REPRODUCTION OF HUMAN RESOURCE DEVOTED TO SCIENCE AND TECHNOLOGY IN ESTONIA COMPARED WITH BALTIC STATES AND NORDIC COUNTRIES 1995-2005

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HRST development process, its development's qualitative and quantitative aspects are questions of national importance. Education's influence on society's development, to processes ongoing in the society and to individuals in the society is immeasurable. Resources that society allocates to improve the education level are substantial and take up a remarkable portion of the state budget.

In Estonia the current amount of specialists graduating each year allows to balance the temporary shortage that appeared in 1990s. In addition we must be in everyday competition with other countries. Estonia is in aforementioned criteria in a good position at the moment among the Baltic States, but this situation might not be permanent. To catch up with developed Nordic countries we must significantly increase our HRST, and most of all be more efficient in using our science and technology human resources. The volume and focus areas for preparing specialists with higher education are today still difficult to forecast in Estonia's transfer towards a knowledge-based society and economy.

Key word: *human resources, human resource development, science and technology*

Introduction

It is important to analyse sustainability of human resources devoted to science and technology in ensuring the development of Estonian society and to compare the current situation with other Baltic States and Nordic countries. And there is one component of human capital that's focused on – education, more specifically higher education. Sustainability in currently viewed sense means whether Estonia is producing enough quantity and quality (third level education) of top- and middle level specialists and technical staff, which would allow the society to keep its development potential and increase it in the view of future interests. To make such assessment, the current situation must be compared with:

- the past to see progress or regress;
- the ideal, to see what else needs to be done and how far the current state is from ideal (for example knowledge based Estonia) ;
- the developments of similar and closest societies, to see the place among others and set goals, where to aim at (for example Baltic States and Nordic countries).

1. Intellectual capital and knowledge-based society

1.1. Intellectual capital

Edvinsson, Malone, Sveiby, Norton and Kaplan, Fukuyama opinion is that IC contains regardless of its structural up build the following components: human capital, intellectual property, structural capital, customer capital, and social capital.

IC is not a fixed value. It is constantly changing - even when the surrounding environment and customs do not change. It can simply age physically and morally. IC must be always considered in certain time and space.

1.2. Human capital

Shortage of both natural and human resources makes economic growth possible only if country or state makes an effort to increase the human capital and use it effectively.

Human capital has the meaning of asset and value. Asset has a value if individuals, organizations or society can get benefits from it. From the existence of human beings and their actions so-called human-centered values arise. Human-centered values are traits that are common to human beings. To hire and educate an employee is expensive and risky because they have the right to leave work, become sick, take a vacation, etc. Knowledge in people's mind belongs to them – not to the organization. Creating conditions for developing humans is both money and time consuming. According to the views of L. Edvinsson and M. S Malone, human capital consists of all individual abilities, knowledge, skills and workers' and leaders' work experiences.

In 2000 Council of the EU set in Lisbon a new strategic goal for its member states and defined the overall strategy in this field for the next decades: to become the most competitive and dynamic knowledge

based economy in the world, which is able to maintain sustainable economic growth and where at the same time are larger number and better working places and better social cohesion. Knowledge has always been the main part of the human society, but radically new is the speed of accumulation and dispersion thanks to the new information and communication technologies. Internet becomes the main infrastructure for this new paradigm. Knowledge is becoming the main source for wealth and power, as well as the reason for differences among nations, regions, companies and individuals. Innovations based on specific knowledge have the main competitive advantage. Competitiveness means the satisfaction of consumer needs on time demanding very clever knowledge management. Education and training systems are facing a challenge to create a learning society as a precondition for knowledge based society and not only for knowledge based economy. In conclusion institutional innovations arise and new social rules will be created.

1.3. Globalization

Modern society has at least two serious challenges: constantly increasing economic integration, e.g. globalization, and the changing role of public sector arising from it. Globalization is a huge opportunity for entrepreneurs and challenge for public sector.

