of the huge set of rules also often requires public officials to interpret the requirements, and as a result public officials with little or no real world implementation experience build up on the already burgeoning set of laws and rules with additional instructions and requirements.

Instead of evaluating the results achieved, review processes also often focus on a purely formal control of the process of filing applications, public procurement, spending or proceeding in accordance with any number of other administrative procedural rules (such as hourly timesheets for work carried out in projects, hundreds of documents required in public procurement, or correctly filed attendance report). As a result, for example, the project manager is forced to procure outdated and overpriced equipment simply because a particular machine was listed in the initial budget proposal, even though more advanced and cheaper machines came to market in the meantime.

The public procurement act severely restricts the ability to procure quality. The project managers are thus always afraid, who will decide to enter the procurement. The interpretation of the Act by public officials for example gives an advantage to providers with low quality low price products.

Similarly, the act on budgeting procedures severely restricts the usefulness of grant schemes and the ability of many institutions to make long term plans. Similarly, the act on public asset management often prevents useful partnerships between academic institutions and firms that would like to use their assets.

[The entire system deforms both its administrators, and the users who will eventually learn to adapt, and start losing interest in the quality of their outputs at the expense of fulfilling often meaningless procedural criteria.]

Cause	Solution
Extreme administrative burdens in EU funds	Debyrocratisation of EU funds
Conservative regulatory system	Reducing the administrative burden
Difficulty to procure quality in public procurement	Amending Public Procurement Act
Inability to control the quality of outputs instead of process	Stefanik stipend

Table 11. Causes and proposed solutions

Problem: Lacking support for and administrative barriers in international mobility

A clear migration strategy capable of active contribution to economic and social development is currently absent in Slovakia. An immigration policy that creates the conditions for entry of highly qualified workers, such as university students, researchers,

scientists, or entrepreneurs in the areas of innovation and technology transfer, can significantly contribute to the development of work, scientific and educational environment, support the exchange of ideas and processes, and generate new job opportunities. The demographic developments in Slovakia and Europe indicate that the Slovak job market depends on foreign human capital.

Slovakia also lags behind in integration policy, which is a necessary part of a successful migration policy. It is therefore important in parallel to invest in programs supporting the integration of both short and long term migrants into the Slovak society.

Cause	Solution
Absence of a comprehensive migration policy	Creation of a comprehensive migration policy
Administrative barriers to mobility of researchers and students and select groups of foreigners (employment law issues, social support, temporary residence permit problems for foreign researchers, etc.)	Creation of a comprehensive migration policy

Table 12. Causes and proposed solutions

CONCLUSION

Minerva 2.0 has identified key barriers preventing a rapid and efficient development of knowledge economy in Slovakia. We proposed a set of 26 measures designed to overcome these barriers. In September 2011 the Slovak government set up a special Governmental council for innovation, tasked with overseeing the implementation of Minerva and coordinating future activities related to the development of a knowledge economy and the innovation ecosystem in Slovakia. In October 2011, we submitted a complex implementation plan for the 26 Minerva measures to a public notice and comment process. We expect that the implementation plan will be approved by the government in early November, thus finalizing the groundwork necessary to start the serious and critically important work of transforming Slovakia into a modern, innovation driven economy.

ACKNOWLEDGMENT

We would like to thank our colleagues in other ministries of the government and the third sector for their valuable input and comments.

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