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THE EFFECT OF POVERTY ON EDUCATION IN ESTONIA

Bachelor's thesis

Programme Applied Economics, specialisation Economic Analysis

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Tallinn 2021

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ABSTRACT

This thesis analyses the effect of poverty on education in Estonia. The OECD-PISA database provides a great dataset to analyse the effects different variables have on the test score of students. This thesis uses data from the 2009 and 2018 PISA surveys, which both have the focus on the reading test. Because of this, the level of students' education is indicated by his/her PISA reading test score. Amongst many variables, PISA survey provides an index that shows the status of students' economic, social and cultural status (ESCS). This thesis considers the ESCS index as the main indicator of the level of poverty of students. Since the rate of relative poverty in Estonia varies greatly between 2009 and 2018, it is possible to analyse how the effect of poverty on education changes when the rate of poverty in the country changes.

In this thesis, OLS linear regression models were used as a research method. The students were divided into two groups by the index of ESCS. The first group included the students whose ESCS index was below zero, representing the poor students. The second group, representing the wealthier students, included students whose ESCS index was above zero. Since the analyses were done for two different years, four different OLS linear regression models were created. The dependent variable in the models was the PISA reading test score. In addition to the ESCS index, the independent variables included various indicators about the nature and background of the students. The analyses found that poverty has a negative effect on education which means that wealthier students have higher PISA reading test scores. The results show that the negative effect of poverty on education is larger when the rate of relative poverty in the country is lower.

Keywords: Poverty, education, human capital, Estonia, Programme of International Student Assessment, PISA

INTRODUCTION

Traditionally, there are two main measures of poverty: the absolute and the relative poverty. The absolute poverty shows the level of income required to finance the minimum needs. The World Bank (WB) considers the absolute poverty line to be 1.9 US dollars per person per day (Principles … 2016). Relative poverty depends on the society a person lives in. In developed countries, most people live above the absolute poverty line, but many people live below the relative poverty line. People from developed countries, who live below the relative poverty line might be considered wealthy in developing countries, because of the different standards in the society. Being relatively poor may result in social exclusion, which can greatly affect students' achievements in school and life, after school. The absolute poor, who struggle with financial limitations, can struggle to attend school overall. (Berg 2008)

Children who come from poor families are usually less successful in school, more likely to drop out of school and less likely to attend an university than students from wealthier families. This results in a low level of education, which is correlated with a higher rate of unemployment and therefore a lower salary. (Connell 1994) The more people with low education and salary, the higher the rate of poverty of a country. With the rise of the rate of poverty, the number of students from poor families also increases. If students from poor families acquire poor education and struggle financially in their adult life, it is more likely that the same might happen to their offsprings. This means, that poverty and poor education are more likely to persist also with future generations.

The human capital theory (Becker 1964; Mincer 1974; Schultz 1961), which arised in the 1960s states, that quality education is an investment and it results in economic growth. According to those theories, education is a key element for reducing poverty and if public expenditures on education increase yearly, it is a sign that policymakers consider education as a way to tackle poverty. On the other hand, education can also be the cause of poverty. If the cost of school is too high, poor families can fall into an even deeper hole by sending their children to school. (Wang 2021)

The objective of this thesis is to evaluate the impact of poverty on the level of students' education in Estonia and to see, how the effect changes when the rate of relative poverty in the country changes. To achieve the goal of this thesis, research questions have been established.

This thesis aims to answer the following research questions:

- How does poverty affect educational test scores?
- Is the effect of poverty on education larger when the rate of poverty is higher?

This thesis uses data from Programme for International Student Assessment (PISA) database carried out by the Organization for Economic Co-operation and Development (OECD). Using quantitative data, the analyses are made to determine the effect and the size of the effect of poverty on education in Estonia. This thesis uses data from the years 2009 and 2018 to compare the results in different economic enviroments.

This thesis is divided into three parts. In the first chapter, a short overview of past reasearch is provided, the importance and benefits of schooling are explained as well as the consequences of not aquireing education. The cost of schooling is also discussed and the human capital theory is explained. In the second chapter, the thesis provides an overview of the data used for the econometrical analysis and the design of the analysis is explained. The third chapter discusses the results of the econometrical analysis and provides some conclusions.

1. POVERTY AND EDUCATION

Poverty can be both the cause and the effect of poor education (Mihai *et al.* 2015). If a child is born into a poor family, he/she might struggle to get a good education for a number of reasons, like lack of resources or having to work for money after school, which leaves no time to attend school or study after school. At the same time, if a person does not recieve good education, they might struggle to earn enough money to live above the poverty line. Lack of education is a key factor for income poverty and income poverty makes it hard to overcome the lack of education (Tilak 2002). This relationship is a vicios cycle, that might go on for generations and it is hard to break out of (Mihai *et al.* 2015).

In today's societies, reducing poverty is an important goal for most development strategies. To reduce poverty, direct and indirect measures can be taken. The direct measures would be to offer food, money and a job for people in need. The indirect measures are providing people services, that potentially increase their income, so they are able to escape poverty. One of those services is education. (Tilak 2002) When in the past, making a living did not require a high level of education, then today, the level of education is one of the most important elements in the labour market. Nowadays, it is hard to succeed in life without a proper education, and this is why providing education is considered to be an important method of reducing poverty.

1.1. Past research

The first writings about the relationship between education and income are from Adam Smith (1776) and Alfred Marshall (1890), but formal modelling of the relationship started a few centuries later. Since then, many studies with different hypotheses on this topic have taken place. (Psacharopoulos, Patrinos 2018) Summaries of some of the past research is presented below.

A study by Stofile et al. (2011) in South Africa found, that poverty has a great negative effect on participating in education. The main problems were hunger, lack of school supplies and lack of family support. As a result of this, students were dropping out of school.

Rowan, Coehn and Raudenbush (2004) reported that in the United States, the achievements of poor and less poor students vary considerably. The U.S. Department of Education (2001) has found, that students from third to fifth grade, who come from high-poverty families, perform below norms in all grades.

Barton and Coley (2009) found, that in the 2007 National Assessment of Education Progress (NAEP) test, students from poorer families scored 25 to 28 points lower in reading and maths, than students from wealthier families. Berliner (2009) also found, that in 2005, fourth grade students from poorer families scored worse in NAEP math test, than students with middle income level.

A study by The Piton Foundation found, that there is a strong correlation between a students' income levels and reading test scores. The socioeconomic status of the students explained 85% of the difference between the lowest test score and the highest test score. (Gottlieb 2002)

The relationship between education and income distribution has been studied by a number of scientists in the past and there are many different outcomes. Becker and Chiswick (1966) found, that in the United States there is a positive correlation between income inequality and schooling inequality and a negative correlation exists between income inequality and the average schooling level. The results show that countries, where the educational attainment is higher, income is distributed more equally. Chiswick (1971), based on data from nine countries shows, that when educational inequality increases, earnings inequality also increases. On the other hand Ram (1984, 1989), reported that income inequality is statistically not affected by either average schooling nor schooling inequality.

The effect of increasing education on income distribution is vague. Knight and Sabot (1983) bring out two different effects – the composition effect and the wage compression effect. The composition effect at first raises income inequality because the number of more highly educated people increases, but in the end the inequality lowers. The wage compression effect lowers income inequality because the labour force becomes relatively more educated.

1.2. The cost of schooling

To successfully aquire good education, people need to attend a school. Every country has a different schooling system. In Estonia, for example, it is mandatory to attend school until the student turns 17 years old. This means, that every person should acquire at least a primary education, and after that they are free to choose, if they want to keep educating themselves or not.

For different reasons, not all people manage to finish primary school and aquire the minimum level of education.

