CHARLES UNIVERSITY

FACULTY OF SOCIAL SCIENCES

Institute of Economic Studies

Department of Economics and Finance

Bachelor's Thesis

2021 **Ksenia Karavaeva**

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The Relationship between Sustainable Development and GDP Growth in EU Countries

Bachelor's Thesis

Author of the Thesis: Ksenia Karavaeva

Economics and Finance

Supervisor: doc. Ing. Tomáš Cahlík CSc.

Year of the defence: 2021

Declaration

1. I hereby declare that I have compiled this thesis using the listed literature and resources only.
2. I hereby declare that my thesis has not been used to gain any other academic title.
3. I fully agree with my work being used for study and scientific purposes.

In Prague on 04.05.2021 Ksenia Karavaeva

References

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Abstract

This thesis studies the relationship between four chosen Sustainable Development Goals and GDP growth in 27 EU countries. The data from WDI database was utilized to estimate the effect of education, health, inequality, and poverty on the dependent variable for the period of 30 years (1990-2019) using fixed-effects and random-effects panel data models. To conduct the analysis, the sample of countries was divided according to the time they joined the EU: earlier and later members. It was found that poverty alleviation has no significant relationship with economic growth. For the earlier members of the EU, the estimation showed that economic growth is associated with higher inequality levels, though this was not a relevant observation for the later members. No significant relationship was found between health and economic growth, contrarily, education is significantly associated with economic growth.

Abstrakt

Tato bakalářská práce zkoumá určitý vztah mezi čtyřmi vybranými cíli udržitelného rozvoje a růstem HDP ve 27 zemích EU. Data z databáze WDI byla použita k odhadu působení vzdělání, zdraví, nerovnosti a chudoby na závislou proměnnou za 30leté období (1990–2019) pomocí panelových datových modelů s fixními a náhodnými efekty. Pro analýzu byl vzorek zemí rozdělen podle doby vstupu do EU: dřívější a pozdější členové. Bylo zjištěno, že snižování úrovně chudoby nebylo významně spojeno s ekonomickým růstem. U dřívějších členů EU hodnocení ukázalo, že ekonomický růst byl spojen s vyšší úrovní nerovnosti, i když toto zjištění nebylo pro pozdější členy relevantní. Nebyl nalezen žádný významný vztah mezi zdravím a ekonomickým růstem, naopak vzdělání je silně spojeno s ekonomickým růstem.

Keywords

Sustainable Development Goals, GDP, Education, Health, Poverty, Inequality, European Union.

Klíčová slova

Cíle Udržitelného Rozvoje, HDP, Vzdělávání, Zdraví, Chudoba, Nerovnost, Evropská Unie.

Název práce

Vztah mezi udržitelným rozvojem a růstem HDP v zemích EU

Acknowledgement

I would like to express my gratitude to my supervisor doc. Ing. Tomáš Cahlík CSc. for his guidance, valuable advice and comments that improved my work.

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1. Introduction

The concept of sustainable development, which emerged from a series of Conferences and Summits, is relatively recent as the first efforts towards a new growth model that would allow economic growth, environmental quality, and social prosperity to coexist, were made in the late 1980s. Prior to that, many international meetings were held in order to define and develop new ideas of sustainability and tackle increasing inequality, poverty, environmental degradation as well as decreasing human health. In 1972 the Conference on Human Environment was organized by the United Nations to address the global environmental issues. The main purpose of the conference was to promote sustainability globally by means of international cooperation and to preserve the natural environment. Economic growth has the potential to diminish many problems: more economically advanced countries gain access to resources that provide healthcare, food, and shelter to their populations. Lifting developing countries out of poverty and removing the potential need for foreign aid as well as allowing them to develop can be achieved by focusing on economic growth. The developing, emerging and developed countries rapidly progressed, reflecting in higher rates of GDP growth. Humanity has achieved major advances in various areas over the past decades, which improved the standard of living considerably.

The UNCED[1] or Earth Summit which occurred in 1992 in Rio de Janeiro, unified the international originations, government officials, and representatives of NGOs[2]. It became the foundation of sustainable development and ensured a global partnership targeting significant improvements in environmental quality. The "Agenda 21: a program of action for sustainable development" (consensus of 178 states of how to secure future) was adapted as a result of the conference. It illustrated the main issues the society must overcome: poverty, illiteracy, continuously growing population, declining health, world hunger. Among the 40 chapters, each challenge is identified, while proposing a realistic solution.

The World Summit on Sustainable Development was held in Johannesburg, South Africa

[1] [1] United Nations Conference on Environment Development

[2] Non-government organizations

in 2002. Its main goal was to highlight the importance of health as a primary resource and an outcome of sustainable development. Health is one of many forms of human capital that shapes the capabilities of people, their behavior and ensures work productivity and the ability to invest in human capital. Therefore, the goals of sustainable development cannot be achieved without a healthy population.

Economic growth has the potential to diminish many problems: more economically advanced countries gain access to resources that provide healthcare, food, and shelter to their populations. Lifting developing countries out of poverty and removing the potential need for foreign aid as well as allowing them to develop can be achieved by focusing on economic growth. The developing, emerging and developed countries rapidly progressed, reflecting higher rates of GDP growth. Humanity has achieved major advances in various areas over the past decades, which improved the standard of living considerably. This field of research is crucial as it has the potential to show that each country in the European Union has to have individual policy implementation and a more complex approach when choosing suitable policies for each member country.

In this paper, the impact of four chosen SDGs on GDP growth in the EU countries is studied empirically. The contribution of the following research to the existing literature is twofold. Firstly, the mutual effect of poverty, inequality, health and education on economic growth was introduced for the EU countries. Most of the existing literature concentrates on the separate sustainable development goals, for instance, Ashraf et al (2009), Benos and Zotou (2014), Bloom et al (2019), which can potentially lead to biased estimates. The results show that such sustainable development goals as poverty alleviation and health improvement are almost not relevant for the EU members. Secondly, the heterogeneous effects of inequality and education on the EU members were found. While for the early EU members economic growth is associated with inequality and education, the economic growth of the late EU members is based mostly on the traditional growth determinants, including investment, international trade, and population growth. To the best of my knowledge, this research is the first to tackle the problem of heterogeneous effects of sustainable development goals on the economic growth of the EU members.

Based on the literature review and on the 2030 Agenda for Sustainable Development three hypotheses were formulated:

H1: Poverty alleviation promotes economic growth

H2: Inequality interacts with poverty and negatively influences economic growth

H3: Health is more relevant to economic growth than education.

According to the conducted analysis, out of four hypotheses, poverty alleviation has no significant effect on economic growth. Economic growth was found to be associated with higher levels of inequality for the countries that joined the EU earlier, however, this relationship is not valid for the later members. Contrary to the expectations, health has no significant relationship with economic growth, while education was found to be associated with it significantly.

This paper is structured in the following order: Section 2 includes a theoretical framework, a literature overview on the previous research, the table describing additional relative studies and analytical methods used in them, and three hypotheses formulated based on the gathered information. In Section 3.1 the definition of variables can be found as well as the data sources. Sections 3.2 and 3.3 contain the description of methodology and empirical model followed by the description of the results. The last section consists of concluding remarks with a summary of the key findings and a brief discussion of the weaknesses and strengths of this study.

2. Related Literature

There are a number of important studies performed to examine the issue of sustainability. For instance, in the 2011 study "The Analysis of Research on Sustainable Development…" by S. K. Szabo it is claimed that sustainable development is a constantly evolving concept that contributes to a rise in quality of life, bearing in mind efficient use of resources. The author found that European policies need to be based around sustainable development, however, in reality, competition dominates the political agenda.

The United Nations General Assembly set 17 interdependent SDGs[3] in 2015 that, according to the UN organization, are "a blueprint to achieve a better and more sustainable future for all". They address the global challenges we face, including poverty, inequality, climate change, environmental degradation, peace, and justice". This paper will focus on an in-depth analysis of 4 SDGs and their influence on economic growth, specifically Goal 1: No Poverty, Goal 3: Good Health and Well-being, Goal 4: Quality Education, Goal 10: Reduce Inequalities.

