TALLINN UNIVERSITY OF TECHNOLOGY
School of Business and Governance
Department of Economics and Finance

Anita Sõtšugova

THE EFFICIENCY OF HIGHER EDUCATION: FREE SYSTEM VS PAID SYSTEM

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Supervisor: Simona Ferraro, PhD

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I declare that I have compiled the paper independently
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Anita Sõtšugova ……
(signature, date)
Student code: 193532TAAB
Student e-mail address: anitoka53@gmail.com

Supervisor: Simona Ferraro, PhD:
The paper conforms to requirements in force

……
(signature, date)

Chairman of the Defence Committee:
Permitted to the defense

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(name, signature, date)

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ABSTRACT

The importance of the higher education has been always highly noted worldwide and several studies have discussed this topic. Higher education is tightly connected with financial knowledge and finances themselves. The antecedent of the higher education is its financing, and the outcome is the graduates' input into their financial management and country's economic situation.

The given thesis aims to explore the determinants of the higher education financing methods' efficiency for some countries using cross sectional data for the year 2019. The data is collected from two databases: the Organisation for Economic Co-operation and Development (OECD) Database and The World Bank Database. The following data are used as the inputs for the analysis: the ratio of the expenditure spent on higher education to GDP (%); GDP per capita (in current US$ (PPP – Purchasing Power Parity)); private to total expenditure ratio (%). Output data are: the ratio of people with diploma to total population (% of 25-34 year-olds); adult education level (% of 25-64 year-olds); employment rate of people with diploma (% of 25-64 year-olds). The thesis and the analysis are based on data from eleven OECD countries (Germany, Iceland, Poland, Latvia, Slovenia, Lithuania, Canada, The United Kingdom, The United States of America, Japan, and The Netherlands). The author also put forward a hypothesis in this study: the paid higher education system is more effective than the free higher education system. Data Envelopment Analysis with Variable Returns to Scale is performed in Excel using the output-oriented approach focusing on how to maximize the output with the same amount of resources (Tóth 2009).

The results of the analysis showed that the main hypothesis of the study was not confirmed. Based on these results, the author can conclude that the free higher education system is more efficient than the paid higher education system, as HE is efficinect in 83% of countries with free system, and only in 40% of countries with paid system. The most efficient country from the list appeared to be Lithuania (efficiency equals 1), the least efficient - The USA (efficiency equals 0,947118). Implications of the estimated model are discussed. Analysis by countries resulted in statistically significant model with clear results. Limitations and implications and options for further research are discussed.

Keywords: higher education, efficiency, free higher education, paid higher education

INTRODUCTION

This bachelor's thesis aims to study the efficiency of higher education funding in different countries. Higher education has become an increasingly essential and respected value in modern society. It is more likely to provide people with higher-income jobs in the future, leading to a skilled and competitive workforce and increased productivity and income tax for the state. Without education, the country would not be economically prosperous due to the lack of knowledge on managing it and developing it most effectively. Hence, it is essential to create a fair and efficient higher education funding model to ensure the country's economic efficiency and reduce social inequality. (Canton et al. 2001)

Each country has different ways of financing higher education: in some countries, higher education is entirely free for both local and international students (for example, Germany). In contrast, in others, it is wholly or partially paid or provides grants, vouchers, and coupons (for example, United Kingdom). Regarding free higher education, the question is whether the public sector will be able to find enough funds in the budget to provide quality teaching in public universities.

The author has chosen eleven countries, members and non members of the European Union to study and analyze. The countries representing free higher education and the reasons for choosing them are:

- Germany – used to have a relatively high Human Capital Index (0,795 in 2017) (The World Bank 2018), this indicates a significant contribution of health and education to labor productivity;
- Iceland – although Iceland has a tiny open economy, its people enjoy a high standard of living and a good environment (OECD 2014);
- Poland – Poland's diversified economy has proven to be one of the most sustainable in the European Union (EU), with GDP falling 2.7% in 2020, the first cut in output since 1991 (The World Bank 2021);
- Lithuania – its economy is the largest among the three Baltic countries (Poissonnier 2017);

- Latvia – a developed country with a highly profitable developed economy; ranks very high on the Human Development Index (OECD 2021);
- Slovenia – the inequality is lower than in most advanced economies, yet GDP per capita is 31% lower than OECD best performers (OECD 2021).

And the remaining five countries represent not-free tertiary education, and the reasons for choosing them are:

- Canada – local citizens have the second-highest quality of life in the world by factors like access to health care, sanitation, and housing as well as education, life expectancy, and personal freedoms (World Economic Forum 2022). Also, about 50% of 25-64 Canadian year-olds have a higher education degree, which is the highest number among all the OECD countries (OECD 2011).
- The United Kingdom – has several of the world's best universities (the University of Oxford – the second place in the world, the University of Cambridge – the third place in the world) (Top Universities 2022).
- The United States of America – world's best university – Massachusett Institute of Technology (MIT) (Top Universities 2022), a great example of private expenditure on higher education (62% of total HE expenditure in 2012), also teachers in the U.S. spend 1050-1100 hours of teaching a year, which is much more than in almost every country. (OECD 2012)
- Japan – is one of the countries with the most educated workforce among OECD countries. The percentage of Japanese adults with tertiary education is one of the highest among OECD countries. About 44% of people aged 25 to 64 in Japan have a tertiary degree, much higher than the OECD average of 30%. This indicator is the third-highest among OECD countries. (OECD 2011)
- The Netherlands – levels of tertiary education have increased over the past decade. However, rates for some levels and some fields of study remain below average, and it often takes longer for students to earn a bachelor's degree than in many other countries. (OECD 2019)

The main goal of this bachelor's thesis is to learn which higher education system, free or not-free, is more effective in terms of the outcomes. To reach thesis' main goal the author will be using Data Envelopment Analysis, in which the model will have three inputs (measured in the ratio of

expenditure spent on higher education to GDP, private to total expenditure ratio, and GDP per capita) and three outputs (adult education level, people with tertiary education diploma ratio to the total population, and employment rate of people with diploma) (Tóth 2009) to see which country has the highest tertiary education efficiency level.

The purpose of this thesis is to answer the following question:

1. Is there a statistically significant relationship between the higher education funding method and educational efficiency expressed in the studied variables (ratio of people with tertiary education diploma to total population, adult education level, employment rate of people with diploma)?

The hypothesis provided:
H1: Higher education is more effective in countries where students have to pay tuition fees.

The author aims to summarize the previous literature, present statistics and results on the above topic, and use econometric modeling as the primary research tool. In order to answer the research question, a Data Envelopment analysis is carried out to conclude what the results of higher education with different funding systems are in terms of the efficiency.

Data Envelopment analysis (DEA) will be applied in Excel. The analysis is output-oriented, which means the maximization of outputs. The data are mainly obtained from Eurostat, OECD, The World Bank, and other statistical sources with reliable and up-to-date information on selected variables. Since the latest data for most of the dimensions are available for 2019 on OECD and other datasources, this is the year for analysis.

The thesis consists of three parts. In the first chapter, the theoretical underpinnings of higher education and its funding around the world are summarized, providing examples of higher education funding systems in the countries selected for analysis and summarizes previous research and relevant factors. In the second chapter, research methodologies will be developed to analyze the performance and outcomes of higher education in these countries. In the third chapter, a study will be carried out, and the results will be modeled and discussed.

1. THEORETICAL FRAMEWORK

This chapter aims to give an overview of higher education and how it can be funded in different countries. The chapter is divided into six subsections. The last subchapter summarises some of the previous theoretical data and empirical studies exploring the case of higher education's funding in the eleven countries chosen by the author.