The lack of resources affect a person's success in education (Lacour, Tissington 2011). Most developed countries offer primary education for free, which means that students do not have to pay tuition to actually go to the school. Still, not only attending school but to also do good at school and aquire all the neccessary skills, there are some other costs that need to be considered. These costs are usually the reason, why students fail to successfully graduate even the minimum level of education, or even worse, not attend school at all. Besides tuition and textbooks, students need some other school supplies, that are not provided for free. Transportation to school, extra clothes and food can be considered a source of expenses of attending school. These are some small costs that people, who do not struggle with poverty, do not even think about, but for poor people, can be a real struggle.

In addition to direct financial costs, schooling has a high opportunity cost. Attending school takes up most of the time in a student's day, but to be successful in school, students need to spend time learning on their own after school. This means that going to school is a full time job for students and the hours spent on studying in a day, are often longer than an actual full time job. This is the opportunity cost of schooling and for poor families it can be very high. Children from poor families often need to use this time to work for a salary to support their families, or help take care of the household while other family members work. This results in not attending school, dropping out of school, or a very low level of education. (Tilak 2002) So, the opportunity cost of attending school is the salary a student would make if instead of going to school they would go to work (Schultz 1960). The opportunity cost of schooling is higher for students living in poverty than those who come from wealthier families, because the wealthier families do not usually need the extra help from their children.

1.2.1. Consequences of the lack of education

A person who lacks education, has a lot of limitations in succeeding in life and this can lead to them being socially excluded. Today, completing tertiary education can decide, whether a person lives below the poverty line or is economically comfortable. (Mihai *et al.* 2015) Since the world is constantly evolving, the level of required education to live without having to economically struggle, also keeps moving up. Studies show, that from 1960s to 1990s, the income returns to primary education were bigger than the income returns to secondary or higher education (Psacharopoulos 1985). Newer studies show, that nowadays, secondary and higher education

yields higher income than primary education (Colclough *et al.* 2010). It is not impossible to be successful and economically very secure without higher or even a secondary education, but ususally it is easier to have a secure future with a proper education.

Not completing school can result in poverty, a decrease in the potential to earn an income and a low chance to improve the quality of life (Mihai *et al.* 2015). The quality of life does not only consider income, but there are other elements, that define the quality of a person's life. A person with a higher quality of life has many skills, is able to communicate with other people and is more informed in any kind of decisionmaking (Tilak 2002). In school, students learn many different skills, like reading, writing and recieve a lot of information about many different topics. A big part of schooling is communicating with people from different genders and ages. This means, that an educated person has a higher quality of life. People, who do not attend school or who drop out of school, are left without those skills and experiences and therefore, their quality of life is lower and it is harder for them to improve the quality of their life.

1.3. Benefits of schooling

Education can be considered as an investment that results in what can be considered as a form of capital (Schultz 1960). As with any other investment, there are inputs and outputs in investing in education. The main input in investing in education is time. The more time a person invests in education, the more educated he/she becomes and usually the higher the benefits he/she gets. Like any other investment, investing in education has a rate of return, that can be expressed in different ways. Education has a social rate of return and a private rate of return, which means, that investing in one person's education does not only benefit that one person, but also the whole society.

The returns to education vary over time and also amongst the levels of education. Primary education has a slightly diminishing private returns to rate over time (Psacharopoulos 1981). As people realise, that education is constantly becoming a more important part of life, the demand for it goes up and the society becomes more educated. The more educated a society becomes, the higher the level of education needed, to yield some level of benefits, becomes. This is why the returns to primary education are diminishing. Today, primary education does not guarantee much, but a higher degree education is quite valuable. In the past, a primary education gave people a lot more benefits than it does nowadays and probably, in the future the benefits will be even smaller.

The rate of return to education is considered to be the sum of the costs and benefits of education. Individually, the benefits of education include the extra income a more highly educated person earnes, compared to a less educated person. The private rate of return to schooling is the sum of individual lifetime earnings and the net present value of the costs of education. If the rate of return is positive or higher, than an alternative rate of return, then it is worth investing in education. To the society, the benefits of investing in education are not only the monetary gains, but also some other good qualities, that education yields. (Psacharopoulos, Patrinos 2018) Educated people have more knowledge and because of that, they are able to make better choices. For example, more educated people make better and more informed choices about their health and as a result, the society becomes healthier, stronger and more long-living.

1.3.1. The human capital theory

The roots of the human capital approach date back to the 18th century, to the writings of Adam Smith (1776) and later Alfred Marshall (1890), who noted, that the most valuable capital is the one, that is invested in humans. The formalisation and development of the theory, that there is a relationship between education and income, took place later by Theodore Schultz (1960), Gary Becker (1964) and Jacob Mincer (1974), who gave education an important role in economic development theories. Before that, the theories mainly considered the conventional production factors to be a part of economic growth (Tilak 2002).

The human capital theory implies that education has productive value to the economy and will lead to economic growth. The more education a human being has, the more valuable of a capital he/she is. Schooling gives people knowledge and skills and makes them more capable to work and manage themselves. This makes people more productive, which means that they are able to make more money and raise their income. Many studies show that there is a correlation between education and income. Income raises when the level of education raises. (Tilak 2002) The more human capital education produces, the more productive the society becomes. This will eventually start help the economy to develop and grow.

Studies show, that there are educational requirements for most professions (Colclough 2012). Regardless of their education level, when entering a new job, every person needs some kind of training, because every workplace is unique. Usually, people with low levels of education need more training, than more highly educated people, to do the same work. Even if a person has not aquired any specific vocational skills for a specific job, he/she still has more basic knowledge, which makes it easier to adjust quicker. For example, it would be unthinkable, if an employer

would have to teach their employees how to read or write. Training employees takes up time and energy, that could be used to be productive and actually make money. That is why employers prefer to hire people who have higher levels of education and therefore are more productive. This also is often the reason, why people are motivated to highly educate themselves, because nowadays it is hard to find a job, that does not require any kind of education.

The human capital approach indicates education as an important tool for reducing poverty (Tilak 2002). Like said earlier, employers value education. By educating themselves, people who were unemployed, are more likely to find work, and people who were already working, are more likely to increase their earnings. This will reduce unemployment and rise people's incomes, which are both important steps towards poverty reduction.

1.3.2. Other approaches

In addition to the human capital approach, there are other approaches, that look at education at different angles.

All human beings have needs. There are needs, that need to be fulfilled in order to stay alive and there are needs that are not directly related to surviving and because of that are not a priority. The basic needs, that are a priority for all human beings are food and clean drinking water, shelter and health. While the human capital approach acknowledges the economical values of education, the basic needs approach sees education as one of the basic needs (Tilak 2002). Like with other basic needs, fulfilling one helps to fulfill the others, education is no exeption. Including education to the list of basic needs means, that fulfilling education helps to fulfill the other basic needs. This means, that the basic needs approach values the financial gains of education indirectly. Having food, water, a home and good health all require financial resources. Going to school and getting an education does not directly earn money, but it will help people make an income in the future and therefore contribute to fulfilling the other basic needs.

The weakness of human capital theory is that it only focuses on economic growth, as a measure to reduce poverty. Poverty does not only mean low incomes, but it also means less opportunities (World Bank 1994). Therefore, development must not only consider the monetary aspects, but people should be the center of attention as well (UNDP 1990). Amartya Sen and Mahbub ul Haq came up with the human development approach, that focuses on expanding people's opportunities. Rather than only concentrating on the economic value, the human development perspective focuses on the wellbeing of human people. The human development approach sees the lack of

education not as something that causes financial poverty, but as something that is a part of human poverty. Human poverty means, that the more options a person has, the better their life is. (Tilak 2002)

Amartya Sen (1999) broadened the human development approach futhrer into the human capabilities approach. Sen divides poverty into income poverty and capability poverty. Human capability is viewed as freedom to maximize one's options and live the highest quality life. The more a person is capable of doing, the more freedom they have. Education increases people's capabilities and is considered as a tool, that helps to maximize people's choices. To reduce poverty, income poverty can not be the only definition of poverty considered, but other qualities of people need attention as well. (Tilak 2002)

2. DATA AND METHODOLOGY

In the first chapter of this thesis, a theoretical background about the relationship between poverty and education was explained. The second chapter will explain the dataset and the setting for the empirical analysis.