1. Poverty and Economic Growth

The first SDG strives to *"end poverty in all forms everywhere".* Alleviating poverty has been one of the key goals of policymakers for many decades. Poverty is a lack of income defined by a predetermined poverty line. As stated by the World Bank, income below US$1.90[4] is considered extreme poverty, meaning that people struggle with fulfilling their basic needs for shelter, sanitation, food, and more. According to UN statistics, the percentage of people living under extreme poverty conditions decreased from 36% (1.9 billion) in 1990 to 10% (735 million) in 2015. However, new research published by UNU World Institute for Development Economics Research suggests that due to the global pandemic, this number could increase by 500 million people. It is possible to point out that our society has experienced shocks, for instance, following the economic crisis in 2008, which lead to instability, stagnation, and consequently increased poverty across the EU. (Stockhammer, 2015)

One of the most famous paradigms written about poverty is Peter Townsend's relative deprivation concept. Townsend explains that poverty can only be measured "objectively and applied consistently only in terms of the concept of relative deprivation… Individuals,

families, and groups in the population can be said to be in poverty when they lack the resources to obtain the types of diet, participate in the activities, and have the living conditions and amenities which are customary…" In other words, poverty can be defined as "command over insufficient resources over time", which results in deprivation. (Townsend, 1979) Some researchers tried to demonstrate the relationship between poverty and economic growth, for instance, Sachs (2006) remarks that as a result of low income, people cannot escape the self-enforcing mechanism of poverty traps. Therefore, they have no resources to invest in their health, in physical or human capital, leading to reduced investments in the economy and, consequently, decreased productivity of the workforce. (Bain *et al.*, 2013) Lopez and Servén (2009) had similar findings and present the evidence that poverty affects growth through investment: high poverty rates avert investment, lowering economic growth. Society undoubtedly has made considerable progress against poverty over the last century, however, most of the progress can be seen in developed countries only. In recent years, greater progress is proposed in developing countries as well.

The demographic phenomenon that occurred in the 21st century is the aging population caused by increasing longevity and declining mortality and fertility rates. This undoubtedly changes the population's capacities and needs. As stated by Perkins et al in "Economics of development", households with lower income do not have access to adequate pension schemes, therefore the dependence of the elderly on their children increases. Later in life, there is a significant risk of becoming poor, while the likelihood of remaining in poverty increases. The working hours are reduced or the elderly stop working completely due to health issues or retirement options. There is no guarantee for income security, making the elderly population economically uncertain with no options to escape poverty. Miles (1999) indicates that the aging population reduces national savings and generates a decrease in real output per capita. Faruqee and Tamirisa (2006) illustrate the macroeconomic effects of the aging population and review the policy responses to this phenomenon. Their research was focused on the Czech Republic due to the potential population aging, including the predictions of elderly populations until 2050. They were able to conclude that in the long run, the change in demographic distribution is likely to reduce GDP by 30%. Also, the savings rate will decrease as the extra aging population expenditures will be covered by borrowing. The authors conclude that increasing labor participation rates will lessen the negative impact of a larger share of the

elderly.

Poverty and disability are two related topics: living in poverty may escalate the risk of disability and being mentally/physically challenged adds to the risk of poverty, people without a disability are on average less likely to be exposed to the risk of poverty and social exclusion that those with an impairment. It is important to note that there are differences throughout nations, however in both developed and developing countries, disabled people are on average more likely to be exposed to the risk of poverty or social exclusion: they tend to have lower levels of education, it is less likely for them to have savings and more likely to have income below the poverty line than the rest of population.

According to the data provided by Eurostat, in Eastern Europe extreme maternal deprivation is more frequent: 35.9% of the disabled population are severely poor in Bulgaria, while in Sweden the share is 3.8%. Financial assistance and support services do not result in the same level of income for disabled people compared to their non-disabled peers. In spite of employment programs and government programs, the physically/mentally impaired still face a higher risk of poverty. 19.2% of the EU population older than 16 years of age without an activity limitation was at risk of poverty or social exclusion in 2018, compared to a significantly higher 28.7% of those with an activity limitation. Additionally, 68% of people with disabilities were at risk of poverty without social benefits, allowances, or access to pensions. An indicator of labor market integration for disabled people in poverty among the working population or in-work poverty. 11% of employed people with impairments were at risk or poverty, with the highest values observed in Luxembourg (20.5%), Romania (20.4%) and Greece (16.4%) and the lowest in the Czech Republic (5.3%), Denmark (4.8%) and Finland (3.5%).

The results of Salvatore and Campano (2012), based on the database of income distributions from 1980 to 2005, illustrate that the income gap between developed and developing countries had been closing due to the rapid growth rates (which occurred, for example, in India and China). However, one of the conclusions the authors reached is that it would take hundreds of more years with the present growth rates for developing countries to close the income gap with developed countries.

2. *Inequality and Economic Growth*

The tenth SDG states *"to reduce inequalities, policies should be universal in principle, paying attention to the needs of disadvantaged and marginalized populations"*. As reported by the UN, nowadays the gap between rich and poor in most OECD countries has reached its peak in the last 30 years. The inequalities within and among countriesare so broad that the richest 10% of the OECD area population earns 9.5 times more than the poorest 10%. During the last quarter of the 20th century, the ratio was 7:1 and it has been continuously growing. Even during periods of economic expansion, incomes of the poor grew at a slower rate and fell significantly during the recession, raising concerns for policymakers. (Cingano, 2014) Several researchers throughout the years focused their attention on the relationship between inequality and growth and whether growth leads to inequality. Kuznets (1955) proposed the Kuznets curve hypothesis (an inverted U-shaped relationship between income inequality and GNP per head) that states that as income increases during the early stages of development, income distribution is expected to worsen at first and later improve as a result of a larger section of the population takes part in the rising national income. Some researchers, however, came to mixed findings: Milanovic (1994) and Fishlow (1995) supported the Kuznets hypothesis, while Bourgoignon and Morrisson (1997), Deininger and Squire (1998) found the relationship to be weak.

The methods to promote growth through inequality were illustrated in older works, for example, Lazear and Rosen (1981) suggested that inequality encourages incentives for innovations and entrepreneurship, while Barro (2000) claimed that inequality allows accumulating the minimum needed to get a good education and start a business for some individuals. Other researchers, however, point out that inequality delays growth, for instance, de la Croix and Doepke (2003) propose that inequality leads to a rise in the fertility of the poor and therefore reduces the accumulation of human capital and growth. Similarly, Galor and Zeira (1993) advocate the view under-investment in human capital is a consequence of inequality. Alesina and Rodrik (1994) showed that growth was harmed by inequality through political economy channels and a higher rate of income inequality leads to a higher rate of taxation and lower growth. Social and political instability caused by unequal income distribution is likely to result in lower growth. Asa consequence, resources are misallocated and uncertainty in political and economic

environments takes place, leading to instability and reduced incentives to invest. (Alesina and Perotti, 1996) Keefer and Knack (2002) advocate the view that "social polarization" and tension between different ethnicities prevail in countries with a lower level of equality leading to "reduced security of property and contract rights" and, therefore, reduced growth.

Recent papers, for instance, by Halter et al (2014) and Easterly (2007) tend to converge toward a consensus that inequality is harmful to the sustainability and speed of economic growth in the long run. Using a sample of OECD countries, Cigano (2014) also finds that inequality interacts with human capital and has a negative statistically significant impact on economic growth. The regressions used in this study control for investment, initial income, and education. The author claims that "what matters most is the gap between low-income households and the rest of the population. In contrast, no evidence is found that those with high incomes pulling away from the rest of population harms growth". (Cingano, 2014) Berg et al (2018) examine the sample of countries from all over the world and indicate that faster economic growth can be attained by lower net inequality. Baseline regression is used in their research where inequality, redistribution, and initial income are included, followed by adding investment, education, and population growth. This allowed researchers to evaluate their results on a broader set of control variables. According to the authors, more unequal societies have higher redistribution tendencies which do not have an effect on economic growth. The findings show that lower education and life expectancy are the channels through which inequality negatively impacts growth.