1.1. The importance of the higher education

In the past, higher education to acquire knowledge was primarily a consumer's good of the middle-class intellectual elite. The efficiency of earnings or the efficiency of the national economy was not essential elements to consider. Higher education, nowadays, is more centered on efficiency analysis, which is not only its goal. Efficiency concepts, moreover, deserve attention both for the chances of an individual and for the efficiency of the state's economy. (Barr 2003) Higher education is vital for a country for several reasons. Education is crucial because it leads to higher economic growth and development levels. Hence, the quality and efficiency of higher education are essential for achieving a high level of human capital within a country. (Goksu, Goksu 2015)

Nowadays, higher education is considered one of the noblest parts of human capital. Higher education as a form of human capital has many external effects that contribute to the beneficiation of society. The benefits of human capital go beyond the economic sphere and create social externalities. These are, for example: increasing the productivity of uneducated workers, reducing crime, reducing poverty, increasing social cohesion, increasing tolerance for diversity, more happiness in society, more charity donations, and more community service participation. Therefore, higher education is an enterprise that has a direct social impact, both economic and social, and provides a compelling reason for society to fund it regardless of its context or funding mechanism. (de Gayardon 2018)

1.2. Access to higher education

Higher education, in general, has become more accessible to ordinary people since the 1950s, thanks in particular to the increase in the number of universities in recent years. The same as some changes have taken place in the fields of teaching and research as well as higher education funding, which also helped to increase the tertiary education participation numbers. (Goksu, Goksu 2015)

Higher education is designed to generate and disseminate knowledge, as well as young people's cognitive and communication skills, such as logical thinking skills and the ability to develop complex values. As a short definition higher education can be defined as education or study at a college or university. A broader definition could be: higher or tertiary education is the optional final stage of formal education that takes place after upper secondary education. (Goksu, Goksu 2015)

The tertiary sector includes universities and other institutions that offer vocational courses for students who have completed upper secondary school and qualified for university entry. (Huisman 2003) Countries typically pursue three goals in higher education: more quantity in terms of students entering universities and graduated students, higher quality in terms of academic performance, and fixed or reduced public spending. It is possible to get two, but only at the expense of the third.
Systems can be:

- Large and tax-financed but quality-conscious (France, Germany, Italy);
- High quality and tax support, but small size (UK before 1989);
- Large and high-quality, but financially costly (Scandinavia). (Barr 2009)

College (is here used as a synonymous to university) enrollments are increasing worldwide. In just the first decade after the turn of the millennium, tertiary enrollment increased by 10% or more in several regions, including Europe, East Asia, and Latin America. By comparison, enrollment trends in the United States, one of the first leaders in the transition to mass higher education, appear relatively stagnant: the proportion of high school graduates pursuing some type of postsecondary education increased immediately between the 1960s and late 1990s dramatically and has since remained relatively stable at around 66%. (Scott-Clayton, Sacerdote 2016)

In the last years, universities have developed and implemented progressive strategies to provide underprivileged populations with access to higher education. However, this policy did not take geographic factors into account for the most part. For example, young people from low-income families travel far and long to get to universities in large countries. Also, in general, most higher education institutions are concentrated only in the central parts of cities (countries), which again makes it difficult to access them in large cities (countries). The establishment of universities, particularly their siting, in an increasingly commercial environment exposes them to commercial forces that often run counter to the democratic goals of the university. Not surprisingly, the growing influence of the market on college curricula is also reflected in the geographic location of the university. (Briscoe, de Oliver 2006)

By looking at Figure 1, it is seen that in most of the countries chosen for the DEA analysis, provided in the second chapter, access to higher education has increased over the last several decades, does not matter whether the country offers free or not-free higher education. The only exception is Canada, where the tertiary enrollment numbers decreased with time.

The data is expressed in the gross percentage, which means that regardless of age, the number of students enrolled in a given level of education is described as a percentage of the official school-age population corresponding to that level of education. (UNESCO 2022)

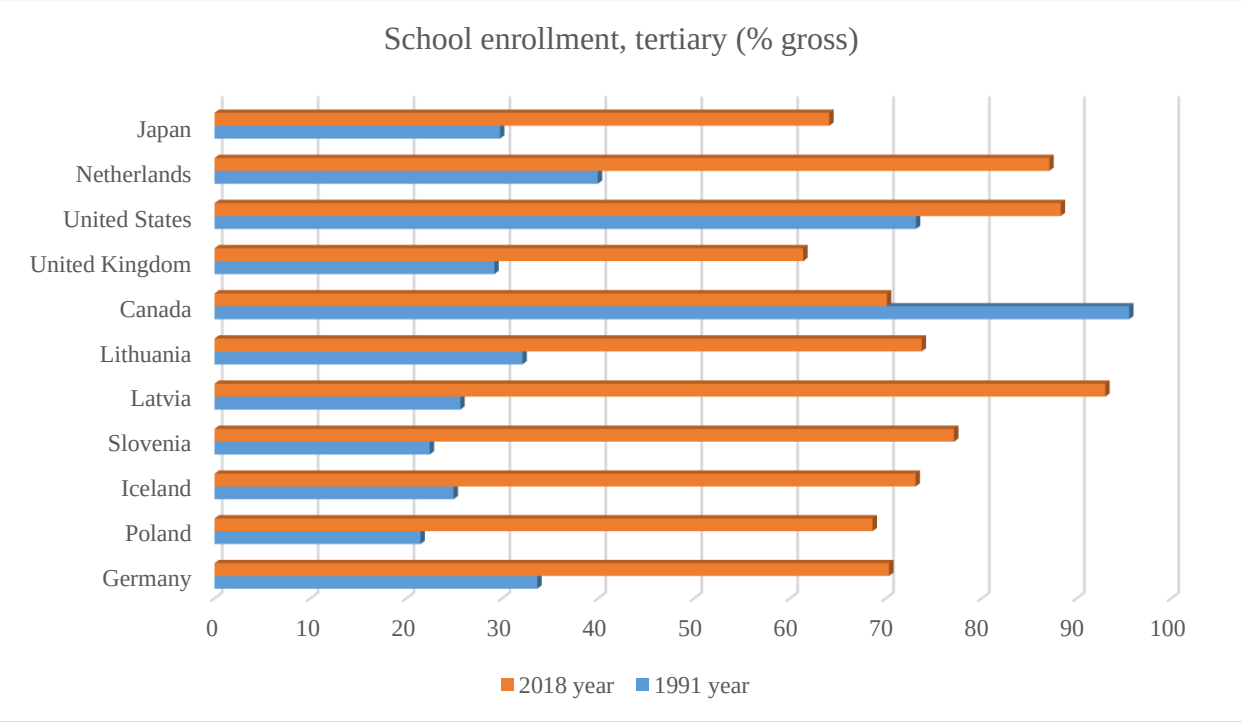

Figure 1. School enrollment, tertiaty (% gross), countries chosen for the analysis, years 1991 and 2018.

Source: The World Bank, Indexmundi, Knoema

Globally, access to higher education now encompasses a third of the age cohort and is growing at an unprecedented rate. The expansion of higher education is often due to the desire of families to maintain or improve their social position. However, the quality of mass higher education is often problematic. Greater social inequality limits educational opportunities. Highly mobile countries have a consensus on social justice and value meticulous and autonomous systems of learning, assessment, and choice in education. As already mentioned, the massive expansion of access to higher education and the struggle for relative educational advantages stem from the universal family's search for the best in social systems where higher education is a commodity in the world, partly zero-sum, but still never fully satisfy everyone. One way or another, almost all graduates take part and are related to the world economy and the economy of the country. (Marginson 2016)

Even if, in the end, policymakers only care about university degrees, the evidence suggests that the likelihood of university degrees depends in part on these many choices made at the entry boundary, and that those choices are often suboptimal. Second, although enrollment rates have generally increased between high- and low-income families, the enrollment rate is actually higher in younger cohorts than among those born in the early 1960s (the US case). (Scott-Clayton, Sacerdote 2016)

Overall, the access to tertiary education worldwide has almost doubled over the past two decades, from 19% to 38% between 2000 and 2018. However, there are still significant differences between regions. Some of these trends were in line with the change in the gender distribution of beneficiaries, which increased from 19% to 36% for men. At the same time, women were the primary beneficiaries of the increase in tertiary enrollment, rising from 19% to 41%. (UNESCO 2020)

