

'Knowledge Workers' in the Baltic Sea Region: Comparative Assessment of Innovative Performance of the Countries in the Macro-Region

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Abstract: *The article studies the problems of human resources stemming from increased mobility, and the emergence of new aspects of migration processes. A comparative analysis of the connection between academic development in the context of university (and the science system) and the process of labour migration taking place in Poland, Latvia, Lithuania and Estonia was carried out. The article examines the limits of the model through European territorial migration process and concludes that the huge migration of high-skilled labour (called the “knowledge workers”) has had a very negative impact on the innovative and academic potential of Poland, Lithuania, Latvia and a negative impact in Estonia. In the final section, the article examines increase in the requirements for competence in the Baltic Sea macro-region of the European Union and Estonia’s university reform of 2013–2016 as an illustrative experiment to (un)resolved problems. The first results of the reform in higher education indicated that it was ineffective—for students, the good ideas of the reform proved to be a lost experiment and the mobility of knowledge workers, as the future academic resource in homeland, turned from Estonia to larger Europe, especially to Finland and the UK.*

Keywords: *academic development in the Baltic countries, Baltic Sea macro-region of the European Union, strategies for human resource and local policies,*

1. Methodology of the Baltic Sea macro-region research

In this article, the conceptual model of macro-region is applied to the study of processes of transforming the social and political space in the Baltic Sea Region (BSR) into a unified whole. The first and second part of this article outline the conceptual principles of the proposed model and the main geo-economic aspects of the Baltic Sea macro-region (with aspects of the 'knowledge triangle', involving science, technology, and innovation) and examine the limits of the model through the process of European territorial migration. The final part examines Estonia's university reform of 2013–2016 as an illustrative experiment to unresolved problems since the higher education reform proved ineffective—for students, the good ideas proposed in the reform proved to be a lost experiment and financing capacities have been sinking over the past five years in Estonia (2013–2017). The aim of the article is to highlight the trends and problems in human resources due to increased mobility, the emergence of new aspects of migration processes, and to study the increase of the total requirements for competence in the Baltic Sea macro-region.

This study of the integration of the Baltic countries into the European economic and technological space makes use of a model that is based on the representation of the Baltic Sea Region as an environment in which open innovative systems direct their 'knowledge triangle' and socio-economic structures towards sustainable development. The trajectory of this system development has been affected by two groups of forces: one involves forces which deflect the development from the sustainable trajectory, while the other represents forces that push the development towards the sustainable trajectory. Extreme resource depletion is a factor that limits the development. (Kirch, Nezerenko & Mezentsev, 2011, p. 204).

Among the very important resources there are also people with higher education in the out-migration flows from the EU countries of the Baltic Sea Rim. However, when resource depletion concerns also people, the situation is largely different, especially when human capital, which should become a subject for intensive economic growth or introduce structural changes in economy (young people with higher education), flows out of the region (Kerikmäe, 2001). Usually, when depletion increases, the rate of consumption of resources is reduced and the society begins to increase investments to renew the resources, as can be seen from the example of knowledge-intensive economy and development of green growth with workplaces policies of the European Commission (Kirch, Mezentsev & Rodin, 2011).

In 2009, the process of Baltic Development was initiated (Baltic Development Forum Report, 2012), with a new strategy for the regional level, within the European Union according to the *EU Strategy for the Baltic Sea Region (BSR)*. The BSR is studied as a formal macro-region around the Baltic Sea, which consists of eight European countries (Denmark, Estonia, Finland, the northern part of Germany, Latvia, Lithuania, the northern part of Poland, Sweden, and Norway) and some regions of the Russian Federation (Communication COM(2009) 248 final, p. 5).

The strategy of the Baltic Sea Region is quite a new field in EU policy-making, and since macro-regional cooperation is a precondition for further development, this macro-region strategy can be viewed as one of the priorities of the strategic framework for Europe 2020 (EC, 2010).

As a conclusion to this, Dr Tobias Etzold stated, first in the 2011 report of the Baltic Development process, that this is “the only way to develop the region and to establish a framework for binding and sustainable regional co-operation in European Union” (Etzold, 2011). In the final remarks and key messages of the following year’s report (with an outlook on 2013, too), he concludes his analysis:

Most countries of the region fulfil their duties in Baltic Sea regional co-operation; they do no less but also not much more than that. This is somewhat surprising given the fact that the Baltic Sea Region is currently Europe’s only economic growth motor. The countries around the Baltic Sea could play a key role in generating growth and helping the continent return to sustainable growth. At least, appropriate networks and frameworks have been established for playing a more active role in implementing infrastructure projects that could benefit the competitiveness of Europe more widely. (Etzold, 2012, pp. 70–71).