This thesis aims to answer the following research questions:

1) How does poverty affect educational test scores?
2) Is the effect of poverty on education larger when the rate of poverty is higher?

2.1. Dataset

To answer the research questions, this thesis uses data from 2009 and 2018 PISA-OECD. PISA survey tests the knowledge of 15-year old students in reading, mathematics and science. In 2018, an optional assessment of financial literacy was also offered and global competency was measured. The main objective of PISA is to assess students' capability to actively participate in life after school. The survey takes place every three years, with 2018 being the seventh and the latest assessment. In 2009, which was the fourth assessment, 65 countries with about 470 000 students took part in the survey, whereas in 2018 there were 79 participating countries with about 600 000 students. In the survey, questionnaires about students' background are collected together with school questionnaire and parents questionnaire, for more detailed data. Each assessment focuses on one of the three main subjects, which means that the volume of that subject in the test is bigger, than of the other subjects. Both the 2009 and 2018 tests had the focus on reading. The PISA survey is a good way to keep track of the effectiveness of a country's education system compared to other countries. (OECD 2020)

This research uses data from PISA student questionnaires. The level of education is indicated by the individual test scores of the students in reading. The main variable that indicates poverty is the index of economic, social and cultural status (ESCS). This index includes the following three variables: the highest level of education of a student's parents, the highest occupational status of a student's parents and home posessions, like books (OECD 2019).

Estonia has taken part of the PISA surveys since 2006. As seen from Figure 1 below, in 2009 there were 4,727 students from Estonia who took the PISA test and the proportion of boys was higher than the proportion of girls. In 2018, the Estonian sample was a little bit bigger than in 2009 with

5,371 students taking the survey. Though again, there were more boys in the sample, this time the sample was more equally distributed between boys and girls. (Kitsing 2011; Tire *et al*. 2019)

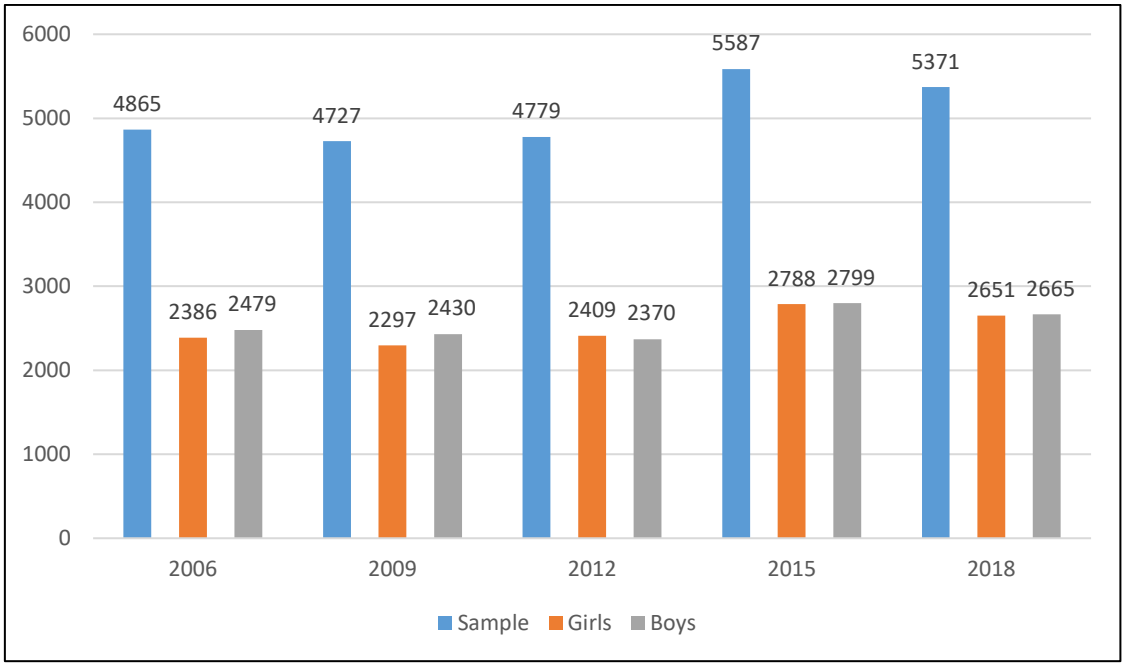

Figure 1. Participation of Estonian students in PISA surveys from 2006 through 2018
Source: (developed by the author, with data from Henno *et al*. 2007; Tire *et al*. 2013; Tire *et al*. 2016; Tire *et al*. 2019)

Countries, participating in the PISA survey, can be ranked based on their average test scores. As seen from Appendix 1, in 2009 Estonia was ranked above average in all the subects. Out of the OECD's countries, Estonia was ranked 10th in reading, 11th in mathematics and 6th in science. Nine years later, in 2018 Estonia's ranking had improved, being ranked 1st in reading, 3rd in mathematics and 1st in science out of the OECD's countries. The average results of Estonia's students are also shown on Figure 2. As seen from the figure below, girls have had a higher average PISA score than boys both in 2009 and 2018 in Estonia, and the gap is quite large. In mathematics, the boys have a higher average score than the girls, but the gap is smaller, than in the reading results. In science, the gap between boys and girls is very small, but girls have had the higher average score both years.

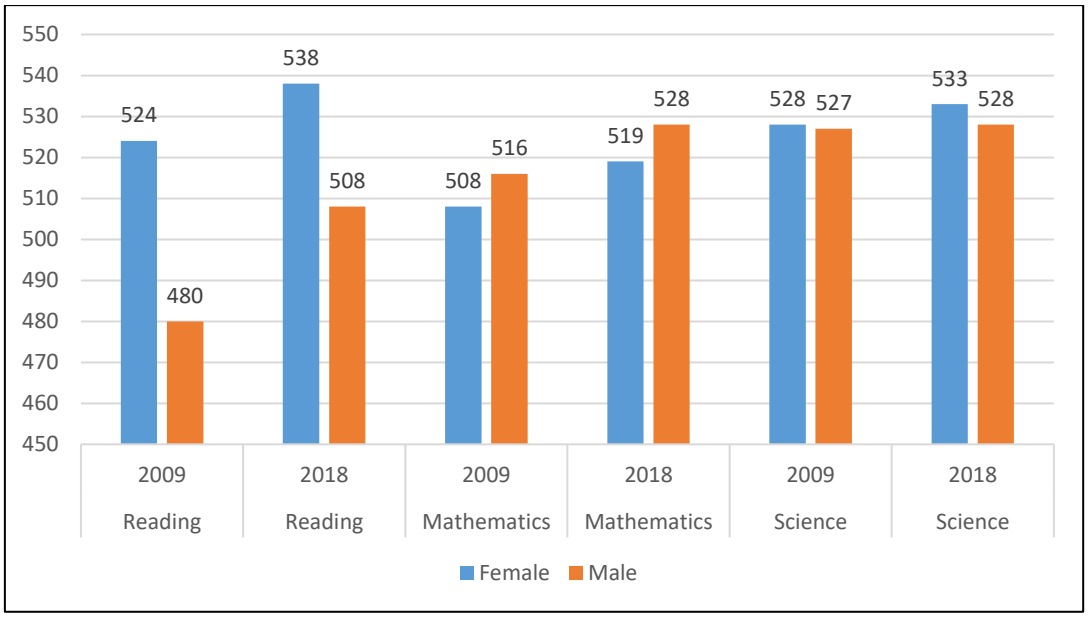

Figure 2. Estonia's students' average PISA test results in 2009 and 2018 by gender
Source: (developed by the author, with data from PISA database)

To find out whether the size of the effect of poverty on education is larger when the rate of poverty is higher, the overall level of poverty of the country needs to be examined. There are two main ways of measuring poverty. The first indicator is absolute poverty. The absolute poverty line is a level of income, that covers the cost of minimum needs. The second indicator is relative poverty and the relative poverty line is 60% of annual net income median of the household. If someone's income is below the absolute poverty line, they are living in absolute poverty and if their income is below the relative poverty line, they are living in relative poverty. (Suhteline … 2019) In this thesis, the rate of relative poverty is examined to determine the level of poverty in Estonia. As seen from Figure 3 below, the rate of relative poverty in Estonia has risen a lot in 2018 compared to 2009. The rate of relative poverty in Estonia was 15.8% in 2009, which is about 6 percent lower than a 21.7% rate of relative poverty in 2018.