On the other hand, inequalities in access persist: poverty, crises, and emergencies, higher tuition fees, entrance examinations, geographic mobility, and discrimination create problems for marginalized communities in accessing higher education. Tertiary education remains out of reach for the world's poorest people, reaching 10% compared to 77% of high-income households, indicating a strong correlation between gross domestic product (GDP) per capita and gross tertiary enrollment. (UNESCO 2020)

However, employers' requirements and government regulations are not the leading indicators that stimulate the expansion of higher education. The societal demand for higher education opportunities is constant and growing. Still, despite this, the needs of states and employers for educational growth are not consistent, and there are no intersections with universities on a daily basis. Professional status is no less critical motivator in terms of obtaining a university degree than earnings. Parents want their children to get higher education due to the fact that it opens opportunities for upward social mobility, or at least remaining the status. (Marginson 2016)

The challenge of facilitating access to higher education is essential as there is strong evidence of the value of post-secondary education. Experimental evidence suggests that an extra year of university translates into about a 9 percent salary increase, even for marginalized students. This wage return is on top of the potential for better health, happiness, and positive social side effects of better educated and more productive citizens. While a bachelor's degree seems to offer the biggest payoffs, two-year degrees (often in highly specialized fields) also provide significant benefits. Even those who go to college but drop out without a degree do better, on average, than those who never go to college. (Scott-Clayton, Sacerdote 2016)

In general, it can be concluded that increased access to higher education is the result, among other things, of an interaction between, on the side of the demand, the growing expectations of families (and countries) and, on the supply side, expanding economies and higher education institutions and a range of supportive public policies, including the financial provision to students. (UNESCO 2020)

1.3. Higher education funding

Each country uses its own higher education funding model with varying levels of success.

While some countries mainly use private sector funding (for example, the U.K., the U.S., Japan, the Netherlands), others use publicly funded higher education systems (for example, Germany, Poland, Latvia, Lithuania). The contribution of the public sector to the financing of higher education varies considerably from one country to another.

1.3.1 The shared funding method

Regarding taxpayer financing, there is a risk in it. Taxation works in financing a high-quality system when the system is small. Taxation also has its limits, such that under a mass system, higher education would lose the political battle to more urgent and politically relevant public spending priorities, including preschool and school education, health care, and pension spending. It is no coincidence that actual funding per student has fallen sharply over the years in many countries as the number of students increases. (Barr 2009)

Some say tax funding leads to low resources. When higher education was an elite single-digit system, it was not a problem to maintain the system's high quality without taxation. The expansion to the mass system was a great success. But growth has consequences. Actual student funding began to fall under Labor governments in the 1970s and continued to fall under subsequent Conservative governments, which fell by more than 40 percent between 1980 and 1997. It is no coincidence that American universities, with their mix of private and public funding, are the richest in the world - much more affluent than their publicly funded counterparts in Canada or universities in countries as wealthy as Sweden. (Barr 2003)

There are various arguments for and against subsidizing higher education through taxes. It has been argued that private incentives to study are relatively high. At the same time funding for these grants can be considered regressive as they are co-financed by relatively poorer non-students. As an alternative to why (higher) tax-financed subsidies are desirable, several arguments have been put forward, such as externalities and credit constraints. However, the economic theory argues that it is the marginal social return that policy should strive for that reflects considerations of equity and efficiency. Tax-financed subsidies are, in most cases, regressive in nature, but this depends on the point of view and the country. The discussion of efficiency arguments focuses on those that are most relevant in light of the empirical evidence and their applicability to different funding pathways: externalities, uninsurable risk, credit constraints, and misrepresentation. Grants - subsidies funded by taxes that are either universal or for poor but talented students and their families - can also help pay for higher education. (Diris, Ooghe 2018)

At first glance, it is paradoxical that tax funding damages access to higher education. However, tax funding not only damages access but is also redistributed to the richer. Higher education benefits society as a whole and should continue to be subsidized by taxpayers in this regard. In

addition, however, tax funding is deeply regressive. If it is unfair for graduates to pay most of the expenses, as proponents of tax funding argue, it is even more unfair to ask taxpayers who do not have a university degree to do so. The root of the problem is that people can choose whether or not to go to university, and there is a sharp socio-economic gradient in the application pattern. For example, the problem is less acute with school education being compulsory (although the issue of who goes to the best schools still exists). (Barr 2003)

It is incorrect to automatically ensure that higher education tax is a "fundamental right," nor is it wrong that it is a privilege that only graduates have to pay for. Instead, it is worth finding a find between funding taxpayers and funding students or graduates according to what will best improve the lifelong income prospects of the poorest members. Determining the best way to achieve this balance in terms of policy specificities is still a relatively challenging task. (Bou-Habib 2010)

The cost-sharing policy has three components: cost-sharing between the government and the beneficiaries, the provision of loans to cover tuition fees, and the grant needed to cover other education costs. (Nkrumah-Young, Powell 2011) The cost-sharing method is based on three different reasons. One of them is the increase in student spending and departments. Another reason is the significant increase in the number of students due to the increase in the student population in recent years. The last reason is the lack of public revenue in many countries. Governments support the financial sustainability of higher education. (Goksu, Goksu 2015)

In financing higher education, the trend is to introduce or expand the part-financed from tuition fees. While tax financing remains a significant pillar in most industrialized countries, fee financing is becoming increasingly important. In Germany, tuition fees have been allowed by the constitution since 2005. In the United Kingdom, maximum tuition fees have more than tripled in the last 12 years. (Demange et al. 2014)

1.3.2. The state funding method

Most industrialized countries traditionally subsidize the provision of higher education. Alternative funding systems based on more immense student contributions are increasingly being used. Income-based loans provide insurance against uncertain learning outcomes. (Del Rey, Racionero 2010)

There are two main reasons for using public money to fund higher education. The first is to promote equity by addressing the lack of capital markets to fund education. Second, the creation of positive externalities. However, it is unnecessary to optimally support every student with the same sentence. Above all, given the financial difficulties of governments and the potential alternative uses of funds, it is desirable to use public funds more efficiently. (de Carvalho Andrade 2010)

In a centrally planned economy, costs are managed by the state; however, in a competitive market, costs are the result of the interaction of supply and demand. A prerequisite for higher education institutions to set their own fees is that there should be no price controls in the higher education market. Price controls are a mechanism of monopolistic competition, which aims to prevent the abuse of power by one supplier. As industries move towards free-market competition, price regulation becomes less necessary and more effective. In a higher education environment, a lack of price controls should lead to variable fees and encourage competition, as well as lead to unrestricted funding of the institution and increased efficiency through competition. (Nkrumah-Young, Powell 2011)

In most systems, governments regulate enrollment numbers, sometimes in both the private and public sectors. The size of the system is usually determined by policy, funding, and regulation. However, governments seem to play the most prominent role in the initial growth of mass higher education, construction sites, education financing, and the cost of living in generating public demand. Often higher education becomes a protective necessity, as not all graduates find professional jobs. The social demand for higher education ceases to be created by the state as soon as the population begins to realize its importance. Also, in countries with paid tuition, middle-class families are more likely to be more willing to pay for tuition, as they cannot afford to miss education. (Marginson 2016)

The "preconditions" for total public funding for higher education are similar to those in a totalitarian state in that central control is needed to address justice and lack of resources. State control is designed to ensure that, in the absence of markets to regulate supply and demand for civil defense, the state balances. State control, therefore, means state planning and management of universities. In the era of free education, there is no evidence of detailed government planning. Decisions on admissions and programs, their development and implementation were made by the university without a direct connection to employment planning and forecasts. Access depended

only on the university's abilities and requirements for access to the university, not on state dictation. The need for staff was determined by the university administration. The data from the previous studies show that the lack of state control over the production and planning of higher education has led to inconsistencies and thus the inability of infrastructure to keep pace with demand and redirect resources from the primary and secondary sectors to higher education. (Nkrumah-Young, Powell 2011)

The direct (upfront) costs of higher education vary considerably, as in many countries' government subsidies keep tuition fees low, while others require significant private contributions. The direct costs are relatively small compared to the alternative costs, which largely reflect the standard of living in the countries. Thus, countries with low direct expenditures, such as Austria, Germany, and Norway, still have relatively high total private costs, while countries with higher tuition fees, such as, for example Chile, have relatively low total costs. (Diris, Ooghe 2018)