This paper considers the importance and sustainability of human resource devoted to science and technology in assuring continuous development. Estonia as a member of the European Union must thoroughly analyze its competitiveness, future close relations with other countries in the view of free market economy where there is no limitation to the free movement of capital, goods, services and people. The education level of each individual is becoming more important as is the average educational level of the whole society – that is education as the ability of an individual and whole society to understand and re-evaluate changes in the environment.

"Higher education is more than the capstone of the traditional education pyramid; it is a critical pillar of human development worldwide. In today's lifelong learning framework, higher education provides not only the high-level skills necessary for every labour market but also the training essentials. It is these individuals who develop the capacity and analytical skills that drive local economies, support civil society, teach children, lead effective governments, and make important decisions which affect entire societies." (An Agenda for a growing Europe. André Sapir (2003))

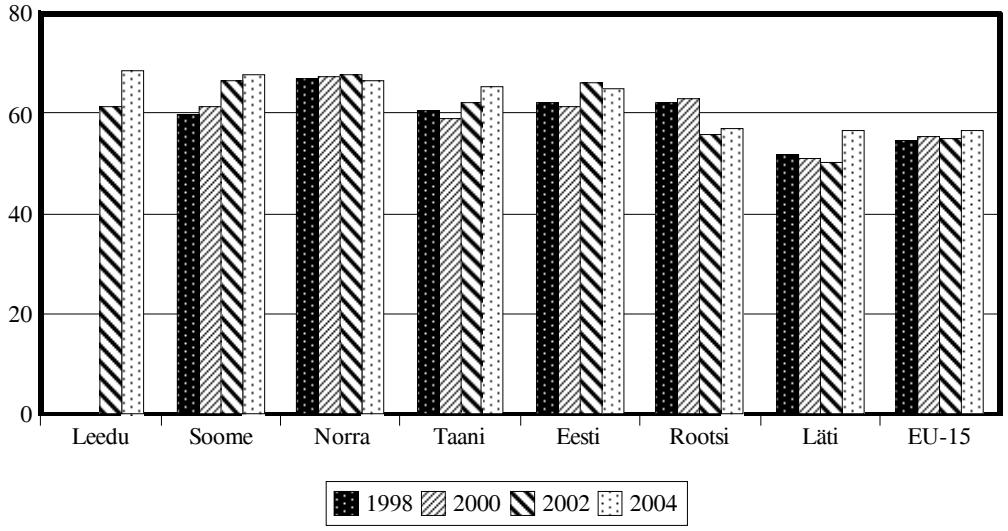
2. Human resources devoted to science and technology

By Canberra Handbook, the term "Human Resources devoted to Science & Technology" (from now on HRST) includes all individuals who have completed the third level education, and also lower education level individuals who are working in the field of science and technology. To categorize an individual into a certain category at least three dimensions have to be considered: level of education, profession and activity in labour force.

The first measure - the third level education (higher education); the second measure - profession that is classified by the system of international profession measurement ISCO-88; the third measure – activity in labour force – sets age limits of 15-74. Frequently a tighter age limit is considered (25-64) when viewing internationally comparable results about human resources leaving out the portion or population who have for their youth not yet managed to complete the third level education or have already left for retirement.

Generally the employment rate of third level education graduates is significantly bigger than for people who have completed any other level of education. In the European Union (below: EU) the employment rate for the third level education graduates is 85%, at the same time the employment rate for people with less than secondary education is 54%. Employment rates in European Union are 19% higher for those who have completed secondary education than for those who have only elementary education.

Until 1999 Estonian science and technology human resources (HRST) decreased, but in the new millennium they have started to grow significantly. The same is valid for core resources (HRSTC). These changes are foremost connected with the number of people completing third level education for the first time (Fig. 1.), which was in 1990s too low to reproduce population with higher education in Estonia. The fast increase of university students since 1995 brought a few years later an increase in the number of university graduates which in turn reflects in the HRST. The same trend can be viewed in Latvia and Lithuania.