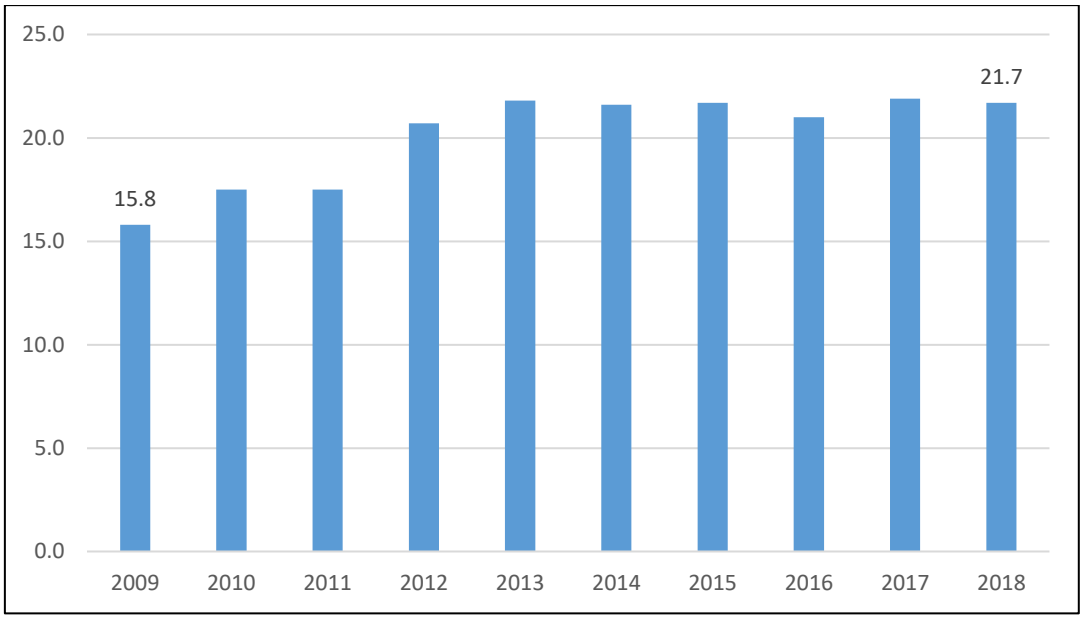

Figure 3. Relative poverty in Estonia from 2009 to 2018
Source: (developed by the author, with data from Eesti Statistikaamet, table LES01)

Income inequality can be measured by Gini coefficient, which shows how evenly income is distributed in a population. The Gini coefficient is based on comparing the cumulative proportions of the population to their cumulative income. If income is distributed perfectly evenly in a population, then the Gini coefficient is one and in the case of income being distributed perfectly unevenly, the coefficient is zero. (OECD 2021)

As seen from Figure 4, in the case of Estonia, the Gini coefficient has remained under 0.4 through 2009 to 2018. In 2009 the coefficient was 0.313 and in 2018 it had fallen to 0.305. The gap between 2009 and 2018 is very small, so income distribution in Estonia has stayed pretty much the same, comparing these two years.

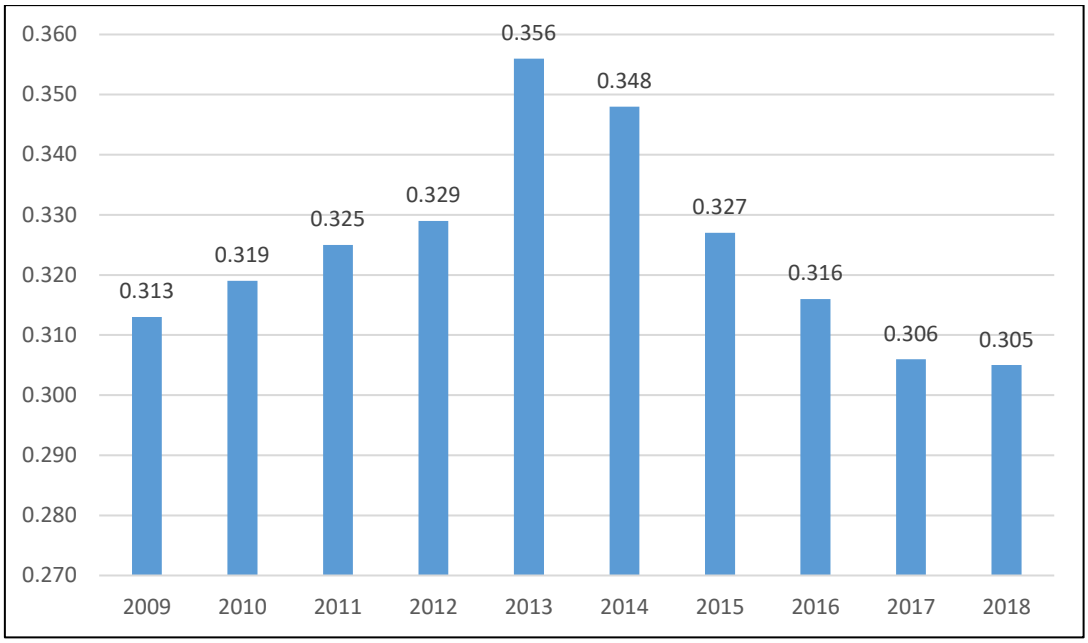

Figure 4. Gini coeficient in Estonia through 2009-2018
Source: (developed by the author, with data from Statistics Estonia 2021)

2.2. Descriptive statistics

PISA-OECD survey offers a very broad variety of student background information. The author of this thesis has chosen only a few of the variables available, that are most relevant to this thesis, to use in the analyses. The variables and the descriptive statistics of the variables are shown in Table 1 (year 2009) and Table 2 (year 2018).

Table 1. Summary statistics of Estonian PISA 2009 dataset

Variables	Observations	Mean	Min	Max	Description
PISA score	4,727	503.473	200.148	753.062	PVRead
Gender (0 = female, 1 = male)	4,727	0.514	0	1	gender
Index of economic, social and cultural status	4,703	0.179	-3.010	3.535	ESCS
Language spoken at home (0 = Estonian, 1 = any other language)	4,601	0.201	0	1	homelang
Immigration status (1 = native, 2 = second generation, 3 = first generation)	4,666	1.086	1	3	immig
Wealth	4,714	-0.020	-2.802	3.101	wealth
Repeating a grade in primary school	4,562	1.039	1	3	Repeat <ISCED 1>
Repeating a grade in lower secondary school	4,477	1.022	1	3	Repeat <ISCED 2>
Home posessions	4,714	0.092	-3.120	4.040	homepos
Home educational resources	4,712	0.296	-3.301	0.982	HEDRES
Cultural posessions	4,702	0.338	-1.441	1.080	CULTPOSS

Source: developed by the author with data from PISA 2009 database

Table 2. Summary statistics of Estonian PISA 2018 dataset

Variables	Observations	Mean	Min	Max	Description
PISA score	5,316	523.275	220.463	809.952	PVread
Gender (0 = female, 1 = male)	5,316	0.501	0	1	gender
Index of economic, social and cultural status	5,202	0.100	-5.185	3.445	ESCS
Language spoken at home (0 = Estonian, 1 = any other language)	5,115	0.280	0	1	homelang
Immigration status (1 = native, 2 = second generation, 3 = first generation)	5,174	1.112	1	3	immig
Wealth	5,213	-0.093	-6.902	4.122	wealth
Repeating a grade in primary school	5,176	1.021	1	3	Repeat <ISCED 1>
Repeating a grade in lower secondary school	5,172	1.018	1	3	Repeat <ISCED 2>
Home posessions	5,214	0.006	-8.581	4.985	homepos
Home educational resources	5,207	0.168	-4.411	1.210	HEDRES
Cultural posessions	5,194	-0.014	-1.793	2.054	CULTPOSS

Source: developed by the author with data from PISA 2018 database

The dependent variable PISA score is an average from all the plausible values in reading.