Five years later, Christian Ketels and David Skilling argued:

The Baltic Sea Region is facing changing circumstances in Europe and the global economy that have the potential to negatively impact its future prosperity. We see in this difficult situation an opportunity for the Region and the countries within it to act rather than only adapt. It can influence the future of European Integration, and has an important contribution to make to the discussions happening right now across Europe. It can prepare for changes in the global economy, and maybe even influence the choices that are being made shaping it. In both of these areas much of the action required is national in

nature. But collaboration in the Region can accompany these efforts, by providing a platform to learn from each other and by joint action that can affect the context in which the countries from the Region operate. (Ketels & Skilling, 2017, p. 16)

In the State of the Region Report of 2011, and the following ones in 2012–2017, the main question is the predominance of structural changes in the global economy and especially how these changes will affect the relationship between the underlying patterns of competitiveness and the economic outcomes that they lead to (see *State of the Region Report, 2011–2017*).

However, the situation for the rightful planning and economic forecasting of the public sector in the Baltic Sea Rim countries is highly problematic and does not create optimism as the theoretical and statistical-informatics bases are low. What could be the problem? Dr Ülo Ennuste summarised in his large critical work about synthetic conception:

As a matter of fact, a very wide intelligent public in Estonia has apparently become passionate about the need for fuller and undistorted disclosure of the socio-economic governmental and private sphere socio-economic information that is targeted at stakeholders and a wide public. In other words, they are worried about a seemingly growing contamination of the knowledge environment—a term coined by András Inotai. (Ennuste, 2009, p. 11)

Since the beginning of European integration processes in 2004, the Baltic countries have very effectively carried out the socio-economic reform up until 2008, but major country-specific challenges, resulting from the 2008–2011 financial-economic crisis, still exist in the economies of the Baltic countries and Poland. The post-crisis socio-economic processes of 2012–2017 have given good results in the Baltic Sea Region at large and today all the southern Baltic countries are making a positive and meaningful impact, although major progress in analysing knowledge environment is yet to be seen.

Currently, all the Baltic countries (all with a very limited population: Estonia—1.3 million, Latvia—about 2 million, and Lithuania 2.8 million) are experiencing significant problems with the negative social impact of the huge migration of human resources on economic growth and academic development.

As the IMF staff discussion note *Emigration and Its Economic Impact on Eastern Europe* (IMF, 2016) states, in Central, Eastern, and Southeastern Europe (CESEE), emigration has lowered potential growth:

It has dampened average annual working-age population growth by about ½–1 percentage point since 1990—implying that the labor supply could have been 10–20 percent greater than observed—with particularly pronounced effects in SEE and the Baltics. Specifically, migration shaved off 0.6–0.9 percentage points of annual growth rates in some countries in SEE (Albania, Montenegro, and Romania) and the Baltics (Latvia and Lithuania) during 1999–2014. About two-thirds of these losses can be ascribed to the direct impact of emigration on the labor supply, with the rest from skill deterioration. [...] A counterfactual analysis indicates that cumulative real labor productivity growth in CESEE countries would have been about 6 percentage points higher (in Estonia—8 percentage points) in the absence of emigration during 1995–2012. (IMF, 2016, pp. 17–22, 42)

A recent analysis concluded that in some European countries “high emigration rates have exacerbated population decline and aging and may have reduced the supply of skilled workers. After EU enlargement, mainly young and skilled people left Central European countries, most of them for Western Europe. Their emigration accelerated population declines in some countries”—Lithuania, Latvia, Estonia, Moldavia and others, “and may have slowed growth.” (The World Bank, 2017, p. 43)

So, as stated in the two analytical reports, the migration of highly skilled labour force from all Baltic Sea countries has had considerable negative impact on their socio-economic development. Today, an extraordinary new research problem has emerged—how negative has been the impact of labour migration on the academic potential of the Baltic Sea Region countries.

2. Migration process and its impact on labour in and outside the Baltic Sea macro-region

Major country-specific challenges, resulting from the 2008–2011 financial-economic crisis, exist in the economies of the Baltic countries (Estonia, Latvia and Lithuania, and Poland). In the post-crisis period, the socio-economic process has given good results in the Baltic Sea Region at large and all the southern Baltic States are making a positive and meaningful impact today. In Poland, as well as in Latvia and Lithuania, the development of the common market is based on the speed of the out-migration process from these three countries and, as a disadvantage, has had some positive and also negative impacts on the countries involved in pan-European processes.

Economic and socio-cultural globalisation and European integration increase the mobility of the population and favour citizens' choice. For the country of origin, the migration of highly qualified personnel to a country with a more efficiently coordinated social system means losses in productivity and financial resources of the educational system. The migration of teachers, qualified researchers and students results in the loss of potential profits from educating the highly qualified personnel who migrate out of the country. Consequently, the educational system also loses its effectiveness in providing the country with professionals that stay in their home country.