Source: Eurostat Database, Labor Force Survey, Statistical Office

Fig. 1. **Tertiary educated people (HRSTC) proportion among 15 to 74 year old employed specialists and technicians (HRSTO) in Baltic States and Nordic countries, 1998-2004 (%-des) (HRSTC/HRSTO)**

From the above data (Fig. 1) it can be concluded that in Estonia people working as specialists and technical staff are with higher education than in other Baltic States and on average in the European Union. This is a good predisposition for faster high technology development and transfer to knowledge-based economy, also for a basis of maintaining the sustainability of society and the competitiveness of the country. At the same time our development has been not constant, there can be noted the beginning of decreasing trend. Finland, also Lithuania in past few years continues to move uphill, Norway remains steadily on a high level.

In last 10 years the number of people completing the third level education has constantly increased in Estonia. But the number of people working as professionals and technicians is decreasing.

Aforementioned facts point that in Estonia :

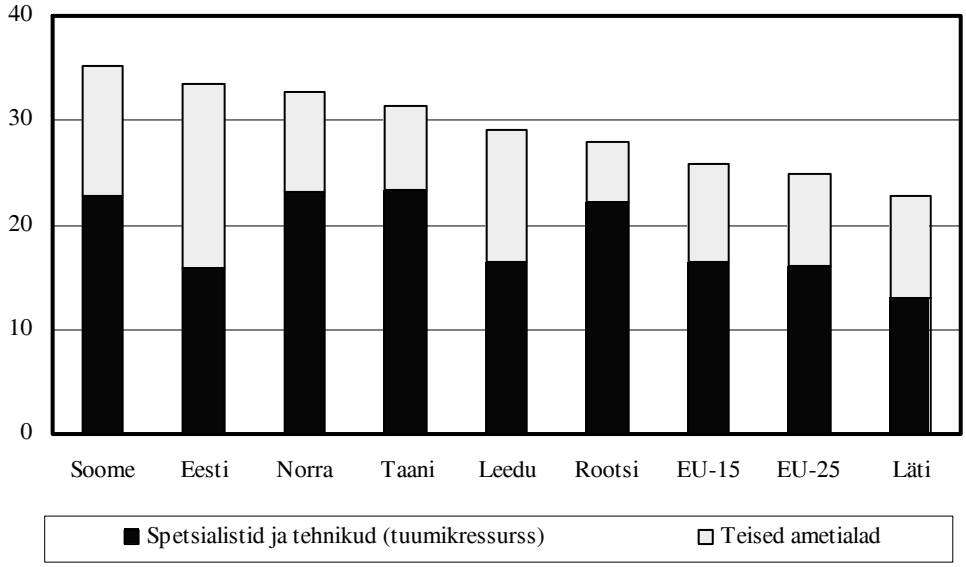
a) a possible ineffective use of human resources or some excess of people with higher education exists or
b) our society is moving towards areas in the future that are not connected with science and technology, which is inevitable when transferring to knowledge based economy.

There are comparably more individuals with third level education in Estonia. Their engagement as science and technology specialists is relatively lower, but engagement in these fields relatively bigger. From this it can be assumed that our specialists have been so far more innovative and our economy more sustainable. But soon, at least in the Baltic States, we will lose this competitive advantage. Mostly because if the preparation of the third level education specialists is hampered which has already begun in 2004 in Estonia.

Estonian figures surpass European Union average level, but still remain slightly below Finland: third level education graduates relative importance in labour force was 35% in 2004 in Finland compared with Estonian 34%. The difference in core resources is noticeable: in Nordic countries their ratio in labour force is more than 22%, but in Estonia 17% which is almost the same as in the European Union before the enlargement process. In both cases, core resource and also generally the proportion of simply higher educated persons in 15-74 year old employed people, the trend is increasing.