The index of economic, social and cultural status includes the following variables: the highest level of education of parents, the highest occupational status of parents and home posessions (OECD 2010).

The International Standard Classification of Education (ISCED) is an indicator of a person's level of education, that is standardized to be comparable across nations. Levels of ISCED are following (UNESCO-UIS 2006):

- 0 = pre – primary education;
- 1 = primary education;
- 2 = lower secondary education;
- 3 = (upper) secondary education:
    - 3A = level three programmes, that provide direct access to ISCED 5A;
    - 3B = level three programmes, that provide direct access to ISCED 5A;
    - 3C = level three programmes that provide direct access to labour market, ISCED 4 or other level three programmes;
- 4 = post secondary non tertiary education;
- 5 = first stage of tertiary education:
    - 5A = mostly theoretical tertiary education;
    - 5B = mostly practical tertiary education that prepares for labour market;
- 6 = second stage of tertiary education.

The variable wealth is an index of family wealth. This variable is based on the answers of students to the questions about whether they have their own room, a link to the internet and some other possessions at home (dishwasher, DVD player, video camera, photocamera) and how many cellular phones and other posessions they have at home (televisions, computers, cars, rooms with a bath or a shower). (OECD 2010)

Variables repeat <ISCED 1>, repeat <ISCED 2> and repeat <ISCED 3> show, wheather the student has repeated a grade in primary education, lower secondary education or upper secondary educaition. The meaning of the values are following: 1 = No, never, 2 = yes, once, 3 = yes, twice or more. (*Ibid*)

Home posessions in an indicator of family wealth and it includes all the same items, that variables wealth, cultural posessions and home educational resources include and also how many books at home a student has. (*Ibid*)

Home educational resources show, whether the student has a desk and a quiet place to study, a computer for schoolwork and educational software, books that help with schoolwork and a dictionary at home. (*Ibid*)

Cultural posessions includes students' answers to questions about what kind of cultural items are found in their home (classic literature, poetry books, art) (*Ibid*).

2.3. Methodology

The object of this thesis is to study whether there is a relationship and how strong the relationship is between the level of poverty and the level of education of a student. The level of poverty in this thesis is indicated by the index of economic, social and cultural status (ESCS) of a student. The students, whose ESCS index is below zero are considered to be poor and the students whose ESCS index is above zero are considered as the wealthier students. To fulfill the purpose of this thesis and to answer the research questions, Ordinary Least Squared (OLS) linear regression analysis and correlation analysis will be performed. To check for multicollinearity, varience inflation factors (VIF) are calculated. If the VIF values are under 10, multicollinearity does not exist (Kennedy 2008). The analysis are done with plausible values. All statistical values are averages from results from the analyses with plausible values.

The correlation analysis is used to evaluate the relationship between the variables used in this thesis. As a result, a Pearson correlation coefficient is indicated, which shows the statistical strength and the direction of the relationship between the variables.

To find out, which variables affect students' test scores and how strong the effect is, OLS analysis will be conducted. An econometric model will be compiled with the variables mentioned before. The regression analysis is performed with a 95% confidence. Further, R-squared and p-value of the regression analysis results will be observed to study the relationship.

The OLS regression model has the following form:

$$PVRead = \alpha x + \beta + \varepsilon$$

Where

- PVRead – test score in reading
- α – Coefficient of independent variable
- x – independent variable
- β – intercept

- ε – random error component

The analyses are done using plausible values. PISA 2009 provides five plausible values and PISA 2018 provides 10 plausible values. A seperate analysis is done with each plausible value and for the final result, an average of the individual results of the analyses is taken, to get an unbiased statistical result.

To examine the effect of poverty, two regression models are done for both years. The economic, social and cultural index, which is the main indicator of a student's level of poverty, is divided into two groups. The first group has all the values of the index, that are below zero and this group represents the students who are relatively poorer. The second group has all ESCS values that are above zero and this represents the wealthier students.

3. ANALYSIS AND RESULTS

This chapter shows the results of the analyses made with the data and conclusions made about the analyses.

3.1. Correlation analyses

The correlation matrix of 2009 can be seen in Appendix 2. The correlation coefficient of the index of student's economic, social and cultural status is -0.075. This shows that there is a weak negative correlation between the main indicator of poverty and the reading test score. A negative correlation means that if the index of ESCS increases, the reading test score decreases, so the wealthier a student, the lower the test score.

The 2018 correlation matrix can be seen in Appendix 3. In contrast to the 2009 correlation coefficient, the ESCS index has a positive correlation coefficient of 0.254. The correlation between the ESCS index and the reading test score is a lot stronger than in 2009. A positive correlation between these variables means that if the index of ESCS increases, the reading test score also increases. In other words, the wealthier a student, the higher his/her test score.

3.2. Regression models 2009

Below, in Table 3 and Table 4, the two 2009 regression models are presented. The first model uses ESCS indexes from the minimum value, which is -3.010 to -0.01 and represents the poorer students. The second model is made with ESCS indexes from the value 0.0 to the maximum value, which is 3.535 and the model represents the wealthier students. The students are divided into these two groups in order to assess the differences between the wealthier and the poorer students.

Table 3. Regression model 2009 with ESCS values below zero

		Observations	2,013
		F - value	53.998
		Significance F	4E-94
		R Square	0.212
PVRead	Coefficient	Standard error	P-value
Gender	-33.570	3.180	0.000
ESCS	20.032	4.660	0.000
Homelang	-23.677	3.662	0.000
IMMIG	-5.117	1.589	0.002
WEALTH	-32.235	3.708	0.000
Repeat ISCED 1	-6.839	1.025	0.000
Repeat ISCED 2	-8.162	0.758	0.000
HOMEPOS	30.231	4.260	0.000
HEDRES	-0.013	0.006	0.044
CULTPOSS	-0.003	0.004	0.479
Intercept	600.865	7.465	0.000

Source: Developed by the author with data from PISA 2009 database

The significance F of the first model is smaller than 0.05, which means that the alternate hypothesis was accepted and the model is statistically significant. The coefficient of determination (R squared) of the model is 0.212, which means that 21.2% of the varience of the level of education can be explained by the model.

To check for multicollinearity, varience inflation factors (VIF) were calculated for all the variables. All VIF values were under 10 which means that there exists no multicollinearity and no variables need to be removed from the model.

The p-values of the variables are all smaller than 0.05 except for cultural possessions, which has a p-value of 0.479. This means, that this variable is statistically not significant and should be removed from the model.

Table 4. Regression model 2009 with ESCS values above zero

		Observations	2,690
		F - value	79.855
		Significance F	7E-141
		R Square	0.230
PVRead	Coefficient	Standard error	P-value
Gender	-41.241	2.755	0.000
ESCS	31.602	3.250	0.000
Homelang	-30.167	3.453	0.000
IMMIG	-7.544	2.060	0.000
WEALTH	-38.595	3.620	0.000
Repeat ISCED 1	-4.931	1.057	0.000
Repeat ISCED 2	-7.753	0.981	0.000
HOMEPOS	30.992	4.774	0.000
HEDRES	7.613	2.096	0.001
CULTPOSS	-0.010	0.003	0.001
Intercept	612.256	6.708	0.000

Source: Developed by the author with data from PISA 2009 database

The second model is also statistically significant, because the significance F is below 0.05. The coefficient of determination (R squared) of the model is 0.230, which means that 23% of the varience of the level of education can be explained by the model.