The migration processes of highly skilled personnel and the side effects of this process on the development of an innovative economy must be examined also within the macro-regions. Within the boundaries of our model, the migration process is often a flow which originates in the emergence of differences in the socio-economic potential between the countries—the country of origin and the country of choice.

Statistical analyses show that Polish, Latvian and Lithuanian migration is beginning to change from a short-term economic migration to a long-term one, because of family reunions and rapidly developing social networks. In Estonia and in all of its neighbouring countries—Poland, Latvia and Lithuania—the unemployment rate is approximately 20%, and this factor has proved to be a major economic problem in the economic crises of 2008–2015.

In Latvia, emigration was about 16,000 people on average during the years of economic growth (2012–2016) and 40,000 people in the years of the economic crisis (2008–2011) and post-crisis period. So, *summa summarum*, Latvia lost *ca* 200,000 people in 2008–2016, and the total loss of the Latvian population was 427,000 in the years 2001–2016. As to migration processes, the demographic loss of 65% and 35% indicates that the most significant factor in Latvia's population decline is migration.

In reality, the years 2000–2016 represented a national demographic catastrophe for Latvia—the decrease in population was from more than 3.4 million people in 2000 to no more than 2 million people according to the 2011 population census, and to mere 1.85 million people today (according to Latvian population census as of July 2016 and other statistics). The main destinations of Latvian emigration are the UK, Ireland and Germany.

In Lithuania, the most significant factor in population decline was migration, amounting to the loss of 657,000 people between the years 2001 and 2016, constituting approximately 19% of the population. In Lithuania, emigration was

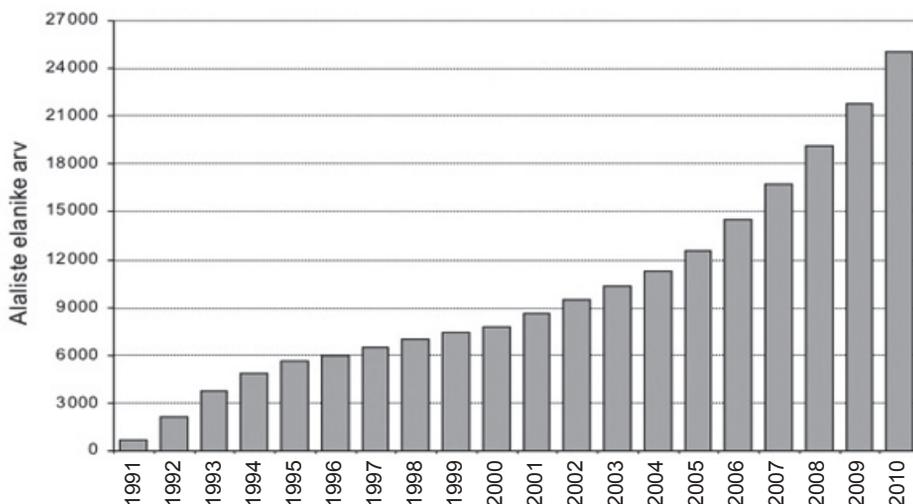
about 15,000–17,000 people on average during the years of economic growth and more than 20,000 people in the first year of the economic crisis (2009). The emigration flow increased in 2010 four times compared to 2009 and the stable high flow continued in 2011–2015, when 50,000 people left Lithuania.

The main destination routes of Lithuanian emigration are Ireland, the UK, Spain, Norway and the USA. Lithuania remains in the forefront according to the migration rates in the European Union.

In Estonia, these issues are not as salient as in Latvia and Lithuania. Here, the most significant factors of population decline were natural increase and labour migration, amounting to the loss of more than 85,000 people between the years 2001 and 2016 (Rannala & Tammur, 2010, p. 63).

However, the labour migration between Estonia and Finland has increased in the past 25 years and, as a result, Estonian migration to Finland has become part of intensifying economic (labour-seeking) migration. Since 2010, the pendulum from free labour to migration labour as the first migration process model could serve as an important impact factor (and as the second model, as in the period of 1991–2010).

Figure 1. The number of people migrated from Estonia in Finland (permanent residents), 1991–2009



Source: Finnish Immigration Service, 2011

Thus, in comparison with Latvia and Lithuania, in Estonia these labour migration processes were not as negative, as approximately 60–75,000 labour migrants from Estonia are there as regular commuter workers—and of this group about 40,000 visit Finland as workers during a one-year working period (Tiit, 2015, pp. 56–75).