Fig. 2. presents a significant difference between the Baltic States and Nordic countries. In the Baltic States the figure is between 50-60%, in Nordic countries it varies from Finland's 65% (which corresponds to the average of the European Union) to Sweden's 80%. In essence this figure shows the number of third level graduates engagement in science and technology related professions. According to 2005 year labour force study data, as much as a third of specialists and technical staff employees do not have the third level education in Estonia. In other words, we are most likely having a shortage of higher education graduated specialists. One of the reasons is that in 1980s and the first half of 1990s we had too few third level education

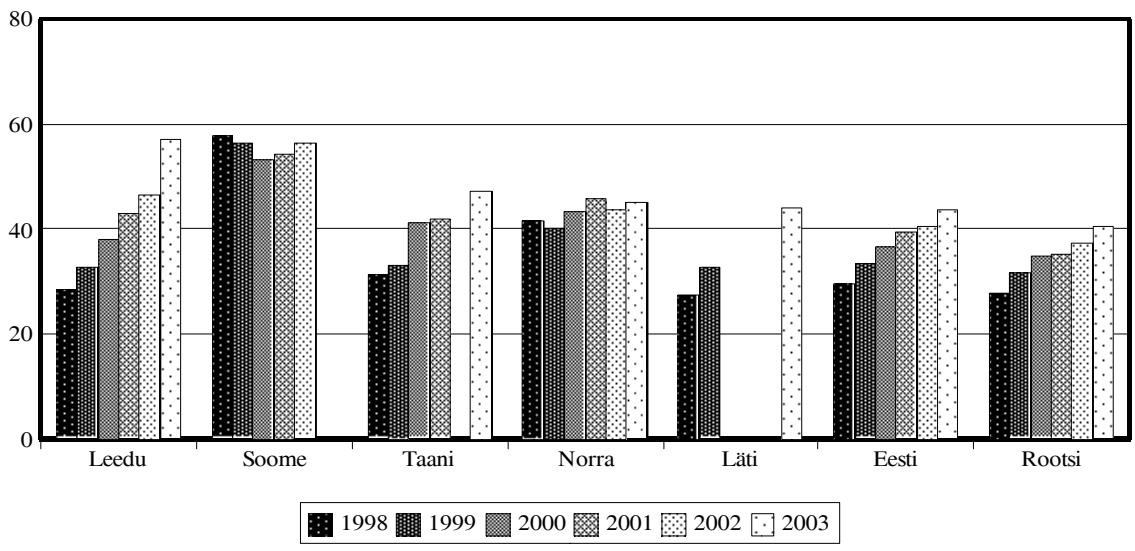
graduates. At the same time the thorough economic and social changes created a situation where older generation did not always find the best engagement. Both higher education structure and economy structure as a whole has changed and is changing while Estonia moves toward knowledge-based society.



Source: Eurostat Database, Statistical Office of Estonia

Fig. 2. **Core resources relative tertiary level educated people's amount in 15-74 year old employed persons in the Baltic States and Nordic countries, 2004 (%)**

There has been a constant increase in the number of higher education graduates in Estonia in last few years. There has been an increase in all Baltic States and Nordic countries. Especially rapid growth has happened in Lithuania. The situation is stable in Finland and Norway, which also have a high education level. Estonia's position is here humble and rather a relative lag can be noted (Fig. 3.).