1.3.3. The private funding method

The market responsibility model sees the citizen as a consumer, and public sector institutions should be judged on the quality of their services rather than closely monitoring how they use resources. At universities, where students have to pay fees, they turn to institutions with poor services less. Consumer choice is essential to ensure quality and efficiency in a market situation. Students should be free to choose a school based on their skills and matriculation requirements. (Nkrumah-Young, Powell 2011)

If students' educational aspirations depend on the perceived costs and benefits of different learning pathways, increasing the lifetime costs of higher education for the average graduate may reduce the desire of teenagers to pursue higher education. For example, fees have remained lower in some parts of the UK, but the new funding system has significantly reduced the risks associated with poor postgraduate labor market outcomes, which could lead to more university applicants. (Hassani-Nezhad et al. 2010)

1.3.4. The effective higher education meets labor market needs

There is currently a strong supply and demand for creative graduates, and indeed, higher education has shown a significant impact on the development of specific sustainable skills that contribute to the development of creative industries. The education system in Europe appears to be significantly

more specialized compared to more general educational programs, the first providing the preparation of highly technical skills to solve specific problems, and the second implying greater adaptability to changes in the economic situation. It has been found that new employees integrate into the respective jobs at different speeds depending on their education/training. This demonstrates that educational programs in developed European countries can primarly meet labor market needs, consistent with previous studies that have emphasized the important role of higher education in forming skills for sustainable development in the prevailing development environment of a knowledge-based economy. (Yue, Zhao 2020)

1.4. Example-countries with free higher education

This chapter aims to give an overview of the chosen six countries with free higher education. The countries are Germany, Iceland, Poland, Lithuania, Latvia, and Slovenia. Each subchapter gives an overview of a country's higher education system and its financing methods.

1.4.1. Higher education in Germany

In German education, the principle of federalism has far-reaching implications: for example, the 16 Länder have sole control over general education systems, including responsibility for education funding. (Ertl 2005)

Public support for higher education in Germany has remained relatively stable over the past two decades. Neither the financial crisis, nor alternative political priorities, nor speculation about the benefits of privatization calls into question the high level of public finances. (Teichler 2016) Already after the end of the Second World War, German higher education was characterized by the increasing financial dependence of educational institutions on direct and indirect state funding. It wasn't until the early 1970s that universities lowered tuition fees in response to student protests and far-reaching reforms in the relationship between universities, the private sector, and the public. In 2002, the majority federal government passed the Law on the Higher Education System, which abolished tuition fees in Germany. There seems to be a widespread belief that the introduction of tuition fees should not prevent young people from poorer backgrounds from acquiring higher education. (Ertl 2005)

1.4.2. Higher education in Iceland

Iceland's recovery in GDP growth over the past decades has created an opportunity for the government to increase funding for higher education significantly. The reform was promoted on the basis of increased public investment. (Neave et al. 2008) Iceland spends 0.8% of its GDP on education, above the OECD average. The higher education sector consists of seven universities (four public and three private) and serves a total of 18000 students. Reflecting the post-crisis pressure on education, higher education spending and enrollment has skyrocketed. As in most Scandinavian countries, higher education is funded almost entirely by public funds, with tuition fees providing little additional funding. The business sector also makes a small contribution to research and development, making Iceland's higher education one of the most government-dependent of any OECD country. (OECD 2019)

1.4.3. Higher education in Poland

State support in Poland for public higher education consists of four components: funding for teaching activities, funding for student financial support, funding for research, and funding for targeted grants. In 2002, public spending on higher education was 1.1% of GDP, ranking 18th out of 28 OECD countries for which data are available. That same year, total spending on tertiary education was 1.5% of GDP, a significant increase from 0.8% of GDP in 1995, ranking it 7th among the same 28 OECD countries. Between 1995 and 2002, public spending on higher education increased by 66% in real terms (5th among 24 countries for which data are available). In addition, a significant increase of 97% (the highest in OECD countries) indicates that students have better access to free Polish higher education. In 2002, 96.4% of public spending on higher education was allocated to educational institutions in the form of direct grants (3rd in the OECD area). (Fulton et al. 2007)

1.4.4. Higher education in Lithuania

According to a national study conducted by Spinter in 2006-2007, financing education in Lithuanian universities is vital for the education of the younger generation. More than 10% of the respondents (eg, orphans) received financial support from the government and other government agencies. The development of the public sector in the field of higher education is only part of the state policy in the field of higher education. (Grudney, Sarvutite, 2010)

The government has announced that it will increase spending on education. In 2019, total public expenditure on education as a percentage of GDP was close to the EU average (4.6% vs. 4.7% in the EU) and exceeded the EU average for total general public expenditure (13.3% vs 10% in EU). The government plans to increase investment in education to meet national education challenges over the next decade. According to the National Education Policy Agreement, funding per student will be at least 36% of GDP per capita in 2030, which will increase to 11% per capita comparing to 2017. (European Commission, 2021)

1.4.5. Higher education in Latvia

Latvia invests heavily in education, but maintaining an extensive and inefficient school network strongly impacts resource allocation. In 2019, public expenditure on education as a share of GDP remained well above the EU average (5.8% compared to the EU average of 4.7%), and as a share of total public expenditure (15% versus the EU average of 10%). The percentage of public expenditure on tertiary education is the smallest compared to primary and secondary education, in line with the EU average of 16%. Expenditure per student, expressed in terms of purchasing power standards, is relatively high relative to GDP per capita in Latvia but remains below the EU average at all education levels, reflecting low teacher salaries. Latvia's National Recovery and Resilience Plan (NRRP) provides investment in digital skills, school infrastructure, and higher education reform. (European Commission, 2021)

The current system is primarily focused on paying for "budget seats," a form of industrial policy in higher education in which the state subsidizes certain occupations. The funding of science is mainly independent of any performance indicator and, according to the old tradition, is carried out by the "scientific institutes" of universities. (Dombrovsky, 2009)

1.4.6. Higher education in Slovenia

In Slovenia, funding for academic activities is allocated from the state budget in the form of total funds (holistic financing) for a university or an independent higher education institution. It takes into account the field of study and the number of registered students and regular university graduates. (Aristovnik, Obadic 2011)

Investment in education and training is above the EU average and growing, but spending per student is falling. The education budget for 2021 increased by 9.2% compared to 2020. Education

spending in 2019 was higher than the EU average (10% and 4.7%, respectively) both as a percentage of GDP (5.5%) and as a percentage of total government spending (12.6%). (European Commission, 2021)

1.5. Example-countries with not-free higher education

This chapter aims to give an overview of the five chosen countries with not-free higher education. The countries are Canada, the United Kingdom, the USA, Japan, and the Netherlands. Each subchapter gives an overview of a single country's higher education system and its financing methods.

1.5.1. Higher education in Canada

Socioeconomic equity of access to higher education in Canada is primarily determined by provincial policy, as each province regulates the cost of tuition fees. As for international students, they do not currently receive government funding in Canada. Their fees are essentially unregulated market prices. All market risks belong to institutions. (W. Lang, 2021)

1.5.2. Higher education in the United Kingdom

Since 1997, students in the UK have been required to pay tuition fees. It was initially set at £1,000 and by 2003 was set at £1,100. Thus, in 2000, 42% of university students in England did not contribute at all, and 19% contributed partially. While universities are collection agency, fees are counted in place of government funding and do not represent additional income. In addition, universities are not allowed to differentiate fees between individual courses or classes. (Greenaway, Haynes, 2003)

Since September 2006, variable tuition fees have been charged to all full-time students at universities in England, Wales, and Northern Ireland, except for students from outside the European Union. The fee was originally capped at £3,000 per annum, but in 2009 this cap was increased to £3,225 in line with annual inflation. Universities may charge up to this amount, but only in full if they have an approved access agreement with the Office of Fair Access (OFFA). In practice, the vast majority of universities charge full fees (with the exception of Leeds Metropolitan University and the University of Greenwich). For students, this "additional" fee

represented a significant increase in the cost of higher education from the £1,125 annual flat fee in place since September 1998. (Miller, 2010)