As a final result it is estimated that in the period of 2004–2010 about 45,000 and in the period of 2011–2016 another 55,000 Estonians and Russians from Estonia emigrated to permanently live and work in Scandinavian countries—primarily Finland, Sweden, Norway, or the UK.

From 2010 onward, the pendulum from free labour to migration labour as the first migration process model could serve as an important impact factor, and another period was 1991–2010 (Tiit, 2015). In 2010, the “visiting workers” (in Estonian, *kalevipojad*) usually did not live permanently in Finland but had stable work places. Reasons for this are very practical and, as Estonian and Finnish sociologists claimed in 2012, the visiting workers represent a good socio-cultural and economic tool in the large process of creating Estonian-Finnish transnational space (Jakobson *et al.*, 2012), first between Helsinki and Tallinn. According to the recently established register, there were about 60,000 migrants from Estonia working in Finland yearly during the last five years, while only 5,000 people from Finland were working in Estonia. According to Koikkalainen (2017, p. 169), since the mid-1990s more than 145,000 Finnish citizens have moved to other EU Member States.

A comparative analysis of the labour migration processes taking place in Latvia and Lithuania indicate that the highly skilled groups (especially post-graduate students) in the national social structure are very effective in the conditions of labour mobility in the European Union—they leave homeland faster than young people leave Estonia.

During the period of 2005–2016, nearly 250,000 Latvians and half a million Lithuanians emigrated to Ireland, the UK, Germany and the USA. In terms of Poland, as a result of huge emigration, 2.5 million Polish people work in Western Europe and in the USA.

3. Data: European Innovation Scoreboard as a complex database

In recent analyses, the development of innovative economy has been named as one of the main objectives of the joint efforts of the Baltic States. Unfortunately, it is not a simple task to measure a country's level of innovation. In order to work out, apply, and assess political criteria for this purpose, it is imperative to provide proper measuring tools for the object under consideration.

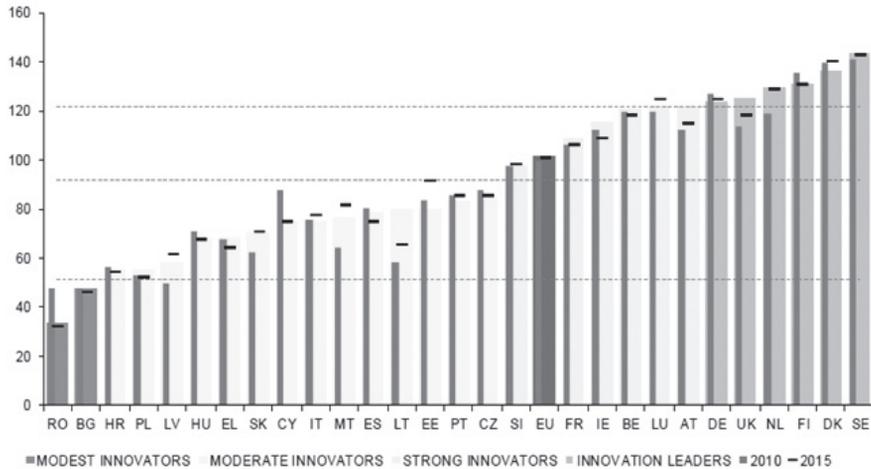
For more than 25 years, the European Commission has been measuring the innovation performance of countries by means of the European Innovation Scoreboard (EIS, 2017). European Innovation Scoreboard (EIS) has been published annually since 2001 to benchmark the relative innovation performance of the EU Member States. EIS uses the most recent statistics mostly from Eurostat, and other international sources have been used wherever possible in order to improve comparability between countries.

EIS is a complex database of recent research on the impact of outward migration on the innovative and academic competitiveness of the countries of the southern Baltic region and of European Union members in comparison, on the whole. Figure 2 presents a comparison of innovation opportunities in Poland, Estonia, Latvia and Lithuania with other European Union countries with the Summary Innovation Index, calculated for the EU-27.

Based on their average performance scores, as calculated by a composite indicator on 27 statistical indicators, the Summary Innovation Index, the Member States fall into four different performance groups (see EIS, 2017, p. 4):

- 1) Denmark, Finland, Germany, the Netherlands, Sweden, and the United Kingdom are *Innovation Leaders* with innovation performance well above that of the EU average.
- 2) Austria, Belgium, France, Ireland, Luxembourg, and Slovenia are *Strong Innovators* with performance above or close to that of the EU average.
- 3) The performance of Croatia, Cyprus, the Czech Republic, Estonia, Greece, Hungary, Italy, Latvia, Lithuania, Malta, Poland, Portugal, Slovakia, and Spain is below that of the EU average. These countries are *Moderate Innovators*.
- 4) Bulgaria and Romania are *Modest Innovators* with performance well below that of the EU average.