Source: Eurostat Database, Statistical Office of Estonia

Fig. 3. **Tertiary education first time graduates for 1000 persons in age 20-29 in the Baltic States and Nordic countries, 1998-2003 (%)**

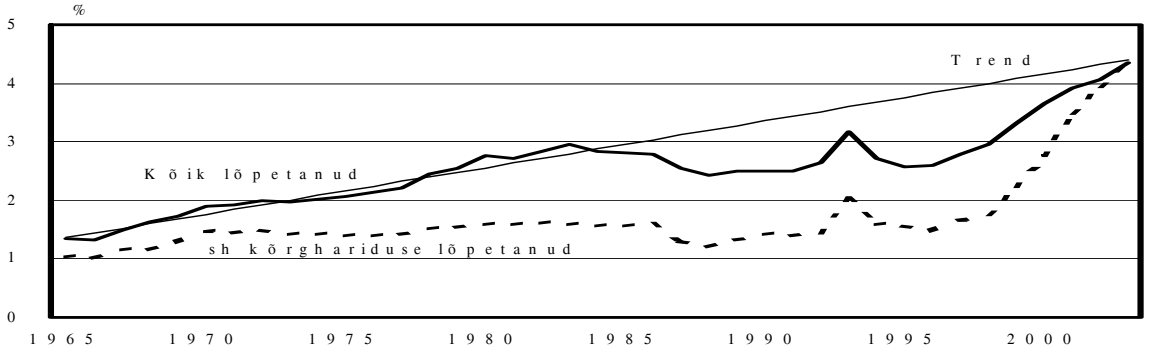
3. Sustainability of HRST development

3.1. Sustainability of HRST

HRST as human capital is the key issue for economic and sustainable development of the society. As already mentioned above, the incoming flow for HRST or next generation are the first time graduates of the third level education, whose number has rapidly grown in Estonia since 1996 (2853) reaching 8554 in 2004. 10127 graduates completed higher education for the first time in 2005. According to expert estimation, the increase has still slowed or even stopped.

To decide about the sustainability of HRST one possibility is to compare whether there is enough higher education graduates to maintain the current level of education (third level education graduates in age group 15-74).

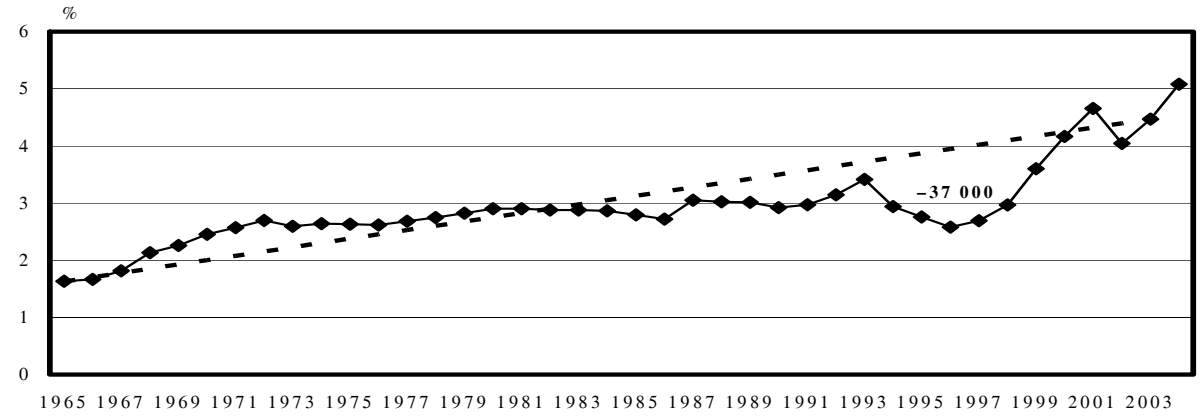
Fig. 4. brings out the "underproduction" in time period 1983-2003 when the trend previously common to Estonia for third level education first time graduates was renewed. According to the calculations based on which the drawing was composed, the so-called shortage of graduates is 24 000. If current number of first time graduates remains the same (including the "overproduction"), it should take about 10-12 years to reach new balance or previous natural state, in other words, to remove the effects of the interim "underproduction".