1.5.3. Higher education in the USA

In 2003–2004, the published average tuition and fees for U.S. public four-year institutions hovered around $6,000, while the net average tuition and fees were only about $1,900. Fast forward to 2013-2014, tuition and fees at these institutions have risen to nearly $8,900, with the net average tuition and fees of just over $3,100. This indicates that published and net average tuition and fees have increased by approximately 35% and 38%, respectively. Although in the period 2009-2010 there was a slight decline, and the overall trend followed a continuous upward trend. (Serna, 2018)

1.5.4. Higher education in Japan

The price of higher education in Japan is indeed not low. According to the 2017 regulation of the Ministry of Education, Culture, Sports, Science, and Technology (MEXT), the standard national university admission fee is 282,000 yen (2062,71 euro according to the exchange rate of 16.04.2022), and the annual tuition fee is 535,800 yen (3919,15 euro). In total, this means that students pay 817,800 yen (5981,86 euro) for their first year at national universities and 2,425,200 yen (17739,31 euro) for four years of study. In terms of private universities, MEXT reported that incoming first-year students in 2016 paid an average of 1,316,816 yen (9631,95 euro) (including accommodation fees). In addition, students must pay for travel expenses, the purchase of study materials, and, in some cases, housing. In addition, when entering a university, it is often required to pay for preparation courses for entrance exams. In general, the cost of university education is placing an increasing burden on family finances. Although university fees in Japan are lower than those in the US, UK, Australia or Canada, the fact that Japanese students and families pay more than 60% of university income, compared to the OECD average of only 30% from private sources, shows that Japanese households bear a relatively large share of the cost of higher education. (Tanaka, 2019)

1.5.5. Higher education in the Netherlands

Since 1986, all Dutch students have been entitled to a basic allowance to cover tuition fees and basic living expenses. Initially, this was independent of the student's performance, but since 1993 it has become a conditional gift that is returned if the student does not complete enough credits each academic year. Since the 2015/2016 academic year, the basic grant has been replaced by a

"social loan", which must be repaid at an interest rate completely below the market rate. (Allen, Belfi, 2020)

1.6. Summarizing the previous studies

For example, Montenegro and Patrinos, in their comparative estimates of global returns to education, currently use the traditional method of estimating private sector income per school year, which consists of estimating logarithmic income equations. The main service functions were applied to three different groups: (i) the general sample, (ii) men, and (iii) women. The average profitability of one more academic year appears to be 10 percent of the total sample. If only men are considered, the cost-benefit ratio for the extra school year is 9.6 percent, while for women, it is much higher at 11.7 percent. These estimates are based on 819 observations from 139 countries between 1970 and 2013 in this study. These results are similar to those of many other literature reviews. The fact that women have a higher level of education than men is confirmed for all three levels of education, and not just when considering returning for the next school year. When considering the return to education, using only the latest estimates and the pooled sample available for each country, five countries with the lowest incomes can be identified: Afghanistan, Armenia, the Russian Federation, Guyana, and Iraq. Five largest economies are Rwanda, South Africa, Ethiopia, Namibia, and Burundi. It is interesting to note that all five of the highest-paid workers are from Africa. (Montenegro, Patrinos 2014)

The results of this previous study by Montenegro and Patrinos (2014) show that:

1) The returns to education are more focused on their respective means than previously thought.
2) The return of education are higher for women than for men.
3) Return to learning and experience are closely and positively linked.
4) Returns from tertiary education are the highest and those from secondary education the lowest. (Montenegro, Patrinos 2014)

This bachelor's thesis' analysis presented in the second and third parts is based on the previous studies of R.Tóth 2009. In that article, the author presents the DEA method and uses it to compare the performance of higher education systems. The author also examines whether their effectiveness is influenced by the degree of public and private sector involvement or by socio-economic factors such as GDP per capita and adult education level. In that study, the author uses

one input and two output variables to compare European higher education systems. The input variable is the ratio of spending on higher education to GDP, and the output variables are the ratio of the number of people with a diploma to the total population and employment rate. All data is for 2006. The survey results observe that Belgium, Denmark, Iceland, Italy, Slovakia, and Spain are the best countries for a standardized approach and their efficiency score equals 1,000. Greece, Poland, and Turkey are at the other end of the line, and their efficiency scores equal 0,905, 0,908, and 0,865 respectively. Turkey is the only country with an efficiency score of less than 0.9, only 13% of the population has a tertiary education, and the employment rate is almost 10% below the European average. The level of education of parents is not statistically significant, probably because European countries actively seek to control and maintain a high level of fairness in school education. An important finding is that in two-thirds of the best-performing higher education systems, changes in GDP per capita are larger than the shift in the PTT. The author concludes that increasing private investment in higher education spending (for example, through tuition fees) is a more effective way to increase efficiency in poorer countries than in richer ones. (Tóth 2009)

The study aimed of Obadić and Aristovnik from 2011 to measure the relative performance of higher education in selected OECD and EU countries, particularly Croatia (as an EU candidate country) and Slovenia, using data coverage analysis (DEA) within the VRS. The results of the study point to significant inefficiencies in spending on tertiary education in Croatia and thus significant potential to reduce public spending and/or increase higher education outcomes/outcomes. On the contrary, regardless of the input-output/output combination, the Slovenian higher education system is much higher than in Croatia, as well as many other comparable EU and OECD countries. The results also show that some developed countries (eg Canada, USA) can serve as a benchmark for efficient use of higher education resources. (Obadić, Aristovnik 2011)

First, the significant inefficiencies found may simply be a reflection of environmental factors (climate, socio-economic status). Second, the precise definition of inputs, outputs, and results can have a significant impact on results. Finally, it is important to keep in mind that when a non-parametric approach is used and DEA has a well-established and valid methodology, differences between countries are not statistically evaluated and this can be considered an additional limitation. from such an approach. methodology. (Obadić, Aristovnik 2011)

2. DATA AND METHODOLOGY

This chapter aims to introduce the data used and the methodology applied. The data is collected from two databases: the Organisation for Economic Co-operation and Development (OECD) Database and the World Bank Database. The dataset will be described in the first subchapter, followed by the introduction of the DEA analysis. The methodology and software program used for the empirical analysis will be discussed in the second subchapter.

2.1. Methodology

Firstly, the author provides the data and then applies the Data Envelopment Analysis (DEA) to six countries with mostly free higher education and five countries with mostly paid higher education. Countries representing free higher education are Germany, Slovenia, Iceland, Poland, Latvia, and Lithuania; countries providing mostly paid higher education to all students are Canada, the USA, the UK, Japan, and the Netherlands. The reasons for choosing these countries are provided in the Introduction part of the paper. All the used data covers the year 2019, selected by the presence of the most recent data available. The provided data covers six topics connected to one another taken as an example from the research of R. Tóth (2009) "Using DEA to evaluate the efficiency of higher education". The model of the DEA analysis held in this bachelor's thesis is output-oriented model, which allows to maximize the outputs while having the same inputs. In an output-oriented model, an inefficient unit becomes efficient by proportionally increasing output while the input ratio remains unchanged (Deazone 2022).