Figure 2. Performance of EU Member States' innovation systems in the period 2010–2016



Source: EIS, 2017, p. 4

Coloured columns show Member States' performance in 2016, using the most recent data for 27 indicators, relative to that of the EU in 2010. The horizontal hyphens show performance in 2015, using the next most recent data for 27 indicators, relative to that of the EU in 2010. Grey columns show Member States' performance in 2010 relative to that of the EU in 2010. For all years the same measurement methodology has been used. The dashed lines show the threshold values between the performance groups in 2016, comparing Member States' performance in 2016 relative to that of the EU in 2016.

As the article's focus is a topical research area in the context of migration and mobility processes, the author has chosen a scientific method to approach the matters of collaboration between universities and business, and has applied statistical bibliometric analysis as the secondary method of data collection in this study. All bibliometric estimates are based on information obtained from the database of European Innovation Scoreboard or are indexed on the basis of EIS data.

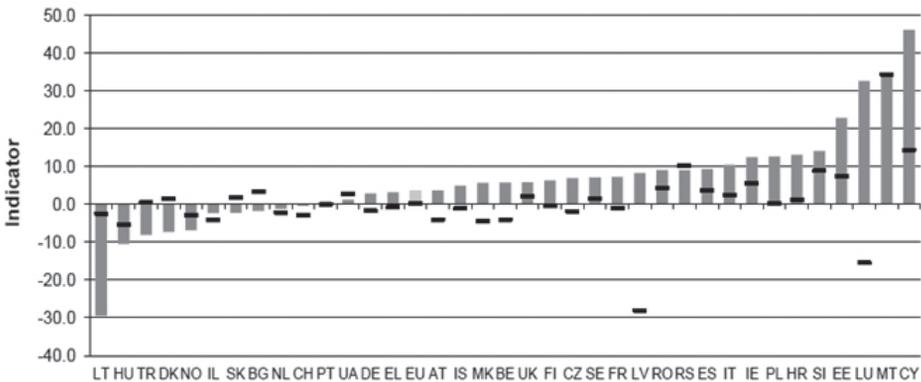
According to the 2015–2016 European Innovation Scoreboard, some of the negative impact is clearly seen in Poland, Lithuania and Latvia. The findings of the most recent EIS report suggest that the rapid advance of Poland and Latvia in innovation performance may be maintained not only owing to the severity of the economic crisis but through the loss of highly skilled labour force in large-scale migration. Such losses in academic human capital through the fast diminishing of the number of researchers and doctoral students will result in difficulties in the technological and academic innovation process in the future.

• **The total number of academic publications by countries of the Baltic Sea Rim**

Among the very negative results, according to European Innovation Scoreboard data on Latvia and Poland (see Fig. 1.2.1 in EIS, 2017, p. 7), is the number of scientific publications, as these countries have less than 250 international scientific co-publications per million population. In Lithuania the number of publications is 400, while in Estonia the number was 1,500 co-publications per million population in 2016.

The position of Lithuania, Latvia and Poland is very low on the indicator, with 4% (Latvia and Lithuania) and 5% (Poland) among the top 10% most cited publications worldwide. As Figure 3 shows, Lithuania has ranked the lowest among all EU countries for the last 10 years and compared to the 2010 performance, the position of Lithuania has fallen most significantly in 2016—about 70% (*sic!*) (EIS, 2017, p. 8).

Figure 3. Scientific publications among the top 10% most cited, performance in 2010–2016



Source: EIS, 2017, p. 8: Annex B - Performance per indicator 2017

Columns show the performance of the normalised indicator scores in the most recent year compared to the situation six years earlier, i.e. the normalised score used for calculating the SII in 2016 is compared to the normalised score used for calculating the SII in 2010. The horizontal hyphens show the performance of the normalised indicator scores in the most recent year compared to the previous year, i.e. the normalised score used for calculating the SII in 2016 is compared to the normalised score used for calculating the SII in 2015.

This indicator is a very important impact factor for the Baltic Sea Rim countries and some others from Central and Northern Europe—for example, Hungary

and Denmark. Thus, we can conclude on the basis of the analysis of European Innovation Scoreboard 2017 that the first cause for the highly negative tendencies in Lithuania and Hungary is the emigration of academic people abroad.

For the study, the author has also drawn on secondary data on a number of key parameters that are important for assessment, in particular:

- **Data from the Forum's Global Competitiveness Index and GEM's Adult Population Survey (December 2016)** to analyse the associations between the competitiveness of European economies (by country case for comparison) and the types of entrepreneurship exhibited. The analysis highlights the impact of intrapreneurial activity and how it changes the overall picture of European entrepreneurship (World Economic Forum, 2016).