Source: Statistical Office

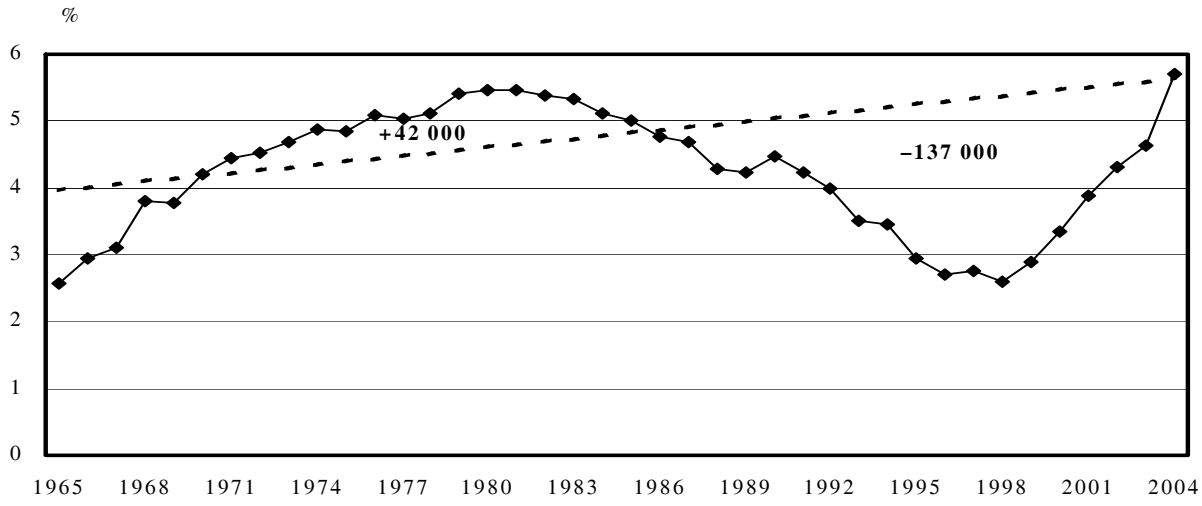
Fig. 4. **First time third level education graduates compared to 20-29 year old population in Estonia, 1965-2003** (%)

Similar processes have taken place also in Latvia and Lithuania. According to Latvian and Lithuanian Statistical Office experts estimate in these countries, "underproduction" in Latvia is 37 thousand and in Lithuania 137 thousand specialists. This probably partly validates the fast increase in the first time graduates of higher education in the Baltic countries, especially in Lithuania.



Source: Statistical Office of Latvia, expert estimations

Fig. 5. **First time third level education graduates compared to 20-29 year old population in Latvia, 1965-2004** (%)