According to the research of Latin American countries between 1970 and 1994 by De Janvry and Sadoulet (1999), the growth of income decreases poverty in rural and urban areas, not inequality, however. Recessions tend to have stronger effects on inequality and poverty than expansions. Also, poverty increases during recessions and falls with income growth, although it is only possible to reduce urban poverty (rural poverty is less responsive to both) when inequality does not exceed a certain (low) level. This means that a given country where the level of inequality is high, cannot rely solely on growthto battle poverty. Housseima and Ben Rejeb (2012) aim to estimate the relationship between poverty, inequality, and economic growth. Their results illustrate that an increase in inequality also increases the proportion of poor, while a 1% increase in GDP per capita leads to a 0.40% fall in the poverty rate. When the Gini coefficient increases by 1%, the

poverty rate rises by 3.26%. This means that if inequality rises, it prevents growth.

Due to the fact that there is a complex relationship between poverty and inequality, in this work, the influence of both indicators on economic growth will be empirically tested. This research contributes to the existing literature as there is not a lot of previous works that would include both parameters and discover their effect.

3. Health and Economic Growth

The third SDG strives *to "ensure healthy lives and promote well-being for all at all ages"*. The research on the topic of health and the resulting economic outcomes covers both macroeconomic and microeconomic levels. The studies on the household level show evidence that health is an important economic performance determinant of an individual. Exposure to diseases and poor childhood health are linked to lower wages and the productivity of adults. Macroeconomic studies emphasize a strong correlation between per capita income and life expectancy or other measures of health. (Ashraf, Lester and Weil, 2009)

As stated by Bloom and Canning (2008) "Health is a direct source of human welfare and also an instrument for rising income levels". This is a rather straightforward relationship: better health can be achieved through higher income, for instance, through access to clean water and sanitation, improved quality of nutrition, and access to healthcare. In their earlier study, Bloom and Canning (2000) claim that health is a consequence, as well as a cause of health, and this "two-way causality" works through a number of mechanisms. First of all, health affects labor productivity as healthier workers are more productive and are less likely to be absent from work due to illness. Later, Bloom and Canning (2005) find that a 1% increase in adult survival rates leads to a 2.8% rise in labor productivity, claiming that their results "would imply a larger role for health than education". Supporting evidence to this claim can be found in a paper by Mayer-Foulkes (2001) who also argued that sickness and a fall in hours worked decrease overall productivity and physical and mental capacities of workers. On the other hand, a healthy population corresponds to an increase in wages and productivity. Secondly, health affects savings, because increased longevity raises the incentive to save for retirement, allowing for higher levels of wealth later in life. Additionally, a healthy workforce is likely to raise incentives for business investment. Thirdly, there is an effect of health on education: health in the

early stages of life has a direct effect on the ability to learn and attend classes, and on further cognitive development of the child. It is also possible that improved health in adults rises the incentives to invest in the education of their children to promote the opportunities and ensure higher income.

Many studies have investigated the effect of health on economic growth. For instance, Knowles and Owen (1997) provide evidence of there being a significant statistical relationship between economic growth and health (proxied by life expectancy), while education has a minor role. Mcdonald and Roberts (2002) conducted an empirical analysis to test whether capital consists of more complex constitutes than knowledge capital. The researchers augmented the Solow growth model to incorporate "both health and education capital". Using panel data analysis of 77 countries, the authors found that health capital affects economic growth rates significantly and, when health capital is omitted from augmented Solow growth models, it produces misspecification biases. (McDonald and Roberts, 2002) Mayer et al (2001) emphasized the role of health over the role of education. As stated by the author, health increases growth through increased economic participation of women and a rise in productivity. Van Zon and Muysken (2003) claim that the main determinant of economic growth is health. The authors also state that there is a two-way relationship between health and growth, and an increase in human and physical capital investment is a consequence of higher growth. The findings of French (2012) state that higher income affects health and better health positively impacts income. However, other researchers came to different conclusions. For instance, Webber (2002) measured health "in terms of the intake calories per head" and found that "this proxy" does not have a significant effect on economic growth. The main finding of this paper was that education has a positive impact on economic growth, which is in line with previous empirical literature that "assesses the statistical impact of education on economic growth". Cooray's (2013) findings establish that there is no significant effect of health capital on economic growth unless it interacts with education and health expenditure.

4. Education and Economic growth

The fourth SDG states that *"obtaining a quality education is the foundation for improving people's lives and sustainable development"*. According to the UN, "education enables upward socioeconomic mobility and is a key to escaping poverty". Economic performance is strongly related to the education system of the nation. It is considered that

education is a key investment in human capital as, by its means, an individual is able to apply their intellectual abilities that are crucial in a developed world. A concept of "absorptive capacity" was developed by Cohen and Levinthal (1990). It is the ability of the individual to utilize prior knowledge, which may be in a form of some basic skills or recent developments in a specific field. Prior knowledge enables one to recognize the value of new knowledge, acquire it, and apply it given the opportunity. Together, these form so-called absorptive capacity, which is improved by education. Many studies, for example, Barro (1991) or Romer (1990), consider education to be the main form of human capital. Todaro and Smith's (2000) findings propose that in the developing countries, 40% of people are illiterate, $\frac{1}{4}$ of 6 to 12 years old children do not attend primary school, while 80% of 12-18 years old teenagers do not enter secondary education facilities. As a result, developing countries are left with unskilled labor and high rates of unemployment which decelerates economic growth. High quality of education ensures higher wages, which helps to diminish inequalities.

Hall and Jones (1999) used the evidence found by Psacharopoulos (1994) on the "profitability of investment in education". The rate of return for the first four years of education was found to be 13.4%, the next four years the value of 10.1% was reported and, finally, for education beyond eight years, the rate of return is 6.8%. Hall and Jones (1999) interpreted these results and concluded that an individual is to earn a 13.4% higher wage compared to those who did not acquire any formal education. Further, the additional year of education "contributes to differentiation in wages for different individuals". Thus, the literature on the topic of education and growth shows that there are decreasing returns to education, meaning that the difference between obtaining primary education and being illiterate has a higher impact on wages than obtaining secondary and further education. This illustrates the nonlinearity of the relationship between education and growth. Self and Grabowski conducted a case study on the Indian population and found that there was a strong link between primary education and economic growth, weaker evidence between secondary education and growth, and almost no evidence for a link between tertiary education and growth. The evidence gathered on annual average schooling years by Pereira and St. Aubyn (2005) is similar to the previous case study, however, secondary education, as well as primary, was found to have a significant and positive effect on growth.

The findings of Li and Liang (2010) establish the positive impact of education on economic growth, however, once the additional variable representing health was added, the statistical impact of health was found to be stronger than that of education. Benos and Zotou (2014) carried out a meta-regression analysis of 57 studies to illustrate the "publication selection bias towards the positive impact of education on growth". Only a few studies in the sample examined the combined effect of health and education.

In the recent studies on the Nigerian population, Ogundari, and Abdulai (2014), using survey data, propose that a healthier workforce with better education not only discover advanced technologies but also adapt to a rapidly changing society to a greater extent. Bloom et al. (2004) also claim that the joined effect of education and health on economic growth is what provides a productive labor force and, as a result, stimulates economic growth. Ogundari and Awokuse (2018), using a dynamic model based on SGMM, establish that the two measures of human capital, specifically education and health, positively influence economic growth, also claiming that health has a larger effect. Cross-country analysis and the empirical evidence could have potential benefits for policymaking, therefore, in this paper, the cross-country analysis of the combined effect of health and education on the countries of the European Union is conducted.

For the purpose of convenience, the table below was constructed in order to illustrate the approaches taken by other researchers to demonstrate the effect of sustainable development goals on GDP growth.

Poverty

Paper	*Variables used*	*Sample and Period*	*Methodology*	*Effects found*
Breunig and Majeed (2020) "Inequality, Poverty and Economic growth"	Investment to GDP ratio, Gini coefficient, Years of Schooling, Log population growth, price of an investment, trade share of GDP, relative redistribution	128 countries 1956-2011, inequality dataset from Solt (2009)	First difference and system GMM	Inequality is linked to high levels of poverty and it has a negative and significant impact on growth.
Bosco (2019) "One size does not fit	Institutional quality, GDP per capita, Total public expenditure, local	31 European countries	Quantile Regression	Poverty is not significantly affected by the total public

all: Quantile regression estimates of cross-country risk of poverty in Europe	expenditure as a percentage of total public expenditure, annual labor income share, corruption in the public sector, uninterrupted democracy, percentage of people between 30-34 years old holding a tertiary level degree, patent application.			expenditure, Institutional quality tends to reduce poverty, differences in poverty among countries are related to GDP.
Lopez and Severin (2006) "A normal relationship? Poverty, Growth and Inequality"	Income, Gross Income, Net Income, Expenditure, Headcount ratio, Poverty Gap, GDP growth, Share of variance in poverty changes, Gini Coefficient	100 countries, 40-year period.	Lognormality tests: Pooled OLS, Random effects model, Nested error component model.	The influence of growth on poverty is stronger in richer countries compared to poorer countries, meaning that poor countries will struggle with achieving fast poverty reduction.