The topcics are:

a) Ratio of expenditure spent on higher education to GDP
b) Ratio of people with diploma to total population
c) Employment rate of people with diploma
d) GDP per capita in current US$ (PPP – gross domestic product converted into international dollars at purchasing power parity) (Databank 2011)
e) Adult education level

f) Private to total expenditure ratio

Data Envelopment Analysis (DEA) is a very effective method for evaluating the relative performance of decision-makers. DEA has received intense attention in theory and practice since it was proposed in 1978. Now DEA can be used in management science, operations research, systems engineering, decision analysis, etc. It is becoming a vital analysis tool and research method in fields. (Wen, Li 2008)

Data Envelopment Analysis (DEA) is a methodology used to evaluate the entities' effectiveness (e.g., programs, organizations, etc.) responsible for using resources to produce relevant results. It is usually used to assess various activities such as public schools, hospital surgical departments, and property maintenance. DEA is a fractional programming model that includes multiple outputs and inputs without recourse to prior weights and without requiring explicit functional relationships between inputs and outputs. It calculates a scalar performance measure and determines effective cost and benefit levels for the evaluated organizations. (Bowlin 2011)

Higher education expenditure is defined as the overall expenditure on higher education that includes the private costs of schools, universities, and other private institutions that provide or support educational services. Higher education institutions in OECD countries are mostly publicly funded, although there is a significant and increasing level of private funding. At this level, the contribution of individuals and other private organizations to educational expenditures is increasingly seen as an effective way of funding students regardless of their economic status. For on-the-job training of trainees and students, the costs of private companies and educational institutions' research and development costs are also taken into account. (OECD 2018)

Allocation efficiency can be interpreted at the societal level, while production efficiency refers to the performance of a firm or organization. Organizations, including universities, can increase the efficiency of their production by increasing output at a fixed cost and getting the same output at a lower cost. To determine the efficiency of production, the well-known formula is often used: Efficiency = output / costs. (Tóth 2009)

It should be kept in mind that the integration of resources into the educational process is not always the same. If they are used at the same level, a Constant Return to Scale (CRS) must be calculated,

so it is preferable to use a Variable Return to Scale (VRS). The output-oriented VRS (Variable Return to Scale) DEA indices are obtained by solving the following linear programming equations:

$$\max \Phi_k + \varepsilon \sum_{r=1}^{s} s_r + \varepsilon \sum_{i=1}^{m} s_i$$

supposing that

$$\Phi_k y_{rk} - \sum_{j=1}^{n} y_{rj}\lambda_j + s_r = 0 \qquad r = 1 \dots s$$

$$x_{jk} - \sum_{r=1}^{n} x_{ij}\lambda_j - s_i = 0\,, \qquad i = 1 \dots m$$

$$\sum_{j=1}^{n} \lambda_j = 1,$$

$$\lambda_j, s_r, s_i \geq 0, j = 1 \dots n$$

„In this system of equations *s* means the number of inputs, *m* the number of outputs. y_{rk} is the sum of *r* outputs of the *k* production unit, x_{ik} is the sum of its *i* inputs. s_r and s_i stands for the weight of outputs and inputs. The *k* unit is considered efficient, if its efficiency score, Φ_k is equal to 1“. (Tóth 2009)

According to Farrell's definition of the (inverse) measure of productivity, each type of output increases by the same factor Φ_i until a limit is reached. DMUs with positive λ_j are also equal. These DMUs must be boundary units, and the line combinations define a boundary point, which is the point of comparison with the DMUs under study. In the case of zero clearance at the output limits, the comparison point exists for the DMUs as a radial extension of the observation. In the case of slack, the breakpoint will coincide with one of the precedents. The general assumption underlying the comparison of different units of production is that the inputs and outputs are indeed comparable, that is, they are homogeneous. (Førsund 2001)

In this thesis, the author is using the next variables as inputs for the analysis based on the the previous studies of R. Tóth (2009):

a) Ratio of expenditure spent on higher education to GDP
b) GDP per capita in current US$ (PPP)

c) Private to total expediture ratio

The variables as outputs:

a) Ratio of people with diploma to total population
b) Adult education level
c) Employment rate of people with diploma

Not all the variables in this thesis ae the same as in the previous study due to the lack of data. In replacement of Parental educational attainment (PEA) and Public-to-total expenditure ratio (PTT) (Tóth 2009) the author has taken Adult education level and Private to total expenditure ratio, accordingly.

2.2. Variables

This chapter aims to overview the variables chosen for the analysis. The data is provided in tables for eleven countries: six – with free higher education and five – providing not-free higher education.

2.2.1. Ratio of expenditure spent on higher education to GDP (input)

Education spending includes schools, universities and other public, and private educational institutions. Costs include tuition and support services for students and their families provided through educational institutions. Expenditures are shown in US dollars per student and as a percentage of GDP (PPP). (OECD 2019)

Table 1. Ratio of expenditure spent on tertiary education to GDP (% of GDP, 2019)

LOCATION	VALUE
Germany	1.28831
Iceland	1.25556
Poland	1.256274
Latvia	1.351366
Slovenia	1.056218
Lithuania	1.080541
Canada	2.182295

UK	2.014494
USA	2.486106
Japan	1.38074
Netherlands	1.676317

Source: OECD 2022, author's calculations

Table 1 shows the difference in the ratio of spending on higher education to GDP in each country chosen for the DEA analysis. Countries shaded grey are the ones providing free higher education, and all the others offer not-free tertiary education to students. The data provided shows that in general countries with paid higher education (Canada, UK, USA, Netherlands) have bigger expenditure spent on higher education. For example, the government that spent the most expenditure on tertiary education in 2019 among free HE countries is Latvia, and its number says 1.351366% of GDP. The country that spent the most expenditure on HE among paid higher education countries is the USA, with 2.486106% of GDP, the percentage is almost two times bigger than in Latvia.

2.2.2. GDP per capita in current US$

Gross domestic product (GDP) is a standard measure of the value-added generated by the production of goods and services in a country over a given period. Thus, it also measures the income from production or the total amount spent on final goods and services (minus imports). While GDP is the single most crucial indicator of economic activity, it does not provide an adequate measure of people's material well-being. Alternative measures might be more appropriate. This indicator is based on nominal GDP (also called GDP at current prices or GDP in value terms). It is available in different units of measurement: US dollars and US dollars per capita (current PPP). All OECD countries compile their data according to the 2008 System of National Accounts (SNA). This indicator is less suitable for comparison over time since changes are associated not only with actual growth but also with changes in prices and PPPs. (OECD 2019)

Table 2. GDP per capita in current US$ (2019)

LOCATION	VALUE
Germany	55652.87782
Iceland	58284.11604
Poland	33427.50343
Latvia	31893.84669

Slovenia	40658.63174
Lithuania	38491.44494
Canada	49286.8116
UK	49070.33313
USA	65055.78537
Japan	42438.75595
Netherlands	59003.86477

Source: OECD 2022, author's calculations

Table 2 shows the difference in GDP per capita in chosen countries, and it is visible that it does not have a solid connection to the higher education funding system in the same countries. The highest in the list GDP per capita is seen in Iceland (58284.11604 US$/capita) among countries providing free higher education, and the USA (65055.78537 US$/capita) – countries providing higher education with tuition fees.

2.2.3. Private to total expenditure ratio

Private spending on education refers to spending financed from private sources such as households and others. This indicator is here expressed as a percentage of GDP on tertiary level. Private spending on education includes all direct expenditure on educational institutions and net government subsidies and excludes expenditures outside educational institutions such as textbooks purchased by families, tutoring, and student living expenses. Private expenditure includes spending on schools, universities, and other public and private organizations that provide or support educational services. (OECD 2019)

Table 3. Private to total expenditure ratio (% of GDP, 2019)

LOCATION	VALUE
Germany	0.21738
Iceland	0.0963099
Poland	0.2321274
Latvia	0.4607738
Slovenia	0.1187086
Lithuania	0.2983143
Canada	1.010782
UK	1.462201
USA	1.599036

Japan	0.9302161
Netherlands	0.4751267

Source: OECD 2022, author's calculations

Table 3 refers to the ratio of private expenditure to total. The numbers clearly show that countries providing not-free higher education have bigger private expenditure ratio due to students paying tuition fees and not recieving free higher education provided by the country's government. For example, the most significant number from the list is seen in the USA, and it was 1.462201% of GDP in 2019. The country with the lowest private to total expenditure ratio on the list in 2019 was Iceland (only 0.0963099% of GDP).