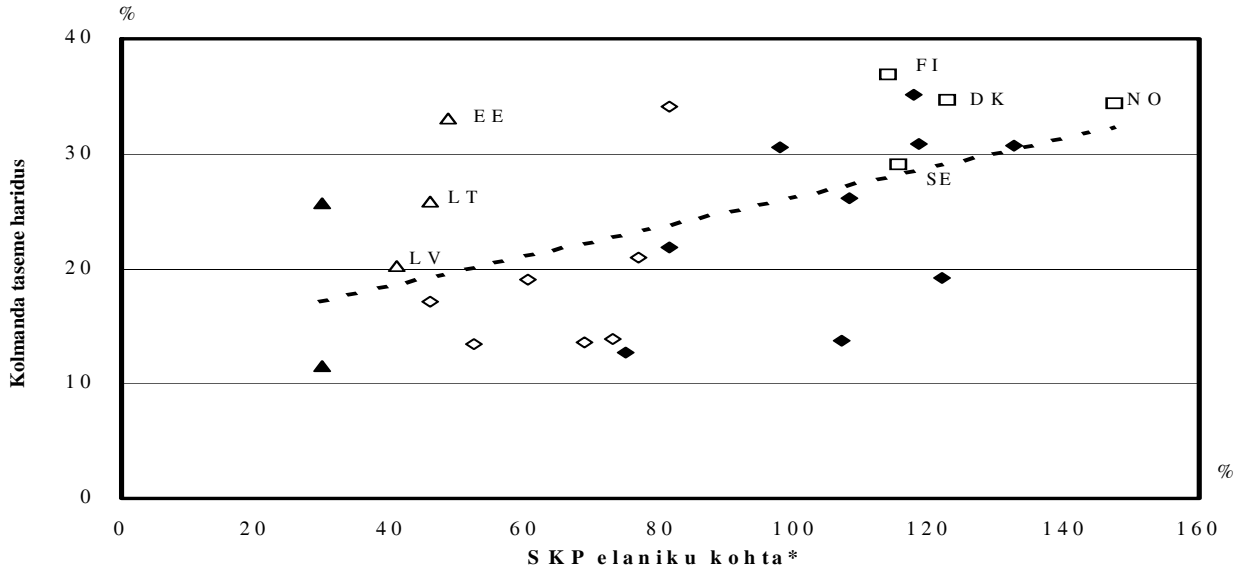


Source: Statistical Office of Latvia, expert estimations

Fig. 6. **First time third level education graduates compared to 20-29 year old population in Lithuania, 1965-2004** (%)

3.2. GDP connection with education of population

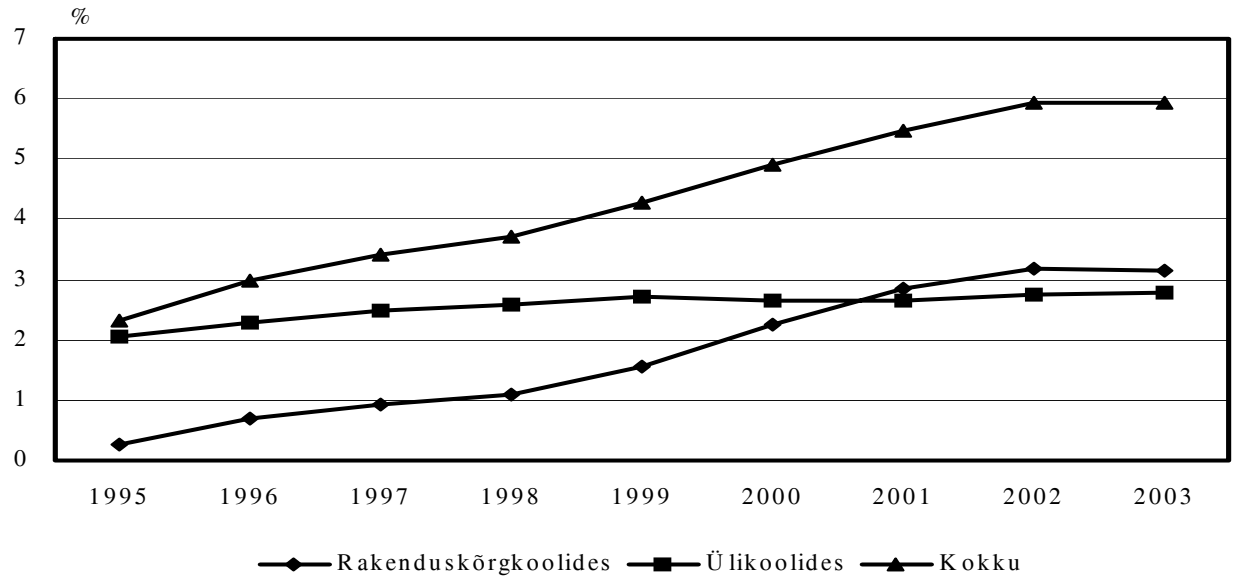
Fig. 7 shows the relationship between the ratio of high-level education graduates in population and country's produced GDP per person. It is possible to draw a conclusion that in countries with higher level of education. In the upper right corner of the figure is a group of EU-15 nations and in left lower corner - the accession states of the EU. The leaders of the first group are Nordic countries; one of the leaders of the second group is Estonia.