Inequality

Paper	*Variables used*	*Sample and Period*	*Methodology*	*Effects found*
Aiyar, Shekhar, and Christian Ebeke. (2020) "Inequality of Opportunity, Inequality of Income and Economic	Real GDP per capita growth, Lagged real per capita GDP, Investment-to-GDP, Trade openness, Secondary school education, Intergenerational immobility, Gini coefficients	166 countries 1950-2015	OLS, System-GMM, Fixed effects	The lower the intergenerational mobility, the more income inequality diminishes growth.

Barro (2000) "Inequality and Growth in a Panel of Countries"	GDP per capita, Rule-of-law index, Ratio of government consumption to GDP, Democracy index, Inflation rate, Years of schooling, Total fertility rate, Ratio of investment to GDP, Growth rate of terms of trade, Gini coefficients as a measure of income inequality, quantile shares	100 countries (1960-1995)	Panel regression analysis, three-stage least squares, random effects	Little overall relation between income inequality and rates of growth and investment. Inequality diminishes growth in poorer countries while encouraging it in richer countries.
De la Croix and Matthias (2003) "Inequality and Growth: Why differential fertility matters"	Differential fertility variable, Initial GDP per capita, Average ratio of investment to GDP, Average ratio of government expenditure to GDP, Initial GINI coefficient for income distribution.	68 countries (1960-1992)	GMM	Families with a lack of experience and skills have more children and invest less in education. As income inequality and fertility differentials rise, the growth rate of human capital reduces.
Lopez and Severin(2006) "A normal relationship? Poverty, Growth and Inequality"	Income, Gross Income, Net Income, Expenditure, Headcount ratio, Poverty Gap, GDP growth, Share of variance in poverty changes, Gini Coefficient	100 countries, 40-year period.	Lognormality tests: Pooled OLS, Random effects model, Nested error component model.	Inequality hinders poverty reduction due to its negative effect on inequality elasticity of poverty and on growth elasticity of poverty.

Education

Paper	*Variables used*	*Sample and Period*	*Methodology*	*Effects found*
Benos and Zotou (2014) "Education and Economic Growth: A Meta-Regression Analysis"	Education: literacy, enrollment, schooling years, student-teacher ratio, educational expenditure, scores Output: GDP per capita	57 studies 1989-2011	Meta-regression analysis and meta-regression model	Publication selection bias, no representation of education effect on growth.
Hongyi and Huang (2009) Health, education, and economic growth in China: Empirical findings and implications	Education: Ratio of student to teacher for primary school, the proportion of people with secondary and above education. Real GDP per capita, investment savings ratio, population growth rate, depreciation rate, technological progress.	28 provinces in China (1978-2005)	OLS, fixed-effect model, random coefficient model, Two-Stage Least Square estimation	Investment in education and health has positive effects on economic growth. Education investment is statistically more important than health investment.
Meulemeester and Rochat (1995) "A causality analysis of the link between higher education and economic development"	The number of students enrolled per capita, constant prices GDP per capita	Sweden, UK, Japan, France, Italy, Australia	Dickey-Fuller unit root test, Granger causality.	Granger Causality was found running from higher education to economic growth in 4 out of 6 countries, suggesting that the relationship is not linearly mechanistic. Education can promote growth in case its content is aimed at it.

Ogundari and Awokuse (2018) ” Human capital contribution to economic growth in Sub-Saharan Africa: Does health status matter more than education?”	Real GDP per capita, investment share of real GDP per capita, trade openness, population size, education enrollment ratio, average of education, government expenditure on education	35 countries from Sub-Saharan Africa (1980-2008)	SGMM	Primary and secondary school enrolment coefficients and average years of schooling have a positive and statistically significant effect on economic growth. Tertiary school enrolment coefficients and government expenditure on education are not statistically significant.

Health

Paper	*Variables used*	*Sample and Period*	*Methodology*	*Effects found*
Ashraf et al (2009) “When does improving health raise gdp?”	Shift in life expectancy at birth from 40 to 60, eradication of malaria and tuberculosis	cross-sectional data from 14 WHO sub-regions, per capita YLDs for men aged 30–44 and boys aged 0–4	Simulation model, Cobb-Douglas production function	In LR large improvements in health result in a modest increase in GDP per capita, this effect takes decades to arrive. Further, controlling malaria and tuberculosis produce a small effect.
Bloom et al (2019)	Adult survival rates, years of schooling in working-age population, life expectancy,	Unbalanced panel of 116 countries	OLS, Fixed effects regression,	The international difference in levels of outcome per worker

"Health and economic growth: reconciling the micro and macro evidence"	years of secondary and total schooling, compulsory schooling years, aggregate experience, quality of economic institutions,	1970-2010	Instrumental variables, Panel GMM	is influenced by health. Public health measures as vaccinations and antibiotic distribution encourage economic development.
Arusha V. Cooray (2013) "Does health capital have differential effects on economic growth?"	Initial GDP per capita, Investment ratio, enrollment ratio (f/m), life expectancy(f/m), money supply, government expenditure, trade, Fertility rate,	210 countries (1990-2008)	OLS, system GMM	Health capital does not have a significant and robust effect on economic growth, only through interactions with health expenditure and education.
Declan French (2011) "Causation between health and income: a need to panic"	Life expectancy at birth, Real GDP per capita	13 OECD countries (1960-2007)	Cross-Sectional dependence, Unit roots, Cointegration tests	Improved health leads to an increase in income, income also affects health, bidirectional causation.
Hongyi and Huang (2009)	Health: the number of hospital beds per 10,000 persons, the number of doctors per 10,000 persons	28 provinces in China (1978-2005)	OLS, fixed-effect model, random coefficient model, Two-Stage Least Square estimation	Education and health investment has positive effects on economic growth. While considering both variables simultaneously, their significance levels are not reduced.
Ogundari and Awokuse (2018)	Real GDP per capita, investment share of real GDP per capita, trade openness, population size, life expectancy at birth	35 countries from Sub-Saharan Africa (1980-2008)	SGMM	Health has positive and statistically significant effect on economic growth. Health measure of

				human capital has larger contribution to economic growth than education measure when comparing the estimated human capital elasticity.

After taking into consideration the related literature, the results of the analysis can be predicted. It is expected that poverty and inequality are related and together, these variables negatively affect economic growth. Higher levels of education and health, on the other hand, are linked to the economic growth and development of the EU countries.

3. The Analysis of Sustainable Development Goals and GDP Growth in the EU Countries

1. Data and Data Sources

In the previous research, the outcome variable (real GDP growth) is obtained from different sources and it is also based on different measures of real GDP. Aiyar and Ebeke (2020) and Breunig and Majeed (2020) in their works use real GDP at constant national prices obtained from Penn World Tables (hereafter – PWT) which is then manually divided by population size to calculate real GDP per capita. Ogundari and Awokuse (2018) use real GDP per capita adjusted by Purchasing Power Parity. In this thesis, real GDP per capita is used at constant national prices obtained from the World Development Indicators (hereafter – WDI) database, due to the reason that the adjustment of this measure by PPP may distort the data by measurement error.

Then real GDP per capita is used to calculate annual real GDP growth following the formula below:

$$y_{it} = \frac{GDP_{it}}{GDP_{it-1}} - 1$$

As a measure of inequality Aiyar and Ebeke (2020) propose a Gini coefficient obtained from a comprehensive dataset (All the Ginis) compiled by Branko Milanovic, while Breunig and Majeed (2020) use the Gini coefficient from an inequality dataset from Solt (2009). In this research, the Gini index from the WDI database is utilized.

To measure poverty, Breunig and Majeed's methodology is followed and the poverty headcount ratio (US$1.90 per day at purchasing power parity) is taken from the WDI database and utilized.