2.2.4. Ratio of people with diploma to total population

It is generally accepted that the population with higher education received higher education by age group. This includes both academic programs that lead to high-quality research, as well as highly skilled professions such as medicine and more professional programs that enter the labor market. The measure is the percentage of the same age population, which is also available by sex. As globalization and technology continue to reshape the needs of global labor markets, there is a growing demand for people with a broader knowledge base and more specific skills. (OECD 2019)

Table 4. Ratio of people with diploma to total population, 25-34 year-olds (% in the same age group, 2019)

LOCATION	VALUE
Germany	33.260235
Iceland	42.176826
Poland	43.484364
Latvia	43.811146
Slovenia	44.105736
Lithuania	55.187374
Canada	62.965115
UK	51.809521
USA	50.380188
Japan	61.514194
Netherlands	49.103264

Source: OECD 2022, author's calculations

Table 4 refers to the ratio of people with diplomas to the total population. Generally, the data provided for the chosen countries shows that countries where students study for free have smaller numbers of people with diploma to the total population. Countries showing the most considerable numbers in this variable are Canada (62.965115%) and Japan (61.514194%), the country showing the smallest number is Germany (33.260235%), even though the German government fully funds the higher education both for local and international students.

2.2.5. Adult education level

This indicator shows the level of adult education, defined as the highest level of education for the population aged 25-64. There are three levels: below upper-secondary, upper secondary, and tertiary education. Upper secondary education usually follows the acquisition of primary education. Lower secondary education usually completes basic education with more subject-oriented and professional teachers. The indicator is measured as a percentage of the population of the same age. (OECD 2019)

Table 5. Adult education level (% of 25-64 year-olds, 2019)

LOCATION	VALUE
Germany	29.900126
Iceland	40.948925
Poland	32.014767
Latvia	35.707733
Slovenia	33.283279
Lithuania	43.149418
Canada	59.374844
UK	47.189125
USA	48.340187
Japan	52.67799
Netherlands	40.385136

Source: OECD 2022, author's calculations

Table 5 refers to the adult education level among the total population in a particular country. Here it is visible that the numbers are pretty chaotic, yet clearly, the difference between free and paid

higher education countries is seen. For example, the most extensive adult education level is present in Canada (59.374844%) – country providing not-free higher education. The smallest number can be seen in Germany (29.900126%) – country where students recieve free higher education.

2.2.6. Employment rate of people with diploma

This indicator shows the employment level of people depending on their education level: below secondary education, incomplete or above secondary education. The employment rate refers to the number of people employed as a percentage of the working-age population. Employees are those who work for at least one hour a week for wages or profit or who have a job but are temporarily unemployed due to illness, leave or strike. This indicator measures the share of those aged 25-64 who are employed among all 25-64 –year-olds. (OECD 2019)

Table 6. Employment rate of people with diploma (% of 25-64 year-olds, 2019)

LOCATION	VALUE
Germany	89.345268
Iceland	90.382393
Poland	88.984108
Latvia	89.259491
Slovenia	90.312386
Lithuania	91.255867
Canada	83.111526
UK	86.628654
USA	82.679253
Japan	86.019836
Netherlands	89.671005

Source: OECD 2022, author's calculations

Table 6 shows the employment rate of people with tertiary education diplomas. Numbers here are pretty similar in both country groups. However, the most enormous number represents the country providing free higher education – Lithuania (91.255867%).

3. DEA ANALYSIS AND RESULTS

The third chapter of the thesis aims to give an oreview of the DEA analysis and its results.

The main goal of the DEA is to determine that organizational units (DMUs: Decision Making Units) with multiple inputs and outputs are performing efficiently. Because when considering only one input variable and one output variable, only partial performance indices can be calculated, and this can be misleading. DEA, like production efficiency, can be interpreted in terms of both costs and results. The output-oriented approach focuses on how high the maximum result can be achieved with the same amount of resources. Some researchers argue that an output-oriented approach is appropriate for higher education because the principle of cost minimization is not applied according to market conditions. (Tóth 2009)

Organizations, including higher education institutions and higher education systems in general, can increase the efficiency of their production by increasing their output at a fixed inputs level or by achieving the same output at a reduction in inputs. The well-known formula is often used to determine production efficiency: Efficiency = output / costs. (Tóth 2009)

3.1. Carrying out the analysis

All the data were taken from OECD and The World Bank Database for 2019. The DEA analysis was performed in Excel. The author used the Microsoft Excel Add-in Solver to perform the DEA analysis. First, the author listed down all the DMUs and added weights to them. The weight of each country was equal to 1, which can also be found in Appendix 1. The author then placed the efficiency indicator in a random cell that was also equal to 1, which the author then placed in the „Set Objective“ and „By Changing Variable Cells“ box. Then the MAX was chosen. In the „Subject to Constraints“, the author placed data from the LHS and RHS columns. LHS refers to left-hand side of an eqaution, and so RHS is the right-side of an equation. Both sides express the same meaning differently because equality is symmetrical. All inputs in the LHS column were ≤ less than or equal to the inputs in the RHS column. Both the inputs and outputs in the LHS column

were found by the author using the SUMPRODUCT function. The author found the input data in the right column by using the INDEX function with the numbers of the varibles and the serial number of the country (DMU). The formula for outputs in the RHS remained the same as for the inputs in RHS, adding the multiplying by the Efficiency score. The output in the left column was ≥ greater than or equal to the output in the right column. Lambda (sum of weights) was equal to one. Therefore, the author chose the Simplex LP method and pressed Solve.

In this bachelor's thesis, the author uses three input and three output variables to compare higher education systems in countries in the European Union and beyond. OECD database was used as the data source.

The LHS-RHS model was created in Excel using the DEA analysis via Solver. The model is output-oriented, which means that it aims to maximize the outcomes. The inputs used in the analysis are:

- Ratio of the expenditure spent on higher education to GDP
- GDP per capita in current US$ (PPP)
- Private to total expenditure ratio

The outputs are:

- Ratio of people with diploma to total population
- Adult education level
- Employment rate of people with diploma

DEA model variables are presented in Table 7, values are for 2019.

Table 7. Variables of the output-oriented DEA model

Countries	**INPUTS**			**OUPUTS**		
	Ratio of the expenditure spent on higher education to GDP	**GDP per capita**	**Private to total expenditure ratio**	**Ratio of people with diploma to total population**	**Adult education level**	**Employment rate of people with diploma**
Germany	1.28831	55652.88	0.21738	33.26024	29.90013	89.34527
Iceland	1.25556	58284.12	0.09631	42.17683	40.94893	90.38239

Poland	1.256274	33427.5	0.232127	43.48436	32.01477	88.98411
Latvia	1.351366	31893.85	0.460774	43.81115	35.70773	89.25949
Slovenia	1.056218	40658.63	0.118709	44.10574	33.28328	90.31239
Lithuania	1.080541	38491.44	0.298314	55.18737	43.14942	91.25587
Canada	2.182295	49286.81	1.010782	62.96512	59.37484	83.11153
United Kingdom	2.014494	49070.33	1.462201	51.80952	47.18913	86.62865
The USA	2.486106	65055.79	1.599036	50.38019	48.34019	82.67925
Japan	1.38074	42438.76	0.930216	61.51419	52.67799	86.01984
Netherlands	1.676317	59003.86	0.475127	49.10326	40.38514	89.67101

Source: OECD (2022)

This model shows which variable has a significant impact on the performance of higher education systems. In the case of significant variables, the sensitivity analysis provides the minimum amount of change in the values of the variables required for DMU reclassification. The absolute value of this sensitivity score does not provide us with useful information. (Tóth 2009) It is more important to compare the performance of each country, because which group of countries the author wants to respond to (free HE: Germany, Iceland, Poland, Latvia, Slovenia, Lithuania or not-free HE: Canada, UK, USA, Japan, Netherlands) is more sensitive to changes in environmental factors.