To check for multicollinearity, varience inflation factors (VIF) were calculated for all the variables. The variables, that have a VIF value greater than 10 are following: wealth, home possessions and home educational resources. These variables should be removed from the model. The p-values of all the variables in this model are higher than 0.05, which means that all the variables are statistically significant.

3.3. Regression models 2018

In Table 5 and Table 6 the two 2018 regression models can be seen. The first model, representing the poorer students uses ESCS indexes from the minimum value, which is -5.185 to the value -0.0001. The second model uses ESCS values from 0.0 to the maximum value 3.445, representing the relatively wealthier students.

Table 5. Regression model 2018 with ESCS values below zero

		Observations	2,297
		F - value	36.029
		Significance F	3E-61
		R Square	0.136
PVRead	Coefficient	Standard error	P-value
Gender	-26.438	3.511	0.000
ESCS	16.041	4.522	0.001
Homelang	-0.101	0.010	0.000
IMMIG	-6.128	2.330	0.013
WEALTH	-32.567	4.382	0.000
Repeat ISCED 1	-7.395	2.133	0.001
Repeat ISCED 2	-11.031	2.002	0.000
HOMEPOS	33.999	4.688	0.000
HEDRES	-0.517	0.641	0.433
CULTPOSS	-0.785	0.293	0.011
Intercept	604.416	7.365	0.000

Source: Developed by the author with data from PISA 2018 database

Since the significance F of the first model is smaller than 0.05, the model is statistically significant. The coefficient of determination (R squared) of the model is 0.136, which means that 13.6% of the varience of the level of education can be explained by the model.

To check for multicollinearity, varience inflation factors (VIF) were calculated for all the variables. All VIF values were under 10, so multicollinearity does not exist. The variable home educational resources has a p-value that is greater than 0.05. Therefore this variable is statistically not significant and should be removed from the model.

Table 6. Regression model 2018 with ESCS values above zero

		Observations	3,019
		F - value	55.988
		Significance F	7E-100
		R Square	0.157
PVRead	Coefficient	Standard error	P-value
Gender	-35.956	3.110	0.000
ESCS	28.727	3.720	0.000
Homelang	-0.122	0.009	0.000
IMMIG	-5.418	2.066	0.010
WEALTH	-0.311	0.953	0.748
Repeat ISCED 1	-14.484	2.863	0.000
Repeat ISCED 2	-7.213	2.771	0.013
HOMEPOS	1.614	0.883	0.081
HEDRES	-0.103	0.555	0.763
CULTPOSS	-0.418	0.374	0.291
Intercept	633.908	6.897	0.000

Source: Developed by the author with data from PISA 2018 database

The second model is also statistically significant, because the significance F is below 0.05. The coefficient of determination (R squared) of the model is 0.157, which means that 15.7% of the varience of the level of education can be explained by the model.

To check for multicollinearity, varience inflation factors (VIF) were calculated for all the variables. The variables that have a VIF value over 10 and because of that should be removed from the model are wealth, home possessions, home educational resources and cultural possessions.

The variables, that have a p-value greater than 0.05 are wealth, home possessions, home educational resources and cultural possessions. These variables are statistically insignificant and should be removed from the model.

3.4. Final regression models 2009

The original models presented above contained variables that needed to be removed from the models because of multicollinearity or because they were statistically not signifficant. The final models of 2009, that contain only significant variables, are presented below in Table 7 and Table 8.

In Table 7 the final regression model of 2009 about the poor students is presented. From the original model in Table 3, variable cultural possessions was removed. In Table 8, the final regression model of 2009 about the wealthier students is presented and the variables that were removed from the original model in Table 4 are wealth, home possessions and home educational resources. Both of the final models are statistically significant and the models explain respectively 21.2% and 17.9% of the variance of the level of education.

Table 7. Final regression model 2009 with ESCS values below zero

		Observations	2,013
		F - value	59.931
		Significance F	6E-95
		R Square	0.212
PVRead	Coefficient	Standard error	P-value
Gender	-33.667	3.177	0.000
ESCS	20.068	4.659	0.000
Homelang	-23.634	3.662	0.000
IMMIG	-5.111	1.589	0.002
WEALTH	-32.216	3.708	0.000
Repeat ISCED 1	-6.829	1.025	0.000
Repeat ISCED 2	-8.202	0.756	0.000
HOMEPOS	30.147	4.258	0.000
HEDRES	-0.016	0.005	0.003
Intercept	600.942	7.463	0.000

Source: Developed by the author with data from PISA 2009 database

The results of the regression analysis show that the more poor a student is, the lower his/her PISA reading test score is. For each unit the index of student's economic, social and cultural status decreases, the test score decreases by 20.068 points.

Looking at the other variables it can be said, that girls score 33.667 points more in reading than boys. Students who speak Estonian at home have 23.634 points higher test score in reading than students who speak any other language. Native students score 5.111 points more in reading than second generation immigrants. Variables repeat <ISCED 1> and repeat <ISCED 2> have coefficients, that show, that for every grade repetition in primary school, the test score decreases 6.829 points and in lower secondary school 8.202 points.

Table 8. Final regression model 2009 with ESCS values above zero

		Observations	2,690
		F - value	83.433
		Significance F	9E-109
		R Square	0.179
PVRead	Coefficient	Standard error	P-value
Gender	-44.432	2.827	0.000
ESCS	33.228	2.912	0.000
Homelang	-26.842	3.551	0.000
IMMIG	-7.077	2.123	0.001
Repeat ISCED 1	-4.795	1.090	0.000
Repeat ISCED 2	-8.084	1.012	0.000
CULTPOSS	-0.008	0.003	0.010
Intercept	618.638	6.888	0.000

Source: Developed by the author with data from PISA 2009 database

Similarly to the previous model, the results indicate that wealthier students score higher in the PISA reading test than relatively poorer students. For each unit the index of student's economic, social and cultural status increases, the test score increases by 33.228 points.

Like in the previous model, girls score more in the reading test. The average test score of girls is 44.432 points higher than the average test score of boys. Estonian speaking students' test scores are 26.842 points higher than the test scores of students who speak any other language at home. Native students score 7.077 points more than second generation immigrants. Repeating a grade in primary school decreases test score by 4.795 points and repeating a grade in lower secondary school decreases test score by 8.084 points.

3.5. Final regression models 2018

Below, in Table 9 and Table 10, final regression models of 2018 are presented. The final regression model of 2018 about the poor students is presented in Table 9 and it does not contain the variable home educational resources, as the original model in Table 5 does. Table 10 shows the final regression model of 2018 about the wealthier students. The difference between the final model and the original model in Table 6 is, that the final model does not contain the variables wealth, home possessions, home educational resources and cultural possessions. Again, both of the final models are statistically significant and the models explain 13.6% and 15.1% of the variance of education.

Table 9. Final regression model 2018 with ESCS values below zero

		Observations	2,297
		F - value	39.958
		Significance F	6E-62
		R Square	0.136
PVRead	Coefficient	Standard error	P-value
Gender	-26.435	3.511	0.000
ESCS	15.993	4.521	0.001
Homelang	-0.102	0.010	0.000
IMMIG	-6.096	2.329	0.014
WEALTH	-32.372	4.375	0.000
Repeat ISCED 1	-7.283	2.129	0.001
Repeat ISCED 2	-11.222	1.988	0.000
HOMEPOS	33.463	4.640	0.000
CULTPOSS	-0.886	0.264	0.002
Intercept	604.460	7.364	0.000

Source: Developed by the author with data from PISA 2018 database

The results of the regression analysis of 2018 about the poor students show that poverty has a negative effect on the PISA reading test scores. By every unit the index of ESCS decreases, the test score decreases 15.993 points.