According to Ogundari and Awokuse (2018), education can be measured either by enrolment ratios for primary, secondary and tertiary levels, years of schooling, or government expenditures on education from the CANA database. In this thesis enrolment ratios are used (for primary, secondary and tertiary levels), government expenditures on education, and pupil-teacher ratio on a primary level all collected from the WDI database, Average years of schooling are presented in the WDI database for every 5 years only, hence, this indicator was dropped.

Health is represented by three indicators: life expectancy at birth as proposed by Ogundari and Awokuse (2018); health expenditures of government in % of GDP and number of hospital beds (per 1000 people) as proposed by Li and Huang (2009). All indicators are obtained from the WDI database.

A vector of control variables according to the previous research (Aiyar and Ebeke, 2020; Breunig and Majeed, 2020; Li and Huang, 2009; Ogundari and Awokuse, 2018) includes population growth, trade openness, fertility rate, and investment in fixed capital as a share of GDP.

Table 3.1 describes the main variables used in the empirical estimation of the model:

Table 3.1. Description of variables

Variable name	**Definition**
Panel A: Variables regarding economic growth	
GDP growth	Annual growth rate of real GDP per capita (in percent)
Panel B: Variables regarding inequality	
Gini index	A measure of income distribution deviation from the perfectly equal income distribution among individuals. Gini index of 0 means perfect equality of income and Gini index 100 means perfect inequality of income
Panel C: Variables regarding poverty	
Poverty headcount	Poverty headcount ratio at $1.90 a day is the share of population which earns less than $1.90 a day at constant 2011 international prices
Panel D: Variables regarding education	
Primary (secondary, tertiary) enrolment	Gross enrollment ratio for primary (secondary, tertiary) school is calculated by dividing the number of students enrolled in primary (secondary, tertiary) education regardless of age by the population of the age group which officially corresponds to primary (secondary, tertiary) education, and multiplying by 100 (WDI, 2020)
Education expenditures	Government expenditure on education expressed as a percentage of GDP
Pupil teacher ratio	Average number of students at the primary level divided by the number of teachers
Panel E: Variables regarding health	
Life expectancy	The number of years a newborn is expected to live according to the prevailing patterns of mortality at the time of birth

Health expenditures	Government expenditure on health expressed as a percentage of GDP
Hospital beds	Inpatient beds available in public, private, general, and specialized hospitals and rehabilitation centers expressed per 1000 people
Panel F: Control variables	
Investment	Gross fixed capital formation representing the share of GDP spent on land improvements; plant, machinery, and equipment purchases; and the construction of roads, railways, schools, offices, hospitals, private residential dwellings, and commercial and industrial buildings
Trade share	Sum of exports and imports of goods and services expressed as a percentage of GDP
Fertility rate	Average number of children that is born to a woman
Population growth	Annual growth rate of population (in percent)

The data is collected on these variables for 27 EU countries (excluding the United Kingdom due to Brexit) for the period of 30 years (1990-2019). The descriptive statistics for the whole dataset are displayed in table 3.2 below.

Table 3.2. Descriptive statistics of the variables in the empirical model

Variable	*Obs*	*Mean*	*Std.Dev*
GDP growth (growth)	782	4.31	55.39
Gini index (gini)	427	31.23	3.8
Poverty headcount (poverty)	427	0.58	0.93
Primary enrolment (primenrol)	759	101.13	5.87
Secondary enrolment (secenrol)	759	104.01	16.72
Tertiary enrolment (tertenrol)	737	52.73	22.21
Pupil teacher ratio (ptratio)	577	14.68	3.64
Education expenditures (educexp)	568	5.04	1.15
Life expectancy (lifexpect)	783	76.83	3.68
Health expenditures (healexp)	482	7.89	1.73
Number of beds (beds)	627	6.43	2.11

Investment (invest)	786	22.37	3.98
Trade share (tradeshr)	786	109.29	61.46
Fertility rate (fert)	783	1.54	0.24
Population growth (popgrowth)	809	9	131.98

It is important to note that the panel is unbalanced and contains missed values for many variables. Particularly, the Gini index and Poverty headcount have the smallest number of observations together with health expenditures. For all variables variation in data is large enough, which gives a chance to estimate model parameters consistently.

2. *Models and Methodology*

To verify the hypotheses stated at the beginning of the chapter, the following econometric model is formulated, based on similar research in the field (Ogundari and Awokuse, 2018):

$$y_{it} = \alpha_0 + \varphi y_{it-1} + \beta_1 ineq_{it} + \beta_2 pov_{it} + \beta_3 heal_{it} + \beta_4 educ_{it} + \delta X_{it} + \gamma_i + \delta_t + \varepsilon_{it} \tag{3.1}$$

Where y_{it} is a real GDP per capita growth rate in country *i* in year *t*;
y_{it-1} is the lagged real GDP per capita growth rate in country *i* in year *t-1*;
$ineq_{it}$ is the variable measuring inequality in country *i* in year *t*;
pov_{it} is the variable measuring poverty in country *i* in year *t*;
$heal_{it}$ is the variable measuring inequality in country *i* in year *t*;
$educ_{it}$ is the variable measuring inequality in country *i* in year *t*;
X_{it} is a vector of relevant macroeconomic control variables which affect real GDP per capita;
γ_i is country-specific effects;
δ_t is time-specific effects;
ε_{it} is the error term of the regression.

Depending on the nature of the unobserved country-specific effects γ_i the models can be specified either as random effects or fixed effects model.

For random effects model the following set of assumptions must be satisfied (Wooldbridge, 2010):

1 a. $E[\varepsilon_{it}|\boldsymbol{x}_{it}, \gamma_i] = 0, t = 1, \dots, T$

1 b. $E[\ \gamma_i|\boldsymbol{x}_{it}] = E\ [\gamma_i] = 0$

2. No multicollinearity in regressors (full rank of matrix $E[\boldsymbol{X}_i'\boldsymbol{\Omega}^{-1}\boldsymbol{X}_i]$)

3. Homoscedasticity of the regression error

where $\boldsymbol{x}_{it}$ is the vector of regressors.

For fixed effects models the following set of assumptions must be satisfied (Wooldridge, 2010):

1. $E[\varepsilon_{it}|\boldsymbol{x}_{it}, \gamma_i] = 0, t = 1, \dots, T$

2. No multicollinearity in regressors (full rank of matrix $E[\boldsymbol{X}_i'\boldsymbol{X}_i]$)

3. Homoscedasticity of the regression error

In order to verify particular assumptions, statistical tests are employed.

Assumption 2 can be verified by observing the joint correlation of the regressors included in the model.

Assumption 3 in the case of panel data is usually tested for the presence of serial autocorrelation. The Traditional Durbin-Watson test can be applied for RE models, while for FE models Wooldridge within-based test is more appropriate (Croissant and Millo, 2019). The null hypothesis of both tests is the absence of serial autocorrelation in RE or FE residuals. If the null hypothesis is rejected, then serial correlation must be controlled for, for instance, the inclusion of lagged dependent variables. If errors are heteroscedastic but serially uncorrelated, the robust standard errors are estimated to facilitate a correct statistical inference.

Additional statistical tests can be employed to verify the presence of unobserved effects and to discriminate between RE and FE models.

Testing for the presence of an unobserved effect can be done with the help of the Breusch-Pagan (1980) test as suggested in Wooldridge (2010) or Biorn (2017). This test is a Lagrange multipliers test based on the OLS residuals, which has a null hypothesis of absence of individual (or time, or both) effects. If the test is rejected, the unobserved effects are present.

It is obvious that the RE model is more restrictive than the FE model because it imposes the independence of unobserved effects from other regressors. If this assumption holds then RE estimators can have smaller variance than FE estimators and this is the advantage of RE estimators. In order to choose between RE and FE approach, the popular Hausman (1978) test can be used. The null hypothesis of this test is that both RE and FE estimators are consistent but RE is more efficient. If the null is rejected, then we prefer the FE estimator because RE is inconsistent.

Model (3.1) is estimated with random effects and fixed effects estimators, using one independent variable from each group with the largest number of observations (gini, poverty, primenrol, lifexpect) first for the whole sample of countries and then separately for two subsets of countries: early and late members of the EU.