Estonia tops the ranking for overall entrepreneurship, owing to its high rate of TEA, for which it ranks second in the sample. Meanwhile Estonia's Early-Stage Entrepreneurial Activity (EEA) rate is slightly above average—4.3%, while TEA is 12.6% (the total is 15.8% with Estonia ranking first in Europe, Sweden occupying the second position and Latvia the third position). Editors of the report summarised that in Estonia almost 80% of started businesses are opportunity-driven and Estonia is often cited as a model for entrepreneurially-oriented policy (World Economic Forum, 2016, p. 19).

- **Budget cuts in higher education in the years of financial crisis (2008–2010), during the post-financial crisis (2011–2012), in the EU Member States, and today**

Budget cuts in higher education in the years of the financial crisis (2008–2010) in the EU Member States was not a uniform response to the crisis, but in all the Baltic States these budget cuts took place. According to large statistical reviews, public expenditure on tertiary education decreased considerably in Estonia, Latvia and Lithuania in 2008–2009, making up 20.6%, 18.5% and 6.6%, respectively (*EHEA*, 2012, pp. 25–27). Nevertheless, having cuts in budget allocations to higher education in 2008–2010, does mean fewer resources in higher education in Poland and Latvia, but not in Lithuania and Estonia in 2011–2012 (see *EHEA*, 2015, pp. 41–42).

As findings of the recent human resource mobility index in Latvia, Estonia and Lithuania (see *EHEA*, 2015, pp. 239–240) show, the lack of investments in the education system has had a negative effect on universities achieving higher level because growth in outward mobility by students with university degrees is the negative result in the higher education process in general.

Geographical proximity, the share of common languages of instruction or historical legacies may not be negligible in determining the origin of incoming students in some countries. For instance, such factors may explain the pattern of students arriving in Estonia (from Finland and Ethiopia, but not from Russia and Latvia) and Finland (from Sweden, Russia, and Estonia but not from Latvia and Lithuania).

According to Professor Jüri Allik's (2018) estimation on the dilemma of financial development in Estonian science, there is only one solution for the future—either to restore sustainable financing in Estonian universities or continue on the inevitable downward path of recent years (because owing to the reforms the budget of the universities has unexpectedly become negative).

Allik argues that the situation is particularly complicated in the largest universities. According to him, the result based on the rhetoric of “transparent financing” and “increase in research funding” by providing more research funds for universities has not been achieved and these promises have been forgotten (Allik, 2018).

Based on the data of the Estonian Statistics Office, one can argue that especially during the last few years (2013–2016) the financing of research and development in Estonia (from the local and national budget) has shown a dangerous decrease—from 154 million to 102 million euros by the year 2016 (*Statistics Estonia*, 2017).

4. Reasons for large university reforms in Estonia

In Estonia, the number of students continues to decrease. While in 2011 there were 69,113 students in Estonia (*Eesti Statistika aastaraamat*, 2011, p. 78), according to the Ministry of Science and Education (2018, p. 4), the number is currently 47,800. The most recent period shows a very negative tendency in the matriculation of students in Estonia—from 2011 to 2017 the drop in the number of students was 30%.

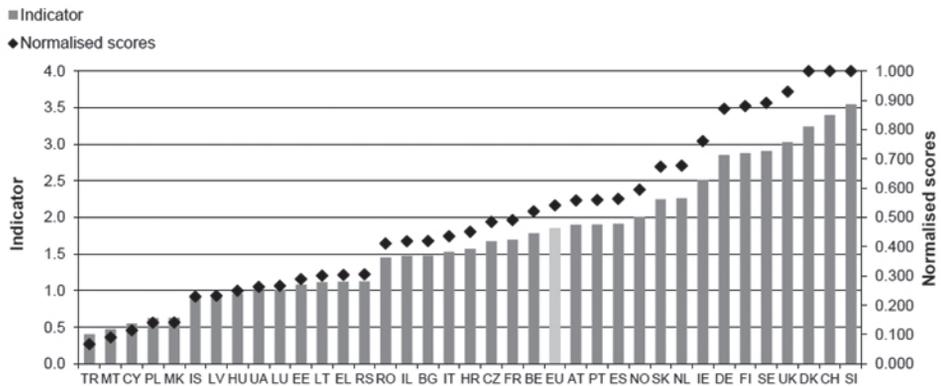
In Poland the situation is better, and also in Lithuania and Latvia the statistics are not as negative as in Estonia. However, some complicated or very negative effects exist in the labour development of innovative economy in Latvia, Poland, Estonia and Lithuania. The potential reasons for this process are the following.