* GDP in current prices converted with ppp (EU25 = 100%). Diagram represents EU old and new member states and accession countries (before merging with EU).
Source: Eurostat, Statistical Office of Estonia, New Cronos.

Fig. 7. **Tertiary educated persons relative number in 25-64 year old economically active population compared with GDP per capita, 2003** (%)

Fig. 8. shows last decade developments in preparation of specialists with higher education in Finland. On one hand, there has been a basic change between academic and vocational education with the latter winning. On the other hand, there is a trend that if this continues, the number of working age population with higher education will reach 60%. It can be concluded that today the preparation of third level education graduates is in appropriate numbers or rather too few.



Source: Suomen Tilastokeskus.

Fig. 8. **Tertiary educated compared with 20-29 year old population in Finland, 1985–2002** (%)

World Competitive power report for years 2004-2005 positioned Finland, which has one of the highest rate of third level education completion rates in the European Union, on the top of the list for the third time in last four years. World Economic Forum finds that this high position is mainly caused by the extremely well macroeconomic government of the country and it scores very highly on its public sector institutions quality measurements, including education sector. The United States of America, on the second position on the rate of completing tertiary education among the OECD countries, is on the second place because of its overall technological superiority, and scored especially high points in figures like organizations spending on research and development, scientific creativity, ownership rates of personal computers and the internet. In 2004 Sweden was on the third position. Therefore two EU countries were in the top three.

Taken as one entity the European Union lags behind its main key global competitors -USA and Japan - in both the rate of tertiary educated persons and competitive power estimations. Only three EU countries are in the top ten (Finland, Sweden and Denmark) and none of the larger member states.

Total investment into higher education in the EU is about 1.1% of GDP. Three best level European countries (Denmark, Finland, Sweden) invest in total 1.7-1.8% of GDP into higher education – still significantly less than best OECD countries. To cover the difference between the spending levels of the EU and US, the European Union should invest an extra 150 billion Euros each year.

In March 2002 Barcelona Council set in Lisbon strategy a goal to increase the investments into research and development as a percentage of GDP. It was recommended that the spending should by 2010 reach 3% and two thirds of this should come from private sector. Higher education should also get its share of this, as additional investments were partly planned to universities.

Conclusions

Estonia must set up a clear target, give it a commonly understood content and, according to the needs arising from this goal, allocate needed intellectual and material resources for acquiring higher education, for example knowledge-based society, Estonia making it to top 5 of the wealthiest countries in the world, etc. The EU experience shows clearly: highly educated people are more employed than people with lower level of education and there are less unemployed people among them. There is a clear connection between higher

education and country's wealth. The higher the average education level of working age population, the higher the GDP per capita in this country. Larger ratio of highly educated persons in the population increases a country's competitive power.

In more than 20 years a growth trend has appeared in preparation of specialists with the third level education in Estonia, continuation of which would today amount to 4% of whole population aged 20-29 (Fig. 4). Today this figure has recovered, but in meantime it decreased to 2.5%. The same has been happening in Latvia and Lithuania (Fig. 5 and 6). In Finland the same figure has stabilized to 6% (Fig. 8), which means that Finland is aiming at having in 10 years in age group 30-39 the ratio of higher education graduates of 60%. This is true movement towards a knowledge-based society, success of which is also shown in connection between the level of education and GDP per capita. In Nordic countries the ratio of higher education graduates is about a third bigger than in the Baltic States, GDP per capita is on average three times bigger (drawing 7).

More favourable conditions must be created for private sector to invest into higher education and research and development work. First of all it is necessary to release these fields from excessive tax burdens, for example, return the VAT paid by the education institutions and remove the special benefit tax from studies.

Problems in the field of education should be included among the problems that are free from party politics and for which long-term programs are devoted like "Eesti Edu 2014" (Estonian Success 2014). Reaching a "social agreement" in Estonia would be a remarkable presumption for future development of HRST. This approach would allow a better balance in forecasting HRST development and whole society's future needs.

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