According to the hypotheses, the signs of both β_1 and β_2 are expected to be negative while β_3 and β_4 to be the positive and normalized size of β_3 is larger than β_4.

The idea to separate sustainable development indicators into different regressions comes from the fact that they can be mutually correlated. Thus, in order to ensure the Assumption 2 of RE and FE models hold, each variable is used separately with the whole set of controls.

The division of a sample into early and late members of the EU is based on the macroeconomic growth models, which assume that in rich countries GDP growths slower, while relatively poorer countries have a so-called "catch-up" effect, which is represented by faster GDP growth (see, for example, Romer, 2012).

The availability of alternative indicators for education and health allows for robustness checks which can support or discard the main estimation results. Now we proceed to the estimation and the discussion.

3. Estimation and results

As the first step, the correlation matrix is built between the independent variables in order to prevent multicollinearity issues. The result is presented in figure 3.1.

There are several potentially problematic groups of variables: Gini index and poverty headcount are highly positively correlated (0.62). Secondary and tertiary enrollments are

positively correlated (0.72) and have a negative correlation with the pupil-teacher ratio (-0.61 in both cases). Life expectancy is positively correlated with health expenditures and negatively correlated with the number of beds. These relationships must be considered when forming appropriate regression models because the inclusion of highly correlated regressors can worsen omitted variable bias problem together and reduce the efficiency of estimators.

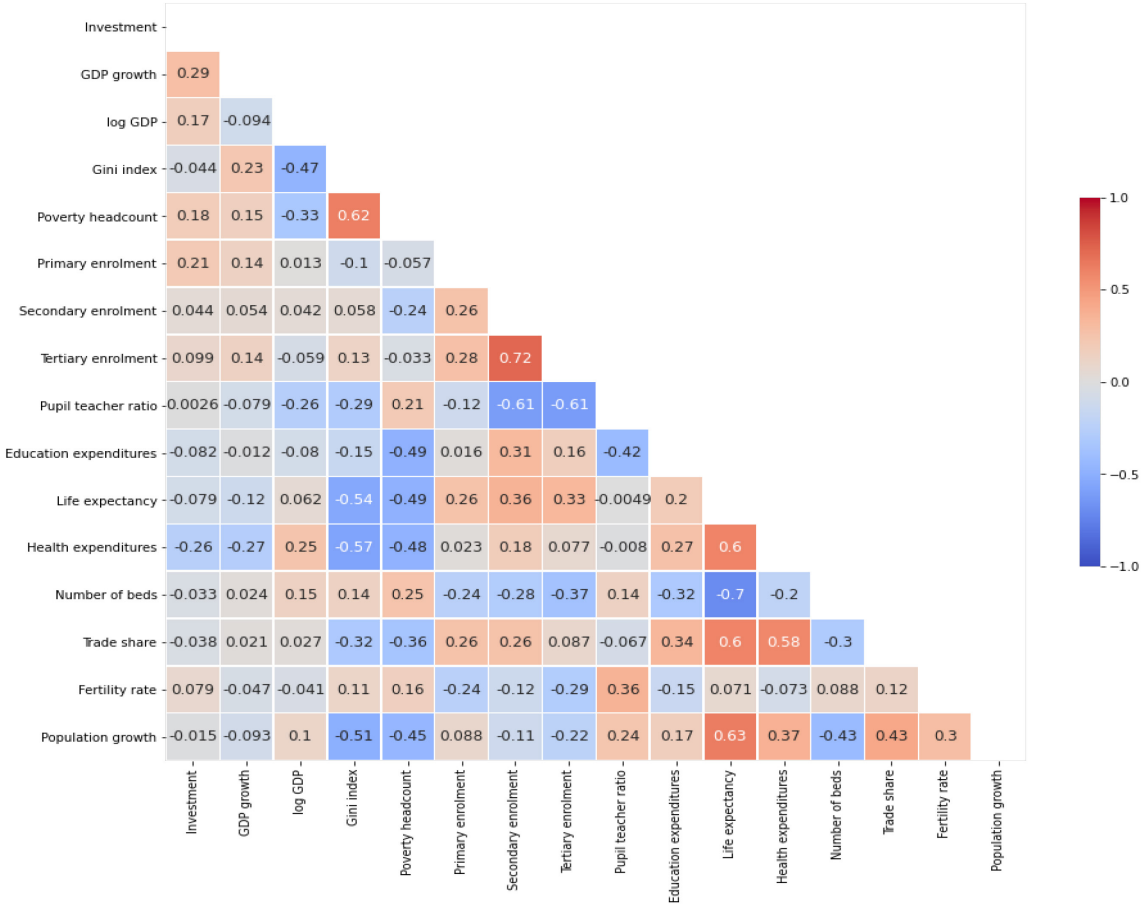

Figure 3.1. Correlation heatmap for the proposed regressors

The estimation is started based on the whole sample of the EU countries for the period 1990-2019, even though some periods are missing due to the lack of data. The estimation strategy is such that first the effects for each group of variables (inequality, poverty, education, health) are estimated separately and afterward, together for all variables. As the main variables for education, enrolment rates are utilized and as the main variable for health – life expectancy.

Table 3.3. below presents the regression results for all specifications. Control variables are not reported.

Table 3.3. The effects of inequality, poverty, education, and health on GDP growth for the whole sample of the EU countries

	FE	RE	FE	RE	FE	RE	FE	RE	FE	RE
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
gini	-0.040	0.012							-0.065	0.014
	(0.089)	(0.014)							(0.094)	(0.017)
poverty			-0.051	0.052					0.013	-0.015
			(0.310)	(0.062)					(0.344)	(0.081)
primenrol					-0.035	-0.026***			-0.037	-0.015
					(0.025)	(0.007)			(0.037)	(0.012)
lifexpect							-0.114	-0.043*	-0.636*	0.019
							(0.180)	(0.025)	(0.350)	(0.037)
invest	0.206***	0.118***	0.208***	0.114***	0.190***	0.119***	0.180***	0.110***	0.183***	0.123***
	(0.061)	(0.017)	(0.061)	(0.016)	(0.039)	(0.011)	(0.038)	(0.012)	(0.067)	(0.018)
tradeshr	0.015*	0.011***	0.015	0.011***	0.018***	0.010***	0.018***	0.009***	0.017*	0.011***
	(0.009)	(0.001)	(0.009)	(0.001)	(0.006)	(0.001)	(0.006)	(0.001)	(0.010)	(0.001)
fert	-1.890	0.156	-1.866	0.125	-0.367	0.507***	-0.129	0.502***	-2.360	0.204
	(1.597)	(0.265)	(1.611)	(0.261)	(0.726)	(0.187)	(0.722)	(0.186)	(1.658)	(0.270)
popgrowth	-1.758***	-0.880***	-1.764***	-0.873***	-1.256***	-0.882***	-1.241***	-0.799***	-1.679***	-0.914***
	(0.352)	(0.093)	(0.352)	(0.094)	(0.230)	(0.067)	(0.230)	(0.076)	(0.361)	(0.111)
log(gdp)	1.833	-0.370*	1.930	-0.350	0.043	-0.362***	0.248	-0.286*	2.701	-0.418
	(2.055)	(0.213)	(2.094)	(0.217)	(0.973)	(0.120)	(0.966)	(0.154)	(2.303)	(0.260)
lag(growth, 1)	0.272***	0.374***	0.270***	0.376***	0.284***	0.364***	0.279***	0.358***	0.260***	0.373***
	(0.053)	(0.020)	(0.053)	(0.020)	(0.037)	(0.014)	(0.036)	(0.014)	(0.054)	(0.020)
Constant		1.122		1.381		3.591***		3.750**		1.406
		(2.333)		(2.254)		(1.358)		(1.576)		(2.951)
Observations	425	425	425	425	704	704	722	722	414	414
R^2	0.225	0.274	0.225	0.275	0.210	0.285	0.206	0.287	0.236	0.270
Adjusted R^2	0.100	0.262	0.099	0.262	0.136	0.277	0.134	0.280	0.101	0.252
Breusch-Pagan test	12.35***	12.35***	12.79***	12.79***	12.42***	12.42***	13.11***	13.11***	14.17***	14.17***
Hausman test		12.793*		12.719*		11.698		12.773*		16.265*
Wooldridge test	1.413		1.405		0.130		0.148		1.611	
Durbin-Watson test		1.794***		1.796***		1.952		1.934		1.809***

The discussion of the results starts with the regression diagnostic tests given at the end of the table. According to the Breusch-Pagan tests, there are unobserved effects in each model, so, usage of RE and FE models is appropriate and necessary in order to prevent the omitted variables bias problem.