The first reason for this process with negative effect is the following: as labour migration processes have been very active in the past five to seven years, there

is an increasing deficit in academic labour resources in countries of the southern Baltic area. The negative impact, in turn, has resulted in a very low number of doctorate graduates per 1,000 population aged 25–34 (see Fig. 4).

According to Eurostat data (EIS, 2017, p. 4), experts have concluded that in 2015, on average 1.8 new PhD degrees were awarded in the EU per 1,000 population aged 25–34. The highest scores are observed in Slovenia, Switzerland, Denmark, and the United Kingdom, with at least 3 new PhD graduates per 1,000 population aged 25–34. In Malta, Cyprus and Poland (only 0.6 new doctoral students per 1,000), the performance is relatively weak with 0.6 or less new PhD graduates per 1,000 of population aged 25–34. In Lithuania and Estonia there is no more than 1 new doctoral student and in Latvia—0.9 doctoral students per 1,000 population aged 25–34 (EIS, 2017).

Figure 4. New doctorate graduates in 2010–2016



Source: EIS, 2017, p. 4: Annex B – Performance per indicator

The situation was alarming for Poland in 2010–2016 when the number of PhD graduates dropped 13% as the academic educational process in Poland was in this period at an unsatisfied stage and labour migration processes have exerted a strongly negative impact in the last five to seven years. For Latvia, Lithuania, Estonia and Hungary, the situation with new doctoral graduates aged 25–34 is also problematic.

The second very essential problem in the flow of students and doctoral graduates is the lack of continuity in the provision of educational services at the level of the best European universities. As recent academic research (Lauristin, 2011, and others) has concluded, the traditional structures of higher education in Estonia are ineffective for higher competitiveness in Estonian universities. Among

the most crucial problems are the lack of continuity in providing educational services at the level of the best European universities.

To resolve these contradictions, a very aggressive plan, initiated as a state programme, was worked out by the Estonian Ministry of Education and Science. The higher education reform can be seen as a counter-argument to making the period of study more optimal for students and professors. Government has planned to expand the concept to a fully state-commissioned study.

For Estonian universities additional contribution to the budget for the period of three years (2013–2015) was 60 million euros. With the basic state-commissioned student places, this could be beneficial for students participating in Estonian language study groups, including students with about 170 euro stipend per month, and post-doctoral students with a stipend of no more than 600 euros.

Thus it can be concluded that in autumn 2017, the university innovation program was not so efficient as initially planned in the cabinets of the ministry and rectors—life in Estonia shortly corrects all ideal plans. As a negative result, the number of new students recruited in autumn 2017 decreased in the natural and economical sciences. However, this was not the case in the Faculty of Information Technology of Tallinn University of Technology (TUT) as the department was integrated from outside when the former IT College was merged into TUT on the initiative of Rector Jaak Aaviksoo (TUT, 2017).

One reason for the decrease in the number of students in Estonia (and Latvia and Lithuania as well) is the demographic gap in population in the past 20–30 years. In Estonia, the younger population has decreased for the last 25 years, falling in the period following 1990 to one third of today's (2017) demographic estimates. While in 2000 there were 16,000 Estonian schoolchildren in the first grade, in 2010 the number of Estonian first-graders had dropped to 12,000, and in August 2017 there were only 9,600 Estonian first-graders plus 5,000 Russian speakers and of other nationalities (the author's estimation based on data from Statistics Estonia, 2015, pp. 21ff).

In the southern Baltic EU member countries, modernisation of the education system and the academic development in universities are not regarded as key elements of enhancing competitiveness in the whole society. Science is not regarded in the university system as the primary instrument for innovation. There is a need to strengthen the link between the different parts of the higher education system, science and government, but it is also necessary to strengthen each part individually—these are the main tendencies of the development of the *knowledge triangle* (Kirch, 2009, pp. 40–47).

In Estonia, the main issue is the predominance of structural changes of global economy and especially how these changes will affect the relationship between the underlying patterns of competitiveness (and the economic outcomes that they lead to), which are at the final stage in today's Estonia.

A good indicator of these trends is a recent assessment based on the bibliometric analysis of regional university–industry interaction in the Baltic Sea macro-region. This allows us to conclude that in the last ten years Poland, Latvia and Estonia have suffered from a negative image in university–industry interaction research. As to the 2010–2015 period, Murashova and Loginova (2017) conclude:

An important role in the formation of this tendency is played by researchers from Sweden, Finland, Norway, Denmark, and Germany, the share of publications of which accounts for 95.5% of the total number of articles published by the countries of the Baltic Sea Region. (Murashova & Loginova, 2017, p. 53)

According to this assessment, only about 5% of the total number of articles are published in the southern Baltic countries. In the coming years it will be a difficult time for academic collaboration, as it is an important factor of competitiveness between the northern and southern Baltic countries in the whole Strategy of the Baltic Sea Macro-Region of European Union.