Similarly to both of the 2009 models, girls score 26.435 points more in reading than boys do. Estonian speaking students have a 0.102 points higher reading test score than students who speak any other language. Native students score 6.096 points more compared to the second generation immigrants. Students who have repeated a grade in primary or lower secondary school score respectively 7.283 and 11.222 points less than students who have not repeated any grades.

Table 10. Final regression model 2018 with ESCS values above zero

		Observations	3,019
		F - value	88.979
		Significance F	5E-99
		R Square	0.151
PVRead	Coefficient	Standard error	P-value
Gender	-35.786	3.114	0.000
ESCS	28.004	3.708	0.000
Homelang	-0.116	0.009	0.000
IMMIG	1.065	1.274	0.432
Repeat ISCED 1	-17.763	2.716	0.000
Repeat ISCED 2	-8.458	2.741	0.003
Intercept	630.649	6.783	0.000

Source: Developed by the author with data from PISA 2018 database

Once again the results confirm that wealthier students perform better in the PISA reading test. For every unit the ESCS index increases, the test score increases 28.004 points. Like in all the previous models, girls score 35.786 points more than boys and Estonian speaking students score 0.116 points more than any other language speaking students. The difference between this model and the pervious models is the positive coefficient of the immigration status. This model suggests that native students score 1.065 points less in the reading test than the second generation immigrants. Repeating a grade in primary school decreases the test score by 17.763 points and repeating a grade in lower secondary school decreases the score by 8.458 points.

CONCLUSIONS

The objective of this thesis is to evaluate the effect of poverty on education in Estonia. Two research questions were raised to help fulfill the aim of this thesis:

- How does poverty affect educational test scores?
- Is the effect of poverty on education larger when the rate of poverty is higher?

With the results of the analyses it is possible to answer these questions. Firstly, the analyses show that poverty has a negative effect on educational test scores. The more poor a student is, the lower his/her test score. Secondly, the effect of poverty on education is larger when the rate of poverty is lower.

Linear regression analyses were performed using data from Programme for International Student Assessment (PISA) database. This thesis focuses on the 2009 and 2018 PISA surveys, as both of those surveys focus on the reading test. Thus, the main indicator of education in this thesis is the PISA reading test score and the indicator of poverty is the economic, social and cultural status (ESCS) of students. The students are divided into two groups by the ESCS index, to distinguish the poor students from the wealthier students. The students with ESCS index below zero represent the poor students and the wealthier students are the ones whose ESCS index was above zero. Separate analyses are done for each group, to analyse the difference between the poor and the wealthier students.

Analysing the group that represents the poor students, it can be seen that for each unit the ESCS index of a student decreases, the PISA reading test score decreases about 20.1 points in 2009 and about 16 points in 2018. Looking at the group with the wealthier students, the results show, that the test scores decrease about 33.2 points in 2009 and about 28 points in 2018 for each unit the ESCS index of a student decreases. In conclusion, results of all analyses indicate, that the higher a student's ESCS index, the higher his/her PISA reading test score. From these results it can also be observed that the ESCS index has a bigger impact on the PISA reading test scores in 2009 than in 2018.

The rate of relative poverty in Estonia has increased quite a lot during the period of 2009 to 2018. In 2009 the rate of relative poverty in Estonia was 15.8% and 21.7% in 2018. As mentioned earlier, poverty had a bigger effect on education in 2009 than in 2018. By this, it can be concluded that poverty has a larger effect on education when the rate of poverty in the country is lower.

The models created in this thesis are not ideal. To understand the economic state of students, the index of economic, social and cultural state is not the best variable to use. Instead, the Gini coefficient and the socio-economic status of peers should be added to the analyses. Morover, the OLS linear regression model is not the best form of analysis to use as it explains very little of the variation of PISA test scores.

KOKKUVÕTE

VAESUSE JA HARIDUSE SUHE EESTIS

Brigita Viilop

Vaesuse ja hariduse suhe on saanud üsna populaarseks uurimisteemaks. Mitmed uuringud on leidnud, et lapsed kes pärinevad vaesest perekonnast, saavutavad koolis kehvemaid tulemusi kui rikkamatest peredest pärit õpilased. Lisaks kehvadele tulemustele koolis on leitud veel, et vaesematel õpilastel on raskusi koolis kohalkäimisega ning nad kipuvad ka rohkem koolist välja langema. Kõik eelnevalt nimetatu võib viia selleni, et hariduse omandamine kas jääb pooleli või omandatakse kehv haridus. Ebakvaliteetne või puudulik haridus võib tulevikus aga viia vaesuseni. Vähese haridusega inimene on vähem produktiivsem kui haritumad inimesed ning seetõttu eelistavad tööandjad tihti töötajaid, kes on rohkem haritud. Seega seostatakse madalamat haridustaset tihti madalama sissetulekutasemega. Kuna lapsed kipuvad kõndima oma vanemate jalajälgedes, siis võib kehva hariduse ja madala sissetuleku tsüklist väljatulemine olla keeruline, mistõttu võib see tsükkel edasi kanduda mitmeid generatsioone.

Käesoleva töö eesmärgiks oli hinnata vaesuse mõju haridusele Eestis. OECD-PISA andmebaas pakub palju erinevaid võimalusi andmete kombineerimiseks, et näha, kuidas erinevad muutujad mõjutavad õpilaste testide tulemusi. Antud töös kasutatakse andmeid 2009. ja 2018. aasta PISA uuringutest, mis keskenduvad mõlemad lugemistestile ning seetõttu vaadeldakse PISA lugemistesti tulemusi kui õpilaste haridustaset. PISA andmebaasis leidub palju informatsiooni õpilaste tausta kohta, mille hulgas on ka erinevaid indikaatoreid õpilaste majandusliku seisundi kohta. Üheks selliseks indikaatoriks on majandusliku, sotsiaalse ja kultuurilise staatuse indeks (ESCS). Antud töös vaadeldakse ESCS indeksit kui peamist vaesuse näitajat. Suhtelise vaesuse määr Eestis erineb aastate 2009 ja 2018 vahel üsna suuresti ning see võimaldab analüüsida, kuidas vaesuse mõju haridusele muutub, kui vaesuse määr muutub. Töö eesmärgi täitmiseks on esialgu todud välja vaesuse ja hariduse suhte teoreetiline tagataust ning lühiülevaade varasematest uuringutest antud teemal.

Uurimismeetodina kasutati antud töös harilikku vähimruutude meetodit. Õpilased jagati ESCS indeksi järgi kahte rühma. Esimeses rühmas olid õpilased, kelle ESCS indeks jäi alla nulli ning see rühm esindab vaesemaid õpilasi. Teise rühma jäid õpilased, kelle ESCS indeks oli nullist suurem

ning see rühm sümboliseerib rikkamaid õpilasi. Analüüse tehti kahe erineva aasta kohta, seega kokku koostati antud töös neli erinevat regressioonmudelit. Mudelite sõltuvaks muutujaks oli õpilaste lugemistesti tulemus. Sõltumatuteks muutujateks olid lisaks ESCS indeksile veel erinevad näitajad õpilaste olemuse ja tausta kohta.

Analüüside tulemustest võib järeldada, et vaesusel on haridusele negatiivne mõju. Mida madalam õpilase ESCS indeks on, seda madalam on tema PISA lugemistesti tulemus. Vaadates vaesemate õpilaste analüüside tulemusi on näha, et iga ühiku kohta, mis ESCS indeks langeb, PISA lugemistesti tulemus väheneb umbes 20.1 puntki aastal 2009 ning umbes 16 puntki aastal 2018. Rikkamate õpilaste puhul vähenevad lugemistestide tulemused umbes 33.2 puntki aastal 2009 ning umbes 28 puntki aastal 2018 iga ühiku kohta, mis ESCS indeks väheneb. Seega saab järeldada, et vaesusel on haridusele negatiivne mõju. Lisaks võib täheldada, et ESCS indeks mõjutab PISA lugemistesti tulemusi rohkem aastal 2009 kui aastal 2018.