Hausman test illustrates that for almost all specifications (except for the model with primary enrolment as the dependent variable) RE is inconsistent and the FE model is more appropriate at a 10% level of significance, although usually 5% or 1% significance level is better.

Wooldridge test suggests no autocorrelation problem for all FE models, while the Durbin-Watson test shows an autocorrelation problem in almost all RE models.

Thus, there are three tests in favor of inference based on FE models: unobserved effects are present, RE model is most probably not consistent and FE residuals are not autocorrelated.

Based on columns (1), (3), and (7) no significant relationship is seen between inequality (gini), poverty, health (lifexpect), and GDP growth. Neither FE nor RE model (column (2), (4), and (8)) shows a significant relationship. The regressions with the independent variable primenrol suggest that the RE model is efficient and consistent and, according to the RE estimation, the relationship between primary school enrolment and GDP growth is negative.

The robustness checks for education are displayed in the appendix, table A.1. It suggests the statistically significant negative relationship between the percentage of education expenditures and GDP growth. For other variables there is either no statistical significance or the model itself is not consistent.

The robustness checks for health are displayed in the appendix, table A.2, and suggest a negative relationship between the number of beds and GDP growth estimated by the FE model at a 10% level of significance. Health expenditures do not have a statistically significant effect on GDP growth.

Thus, the estimation for the whole sample suggests the absence of the relationship between sustainable development indicators and GDP growth conditional on other growth determinants.

As it is suggested by the economic theory, countries with different levels of GDP per capita may have different growth ratios and, thus, as an additional robustness check, we can estimate similar models for two subsets: early and late members of the EU. The early members are Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden. Most of these countries are considered high-income wealthy countries. The second group includes Bulgaria, Croatia, Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia, Slovenia.

The estimation results for the early member of the EU are displayed in table 3.4.

Table 3.4. The effects of inequality, poverty, education, and health on GDP growth for the early EU members

	FE	RE	FE	RE	FE	RE	FE	RE	FE	RE
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
gini	0.031	0.085***							0.114	0.119***
	(0.113)	(0.027)							(0.124)	(0.030)
poverty			-0.559	-0.074					-0.881	-0.260
			(0.681)	(0.217)					(0.726)	(0.242)
primenrol					-0.055**	-0.027***			-0.096**	-0.014
					(0.026)	(0.010)			(0.045)	(0.015)
lifexpect							-0.270	-0.042	-0.803	-0.133*
							(0.287)	(0.089)	(0.519)	(0.068)
invest	-0.043	0.101***	-0.048	0.073**	0.015	0.083***	0.013	0.068	-0.056	0.095***
	(0.100)	(0.034)	(0.100)	(0.034)	(0.064)	(0.025)	(0.063)	(0.045)	(0.102)	(0.035)
tradeshr	-0.009	0.005**	-0.009	0.006***	0.005	0.010***	0.005	0.008***	-0.011	0.003
	(0.010)	(0.002)	(0.010)	(0.002)	(0.007)	(0.002)	(0.006)	(0.003)	(0.011)	(0.002)
fert	-1.747	1.420***	-1.921	0.786**	0.236	0.754***	-0.257	0.733*	-2.739	1.372***
	(2.260)	(0.348)	(2.254)	(0.330)	(1.232)	(0.233)	(1.286)	(0.434)	(2.408)	(0.367)
popgrowth	-1.342***	-1.245***	-1.349***	-1.011***	-1.054***	-0.783***	-1.095***	-0.711**	-1.338***	-1.178***
	(0.466)	(0.191)	(0.465)	(0.188)	(0.328)	(0.151)	(0.326)	(0.280)	(0.472)	(0.196)
log(gdp)	9.369***	1.620***	8.774***	0.760	4.495**	-0.650*	4.516**	-0.317	10.608***	2.017***
	(3.375)	(0.538)	(3.344)	(0.483)	(1.904)	(0.346)	(1.895)	(0.622)	(3.555)	(0.585)
lag(growth, 1)	0.291***	0.380***	0.286***	0.396***	0.332***	0.430***	0.328***	0.427***	0.241***	0.364***
	(0.080)	(0.034)	(0.080)	(0.034)	(0.054)	(0.026)	(0.053)	(0.048)	(0.083)	(0.034)
Constant		-23.313***		-10.112**		7.050*		4.517		-16.091**
		(6.257)		(5.097)		(3.843)		(8.490)		(7.229)
Observations	250	250	250	250	380	380	392	392	243	243
R^2	0.214	0.195	0.217	0.200	0.216	0.237	0.203	0.270	0.237	0.211
Adjusted R^2	0.036	0.171	0.039	0.177	0.105	0.223	0.094	0.257	0.043	0.177
Breusch-Pagan test	12.35***	12.35***	12.79***	12.79***	12.42***	12.42***	13.11***	13.11***	14.17***	14.17***
Hausman test		11.411*		11.935		7.33		7.868		15.405**
Wooldridge test	0.137		0.174		0.27		0.227		0.206	
Durbin-Watson test		1.965		1.952		2.009		2.069		1.997

For the subset of the early EU members, the regression diagnostics suggest that for almost all specifications where the sustainable development indicators are used separately, both RE and FE models are consistent, thus, we can draw the conclusions from the RE model which is mode efficient. Moreover, according to the Durbin-Watson tests, in all specifications, the serial correlation of residual is not present.

For the given subset, the Gini coefficient has a positive association with GDP growth, while the primary enrolment has a statistically significant negative effect on GDP growth. Poverty and health show no significant relationship with GDP growth.

Next, the same specifications are estimated using the sample of the countries which joined the EU after 2007. The estimation results are shown in Table 3.5.

Table 3.5. The effects of inequality, poverty, education, and health on GDP growth for the late EU members

	FE	RE	FE	RE	FE	RE	FE	RE	FE	RE
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
gini	-0.001	0.053**							0.045	0.052*
	(0.143)	(0.024)							(0.159)	(0.028)
poverty			-0.325	0.164**					-0.494	0.076
			(0.366)	(0.080)					(0.434)	(0.104)
primenrol					-0.008	-0.031**			0.062	-0.025
					(0.047)	(0.015)			(0.073)	(0.024)
lifexpect							-0.286	-0.062	-0.330	0.043
							(0.269)	(0.044)	(0.515)	(0.070)
invest	0.360***	0.171***	0.367***	0.150***	0.302***	0.144***	0.291***	0.129***	0.340***	0.178***
	(0.103)	(0.025)	(0.102)	(0.025)	(0.061)	(0.015)	(0.060)	(0.016)	(0.113)	(0.027)
tradeshr	0.114***	0.011***	0.114***	0.011***	0.039***	0.010***	0.039***	0.010***	0.120***	0.012***
	(0.025)	(0.002)	(0.025)	(0.002)	(0.011)	(0.001)	(0.011)	(0.001)	(0.026)	(0.002)
fert	-3.134	-3.871***	-3.320	-3.812***	0.544	0.453	1.174	0.636*	-3.610	-4.099***
	(2.637)	(0.793)	(2.638)	(0.790)	(1.187)	(0.351)	(1.249)	(0.345)	(2.718)	(0.778)
popgrowth	-0.450	-0.708***	-0.338	-0.759***	-0.565	-0.682***	-0.455	-0.585***	-0.389	-0.851***
	(0.628)	(0.139)	(0.638)	(0.139)	(0.356)	(0.088)	(0.365)	(0.101)	(0.675)	(0.171)
log(gdp)	0.204	-0.632	-0.871	-0.416	-3.154	-1.090***	-3.066	-0.717*	0.590	-0.390
	(4.230)	(0.569)	(4.307)	(0.621)	(2.048)	(0.299)	(2.008)	(0.373)	(4.702)	(0.713)
lag(growth, 1)	0.167**	0.343***	0.163*	0.356***	0.182***	0.314***	0.171***	0.310***	0.145*	0.333***
	(0.084)	(0.029)	(0.083)	(0.028)	(0.058)	(0.018)	(0.058)	(0.018)	(0.086)	(0.028)
Constant		6.802		6.544		10.974***		8.996***		3.588
		(5.847)		(6.001)		(3.176)		(3.043)		(6.854)
Observations	175	175	175	175	324	324	330	330	171	171
R^2	0.331	0.288	0.335	0.289	0.207	0.243	0.208	0.239	0.349	0.299
Adjusted R^2	0.151	0.258	0.156	0.259	0.075	0.227	0.080	0.222	0.149	0.255
Breusch-Pagan test	12.35***	12.35***	12.79***	12.79***	12.42***	12.42***	13.11***	13.11***	14.17***	14.17***
Hausman test		22.38***		24.25***		12.704**		14.855**		25.39***
Wooldridge test	27.14***		25.95***		0.001		0.017		23.91***	
Durbin-Watson test		1.578***		1.618***		1.933		1.927		1.567***

For all specifications now Hausman test suggests inconsistency of RE estimators, so the inference is based on FE models. Moreover, FE models with *gini* and *poverty* variables have serial error correlations. The FE estimates for the subsample of the late EU members suggest no relationship between sustainable development indicators and GDP growth.