This larger process would require the creation of hundreds of new highly qualified jobs over the next years in home countries. A favourable factor for Estonia is that ca 40,000 new workplaces can be established for ICT people up until 2020, and ICT could become Estonia's main industry (Kotka, 2012).

However, until today only half of this large program has been completed. In this situation, an important role must be attributed to the 'knowledge triangle' which is concerned with creating innovative E-technological mechanisms—large platforms such as X-road and e-residents (Pau, 2017)—and an institutional network (between scientific institutions and high technology centres) for larger innovation process in Estonia.

Higher level research is carried out not only in universities (there are 6 universities and 15 other academic institutions in Estonia), but also in research centres of excellence and competence centres. The centres of excellence are composed of internationally highly regarded research groups who work under clearly defined common goals. Currently in Estonia there are 12 centres of excellence and 8 competence centres, and the total number of positively evaluated Estonian R&D institutions is 40 (Research in Estonia, n.d.).

5. Conclusions

First, modernisation of the education system and academic science development in universities today are the two key elements of enhancing competitiveness in the whole society. In the Baltic Sea macro-region, an important role must be attributed to the ‘knowledge triangle’, which is concerned with creating new economic mechanisms and creating a structure of institutions to carry out the new comprehensive and dynamic innovation model.

For Estonia, the final challenge was to create a new aggressive plan for a university and science reform in Estonia in 2013–2016. The results of the reform, however, showed that it was ineffective—alongside the reform there emerged new major unresolved problems for the future political decisions. Since there have been no effective academic reforms in science and higher education in Poland and Lithuania and, as a result, no labour resource formation in the country, a very large share of young post-graduates (about 35–55%) leave their homeland.

It can be concluded that in all the countries analysed here—Poland, Estonia, Latvia and Lithuania—there exists a negative factor for a national demographical crisis in the nearest future, in the period of ten-twenty years in 2027–2037, as the decrease in the populations of the countries will be huge in Latvia and Lithuania (30–40%) and some 10–20% in Estonia and Poland.

Second, the migration of highly skilled labour force from all the Baltic Sea countries (Poland, Latvia, Lithuania and Estonia) today will have a negative impact on the economic potential of the region. The trend of migration flows of young and educated people is currently predominantly northward—to the Scandinavian countries—rather than the UK, as in the past ten years. This means that, broadly speaking, half of the emigrated skilled labour people (150,000 out of 300,000) in Northern Europe (Sweden, Denmark, Finland and Norway) came from the Baltic States—Poland, Lithuania, Latvia and Estonia.

Therefore, in the future it is inevitable to implement effective policies that would encourage networking and innovative cooperation within the Baltic Sea macro-region. A good political measure for this would be to turn the outward mobility in the southern Baltic countries to inward mobility. In the last five years, Latvia and Estonia have shown some positive trends of re-immigration—in 2012–2016 the number of repatriates to Latvia was 31,850 and to Estonia 20,000. (Statistics Estonia, 2018).

The final conclusion is that there are very optimal results for the whole political and technological connectivity—for example, the development of the macro-region benefits the whole macro-region of the Baltic Sea Rim, both the destination countries of the northern Baltic region as well as the donor countries of the southern Baltic. The destination countries acquire new high-educated labour force, while the benefit for the donor countries is the opportunity to be integrated into the research and innovation networks of countries that have already performed well and given good results in the field of innovation.

As said in article's introduction, the key issue is the predominance of structural changes in the global economy and especially how these changes will affect the relationship between the underlying patterns of competitiveness and the economic outcomes that they lead to. The coming years will be a very difficult time for collaboration and competitiveness across the Baltic Sea macro-region. As concluded in the analysis about migration losses in all the Baltic countries, they all have major problems with the formation of working resource—about half of the young educated population plans to migrate from Latvia, Lithuania, Poland and Estonia to other European countries.

The overall economic recession in the EU in 2008–2010 (and the financial crises in 2011–2014) have largely expanded to a “competitiveness shock”, as described in connection with France's economy (see *The Economist*, 2012). In Estonia we have a chance to expand this competitiveness shock at the minimal level— it can be reduced to a large extent with successful repatriation (re-emigration) of Estonian youth to home.

This larger process would require the creation of hundreds of new highly qualified jobs over the next years in home countries. Also, stability in innovation process is highly important as this stability process can exist only in cooperation with Estonian national governmental (institutional) juridical structure, as Estonian experts Jüri Raidla and Urmas Varblane (2018) have claimed.

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