Table 8. Results for higher education effiency

Countries	**OUTPUT-ORIENTED DEA**		
	Efficiency score	**Rank**	**Peers**
Germany	0.982832	8	Iceland (0.400656), Lithuania (0.599344)
Iceland	1	1	Slovenia (5.77E-15), Lithuania (1.53E-16)
Poland	1	1	Latvia (1.67E-16), Lithuania (1.11E-16)
Latvia	1	1	Lithuania (1.8E-16), Japan (3.33E-16)
Slovenia	1	1	Iceland (2.78E-16), Lithuania (8.33E-17)

Lithuania	1	1	Lithuania (1)
Canada	1	1	Lithuania (3.05E-16), Japan (4.33E-15)
United Kingdom	0.976978	10	Lithuania (0.682493), Netherlands (0.317507)
The USA	0.947118	11	Lithuania (0.513738), Canada (0.486262)
Japan	1	1	Lithuania (2.22E-16), Canada (1.67E-16)
Netherlands	0.982633	9	Lithuania (1)

Source: the author's analysis

In Table 8, the author presents the results of the evaluation of the effectiveness of the DEA and standard scales of variable incomes of comparable countries for each observed country. It is easy to see from Table 8 that European countries with with free HE lead the standard approach with the efficiency score equal to 1 (Iceland, Poland, Latvia, Slovenia, Lithuania). Canada (efficiency score = 1) and Japan (efficiency score = 1), being non-European countries and representing paid HE, are also on the highest positions of the list. Germany (0.982832), Netherlands (0.982633), The UK (0.976978), and the USA (0.947118) are at the other end of the rankings. Lithuania is showing the best efficiency score and also is appearing in the „Peers" graph of each country.

3.2. Findings

The DEA analysis was performed in Excel. In the course of the analysis, the author found that all countries except Germany, Netherlands, The UK, and the USA, are efficient, meaning that their higher education systems are efficient. Germany represents the free HE system, while Netherlands, The UK, and the USA offers students to pay fees for studying. What all these countries have in common, is relatively low employment rate of people with diploma (lower than 0,9), if comparing to other countries in the list. However, looking at the list of analogue countries in Table 8, it can be seen that there is one country that often exists in this list - Lithuania (11 times). This may indicate that this country is the most efficient and has the most profitable education system. The results of the analysis showed that the main hypothesis of the work was not confirmed. Based on this results, the author can conclude that the free higher education system is more efficient than

the paid higher education system, as HE is efficinect in 83% of countries with free system, and only in in 40% of countries with paid system.

CONCLUSION

Higher education is designed to generate and disseminate knowledge as well as cognitive and communication skills, such as young people's ability to think logically and develop complex values. Higher education can be defined as education or training at a college or university. A wider definition could be: higher (tertiary) education is the optional final stage of formal education that takes place after upper secondary education. (Goksu, Goksu 2015)

Despite the fact that there are significant differences between regions; overall, access to higher education worldwide nearly doubled between 2000 and 2018, from 19% to 38%. Some of these trends were in line with changes in the gender distribution of beneficiaries. Women were the main beneficiaries of the increase in the number of people with higher education, which increased from 19% to 41%, and among men from 19% to 36%. (UNESCO, 2020)

Higher education can be considered as one of the most important factors of modern life, both at the individual and national levels, contributing to the economic and social development of the country. A knowledge-based society creates conditions for effective decision-making and creates conditions for overcoming difficult situations in an ever-changing world. Highly educated people are the driving force of the state, so it is important to develop a cost-effective and socially fair model for financing the higher education system. (Vikat 2014) There are several types of funding for higher education: cost-shared funding, government funding (i.e. free higher education), funding from private sources (fee-based higher education), grants, vouchers. Many believe that the most effective way to fund higher education is to focus on three factors: partial tuition fees differ between disciplines and universities, the introduction of income-based student loans, and the implementation of various measures to increase participation in higher education (Vikat 2014).

Currently, higher education has had a significant impact on the development of specific sustainable skills that contribute to the development of creative industries. The education system in Europe appears to be much more specialized than more general educational programs. Also, new employees are integrated into their respective jobs at different rates depending on their

education/training. This shows that educational programs in developed European countries can primarily meet the needs of the labor market, which is consistent with previous studies that have emphasized the important role of higher education in building skills for sustainable development in the prevailing conditions of knowledge-based economy development. (Yue, Zhao 2020)

The purpose of this bachelor's thesis was to establish criteria for the effectiveness of higher education and decide which is more effective: free higher education system or not-free higher education system.

In this this work, the author used the data from OECD and The World Bank Databases for 2019. To explore effectiveness, the author chose inputs and outputs based on previous scientific literature to perform a Data Envelopment Analysis. The inputs used in the analysis were: the ratio of the expenditure spent on higher education to GDP (%); GDP per capita (in current US$ (PPP)); private to total expenditure ratio (%). The outputs were: the ratio of people with diploma to total population (% of 25-34 year-olds); adult education level (% of 25-64 year-olds); employment rate of people with diploma (% of 25-64 year-olds). The thesis and the analysis were conducted on the basis of data from 11 OECD countries (free HE: Germany, Iceland, Poland, Latvia, Slovenia, Lithuania; paid HE: Canada, the United Kingdom, the United States of America, Japan, the Netherlands). The author also hypothesized in given research: a paid higher education system is more efficient than a free higher education system.

The results of the analysis showed that the main hypothesis of the study was not confirmed. The country providing the most efficient higher education system, according to the analysis, is Lithuania (efficiency score = 1). Based on these results, the author can conclude that the free higher education system is more efficient than the paid higher education system, as the higher education system is effective in 83% of the countries with a free higher education system and only 40% of the countries with a paid higher education appear to have an efficient system.

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APPENDICES

Appendix 1. List of countries in DEA analysis

	Country					
Free higher education system	Germany	Iceland	Poland	Latvia	Slovenia	Lithuania
Not-free higher education system	Canada	The UK	The USA	Japan	The Netherlands	

Source: the author's calculations

Appendix 2. Subchapter's 3.1. data

Countries	INPUTS			OUTPUTS			
	Ratio of the expenditure spent on higher education to GDP	**GDP per capita**	**Private to total expenditure ratio**	**Ratio of people with diploma to total population**	**Adult education level**	**Employment rate of people with diploma**	**Weights (λ)**
Germany	1.28831	55652.88	0.21738	33.26024	29.90013	89.34527	1
Iceland	1.25556	58284.12	0.09631	42.17683	40.94893	90.38239	1
Poland	1.256274	33427.5	0.232127	43.48436	32.01477	88.98411	1
Latvia	1.351366	31893.85	0.460774	43.81115	35.70773	89.25949	1
Slovenia	1.056218	40658.63	0.118709	44.10574	33.28328	90.31239	1
Lithuania	1.080541	38491.44	0.298314	55.18737	43.14942	91.25587	1
Canada	2.182295	49286.81	1.010782	62.96512	59.37484	83.11153	1
UK	2.014494	49070.33	1.462201	51.80952	47.18913	86.62865	1
USA	2.486106	65055.79	1.599036	50.38019	48.34019	82.67925	1
Netherlands	1.38074	42438.76	0.930216	61.51419	52.67799	86.01984	1
Japan	1.676317	59003.86	0.475127	49.10326	40.38514	89.67101	1

Source: OECD (2022), the author's calculations

Appendix 3. Lihtlitsents

Lihtlitsents lõputöö reprodutseerimiseks ja lõputöö üldsusele kättesaadavaks tegemiseks[1]

Mina _____Anita Sõtšugova_____ (a*utori nimi*)

1. Annan Tallinna Tehnikaülikoolile tasuta loa (lihtlitsentsi) enda loodud teose
____THE EFFICIENCY OF HIGHER EDUCATION: FREE SYSTEM VS PAID SYSTEM____,
(*lõputöö pealkiri*)

mille juhendaja on _____Simona Ferraro, PhD_____,
(*juhendaja nimi*)

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__12.05.2022__(kuupäev)

[1] *Lihtlitsents ei kehti juurdepääsupiirangu kehtivuse ajal vastavalt üliõpilase taotlusele lõputööle juurdepääsupiirangu kehtestamiseks, mis on allkirjastatud teaduskonna dekaani poolt, välja arvatud ülikooli õigus lõputööd reprodutseerida üksnes säilitamise eesmärgil. Kui lõputöö on loonud kaks või enam isikut oma ühise loomingulise tegevusega ning lõputöö kaas- või ühisautor(id) ei ole andnud lõputööd kaitsvale üliõpilasele kindlaksmääratud tähtajaks nõusolekut lõputöö reprodutseerimiseks ja avalikustamiseks vastavalt lihtlitsentsi punktidele 1.1. jq 1.2, siis lihtlitsents nimetatud tähtaja jooksul ei kehti.*