Based on the results the stated thesis hypotheses can be assessed:

Hypothesis 1. Poverty alleviation promotes economic growth. It was found to not be relevant for the EU countries. Neither the full sample nor separate subsamples of countries showed that poverty alleviation has a significant relationship with economic growth.

Hypothesis 2. Inequality interacts with poverty and negatively influences economic growth. The estimation suggests that rather economic growth is associated with higher

inequality for the early members of the EU, and is not relevant for the late-comers.

Hypothesis 3. Health is more relevant to economic growth than education. Based on all models health variables do not have a significant relationship with economic growth, while education, on the other hand, is significantly associated with economic growth.

4. Conclusion

Based on the estimation, it is possible to assume that despite the acceptance of the UN 2030 Agenda for Sustainable growth by all countries, there must be a personal approach in the future implementation of sustainable development goals. Even on the EU level, the policy needs to be customized according to the needs of countries. Older EU members, countries with stronger economies, high GDP per capita, and strong social institutions must carefully consider the growth prospects as it is associated with the higher inequality and lower primary enrolment. As for the countries of the "second wave", the sustainable development indicators are not associated with GDP growth, which rather depends on the traditional growth determinants: investment, international trade, population growth, and fertility rate. The policy recommendation based on the results of this study can suggest a different treatment of the sustainable development goals implementation in the EU countries. While some countries need to pay attention to inequality associated with economic growth, other countries should promote education in the first place.

The coefficient estimates have a "ceteris paribus" interpretation, which means, holding all other factors fixed, a unit change in the right-hand side variable is associated with the beta change in the left-hand-side variable. As Wooldridge (2010) notes, "simply finding that two variables are correlated is rarely enough to conclude that a change in one variable causes a change in another". This result is due to the nature of economic data: rarely can a controlled experiment be conducted that allows a simple correlation analysis to uncover causality. Thus, based on the analysis, it is not possible to determine a causal relationship between education, health, poverty, inequality, and economic growth (if these four variables affect economic growth and not vice versa). Instead, econometric methods can be used to effectively hold other factors fixed. In the case of the current study, a randomized controlled experiment cannot be carried out to verify the causal effects of inequality, poverty, education, and health on economic growth. As it is shown in Leszczensky & Wolbring (2019), there are almost no methods to apply to the observational panel data to establish the causal relationship. Partially, we can rely on the previous studies that established this causality, and partially we can rely on the macroeconomic theory, which states that economic growth depends on human capital, which is influenced by education, health, and poverty.

There are strengths and weaknesses to this research study. One of the possible weaknesses is the limited data available on some of the indicators in the sample. The suggestion for future studies is to address this issue, consider covering more databases and use other proxies for the four variables when possible. Additionally, missing data might become available in the future. The main strength of this thesis is that it addressed the crucial issues of sustainable development and adds valuable information to the existing literature on the topic of sustainable development as the analysis was conducted using a new method and perspective. It was possible to determine the relativeness of sustainable development goals in achieving growth of GDP and, consequently, the country's progress.

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Appendix

Appendix no. 1: The effects education on GDP growth for the whole sample of the EU countries (table)

	FE	RE	FE	RE	FE	RE	FE	RE
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
secenrol	-0.021*	-0.005*						
	(0.013)	(0.003)						
tertenrol			-0.001	0.002				
			(0.012)	(0.003)				
educexp					-0.684***	-0.144***		
					(0.184)	(0.042)		
ptratio							0.101	0.036**
							(0.074)	(0.016)
invest	0.179***	0.111***	0.183***	0.117***	0.124***	0.044***	0.247***	0.123***
	(0.038)	(0.011)	(0.040)	(0.012)	(0.042)	(0.013)	(0.045)	(0.013)
tradeshr	0.018***	0.009***	0.017***	0.010***	0.028***	0.009***	0.028***	0.010***
	(0.006)	(0.001)	(0.006)	(0.001)	(0.007)	(0.001)	(0.008)	(0.001)
fert	-0.363	0.655***	-0.241	0.492***	-0.942	0.648***	-0.958	0.415*
	(0.727)	(0.193)	(0.736)	(0.190)	(0.835)	(0.233)	(0.855)	(0.225)
popgrowth	-1.223***	-0.863***	-1.239***	-0.851***	-0.971***	-0.684***	-1.357***	-0.976***
	(0.227)	(0.068)	(0.243)	(0.071)	(0.263)	(0.076)	(0.251)	(0.076)
lgdp	0.473	-0.403***	0.141	-0.476***	-2.470**	-1.068***	-1.190	-0.335**
	(0.964)	(0.128)	(1.000)	(0.132)	(1.125)	(0.151)	(1.199)	(0.156)
lag(growth, 1)	0.275***	0.361***	0.281***	0.361***	0.286***	0.376***	0.245***	0.324***
	(0.036)	(0.014)	(0.038)	(0.014)	(0.039)	(0.016)	(0.041)	(0.016)
Constant		1.879		2.071		10.669***		0.416
		(1.263)		(1.300)		(1.532)		(1.678)
Observations	706	706	681	681	543	543	547	547
R^2	0.209	0.279	0.201	0.285	0.228	0.294	0.214	0.253
Adjusted R^2	0.135	0.272	0.124	0.277	0.134	0.285	0.119	0.243
Breusch-Pagan test	12.78***	12.78***	12.81***	12.81***	15.19***	15.19***	14.01***	14.01***
Hausman test		14.216**		10.424		24.57***		15.526**
Wooldridge test	0.289		0.152		0.130		0.014	
Durbin-Watson test		1.941		1.967		1.8698**		1.93

Appendix no. 2: The effects of health on GDP growth for the whole sample of the EU countries (table)

	FE	RE	FE	RE
	(1)	(2)	(3)	(4)
healexp	-0.037	-0.149*		
	(0.198)	(0.082)		
beds			-0.244*	-0.106***
			(0.134)	(0.024)
invest	0.169***	0.109***	0.181***	0.132***
	(0.048)	(0.033)	(0.039)	(0.012)
tradeshr	0.037***	0.009***	0.017***	0.011***
	(0.009)	(0.002)	(0.006)	(0.001)
fert	-2.055*	0.227	-1.186	0.236
	(1.219)	(0.568)	(0.860)	(0.198)
popgrowth	-1.103***	-0.858***	-1.347***	-1.050***
	(0.246)	(0.178)	(0.238)	(0.076)
lgdp	-1.406	-0.693*	0.470	-0.309**
	(1.399)	(0.419)	(0.981)	(0.127)
lag(growth, 1)	0.274***	0.345***	0.280***	0.360***
	(0.044)	(0.041)	(0.037)	(0.014)
Constant		6.317		1.169
		(3.990)		(1.321)
Observations	513	513	693	693
R^2	0.237	0.408	0.224	0.293
Adjusted R^2	0.153	0.400	0.151	0.286
Breusch-Pagan test	15.98***	15.98***	13.15***	13.15***
Hausman test		42.21***		12.316*
Wooldridge test	2.265		0.098	
Durbin-Watson test		1.815***		1.925