Vaadates suhtelise vaesuse määra Eestis on näha, et perioodil 2009-2018 on see üsna palju tõusnud. Aastal 2009 oli suhtelise vaesuse määr Eestis 15.8% ning aastal 2018 oli see 21.7%. Kuna vaesus mõjutas haridust rohkem aastal 2009, siis võib teha järelduse, et vaesusel on haridusele suurem mõju, kui suhtelise vaesuse määr riigis on madalam.

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APPENDICES

Appendix 1. Estonia's students' performance in reading, mathematics and science on the 2009 and 2018 PISA study

Reading				
Rank	**Country**	**2009**	**Country**	**2018**
1	Korea	539	Estonia	523
2	Finland	536	Canada	520
3	Canada	524	Finland	520
4	New Zealand	521	Ireland	518
5	Japan	520	Korea	514
6	Australia	515	Poland	512
7	Netherlands	508	Sweden	506
8	Belgium	506	New Zealand	506
9	Norway	503	United States	505
10	Estonia	501	United Kingdom	504
11	Switzerland	501	Japan	504
12	Poland	500	Australia	503
13	Iceland	500	Denmark	501
14	United States	500	Norway	499
15	Sweden	497	Germany	498
16	Germany	497	Slovenia	495
17	Ireland	496	Belgium	493
18	France	496	France	493
19	Denmark	495	Portugal	492
20	United Kingdom	494	Czech Republic	490
21	Hungary	494	Netherlands	485
22	Portugal	489	Austria	484
23	Italy	486	Switzerland	484
24	Latvia	484	Latvia	479
25	Slovenia	483	Italy	476
26	Greece	483	Hungary	476
27	Spain	481	Lithuania	476
28	Czech Republic	478	Iceland	474
29	Slovak Republic	477	Israel	470
30	Israel	474	Luxembourg	470
31	Luxembourg	472	Turkey	466
32	Austria	470	Slovak Republic	458
33	Lithuania	468	Greece	457

34	Turkey	464	Chile	452
35	Chile	449	Mexico	420
36	Mexico	425	Colombia	412
37	Colombia	413	Spain	n/a
Mathematics				
Rank	**Country**	**2009**	**Country**	**2018**
1	Korea	546	Japan	527
2	Finland	541	Korea	526
3	Switzerland	534	Estonia	523
4	Japan	529	Netherlands	519
5	Canada	527	Poland	516
6	Netherlands	526	Switzerland	515
7	New Zealand	519	Canada	512
8	Belgium	515	Denmark	509
9	Australia	514	Slovenia	509
10	Germany	513	Belgium	508
11	Estonia	512	Finland	507
12	Iceland	507	Sweden	502
13	Denmark	503	United Kingdom	502
14	Slovenia	501	Norway	501
15	Norway	498	Germany	500
16	France	497	Ireland	500
17	Slovak Republic	497	Czech Republic	499
18	Austria	496	Austria	499
19	Poland	495	Latvia	496
20	Sweden	494	France	495
21	Czech Republic	493	Iceland	495
22	United Kingdom	492	New Zealand	494
23	Hungary	490	Portugal	492
24	Luxembourg	489	Australia	491
25	United States	487	Italy	487
26	Ireland	487	Slovak Republic	486
27	Portugal	487	Luxembourg	483
28	Spain	483	Spain	481
29	Italy	483	Lithuania	481
30	Latvia	482	Hungary	481
31	Lithuania	477	United States	478
32	Greece	466	Israel	463
33	Israel	447	Turkey	454
34	Turkey	445	Greece	451
35	Chile	421	Chile	417
36	Mexico	419	Mexico	409
37	Colombia	381	Colombia	391
Science				

Rank	Country	2009	Country	2018
1	Finland	554	Estonia	530
2	Japan	539	Japan	529
3	Korea	538	Finland	522
4	New Zealand	532	Korea	519
5	Canada	529	Canada	518
6	Estonia	528	Poland	511
7	Australia	527	New Zealand	508
8	Netherlands	522	Slovenia	507
9	Germany	520	United Kingdom	505
10	Switzerland	517	Netherlands	503
11	United Kingdom	514	Germany	503
12	Slovenia	512	Australia	503
13	Poland	508	United States	502
14	Ireland	508	Sweden	499
15	Belgium	507	Belgium	499
16	Hungary	503	Czech Republic	497
17	United States	502	Ireland	496
18	Czech Republic	500	Switzerland	495
19	Norway	500	France	493
20	Denmark	499	Denmark	493
21	France	498	Portugal	492
22	Iceland	496	Norway	490
23	Sweden	495	Austria	490
24	Austria	494	Latvia	487
25	Latvia	494	Spain	483
26	Portugal	493	Lithuania	482
27	Lithuania	491	Hungary	481
28	Slovak Republic	490	Luxembourg	477
29	Italy	489	Iceland	475
30	Spain	488	Turkey	468
31	Luxembourg	484	Italy	468
32	Greece	470	Slovak Republic	464
33	Israel	455	Israel	462
34	Turkey	454	Greece	452
35	Chile	447	Chile	444
36	Mexico	416	Mexico	419
37	Colombia	402	Colombia	413

Source: Organisation for Economic Co-operation and Development (OECD), 2020

Appendix 2. Correlation matrix 2009

	PVRead	Gender	ESCS	LANGN	IMMIG	Wealth	Repeat ISCED 1	Repeat ISCED 2	HOMEPOS	HEDRES	CULTPOSS
PVRead	1	-	-	-	-	-	-	-	-	-	-
Gender	-0.255	1	-	-	-	-	-	-	-	-	-
ESCS	-0.075	0.052	1	-	-	-	-	-	-	-	-
LANGN	-0.122	-0.027	-0.102	1	-	-	-	-	-	-	-
IMMIG	-0.130	0.042	0.254	0.106	1	-	-	-	-	-	-
Wealth	-0.062	0.035	0.678	-0.138	0.318	1	-	-	-	-	-
Repeat ISCED 1	-0.165	0.052	0.154	-0.074	0.109	0.194	1	-	-	-	-
Repeat ISCED 2	-0.235	0.039	0.110	-0.056	0.057	0.155	0.174	1	-	-	-
HOMEPOS	-0.062	0.035	0.678	-0.138	0.318	1.000	0.194	0.155	1	-	-
HEDRES	-0.081	0.040	0.631	-0.132	0.361	0.931	0.179	0.160	0.931	1	-
CULTPOSS	-0.096	0.047	0.487	-0.108	0.306	0.720	0.151	0.143	0.720	0.774	1

Source: PISA 2009 database

Appendix 3. Correlation matrix 2018

	PVRead	Gender	ESCS	LANGN	IMMIG	Wealth	Repeat ISCED 1	Repeat ISCED 2	HOMEPOS	HEDRES	CULTPOSS
PVRead	1	-	-	-	-	-	-	-	-	-	-
Gender	-0.176	1	-	-	-	-	-	-	-	-	-
ESCS	0.254	0.030	1	-	-	-	-	-	-	-	-
LANGN	-0.233	-0.003	-0.043	1	-	-	-	-	-	-	-
IMMIG	-0.112	0.052	-0.011	0.503	1	-	-	-	-	-	-
Wealth	-0.058	0.042	0.012	0.493	0.812	1	-	-	-	-	-
Repeat ISCED 1	-0.110	0.028	-0.031	-0.082	-0.125	-0.184	1	-	-	-	-
Repeat ISCED 2	-0.112	0.017	-0.052	-0.079	-0.131	-0.194	0.283	1	-	-	-
HOMEPOS	-0.049	0.038	0.023	0.495	0.807	0.995	-0.201	-0.196	1	-	-
HEDRES	-0.067	0.045	0.012	0.492	0.795	0.969	-0.169	-0.173	0.965	1	-
CULTPOSS	-0.075	0.044	0.012	0.463	0.749	0.915	-0.146	-0.162	0.912	0.942	1

Source: PISA 2018 database

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