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"EDUCATION AND INCOME INEQUALITY: AN EMPIRICAL ANALYSIS FOR THE SLOVAK REPUBLIC"

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Firma dello studente

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Ringrazio il Professor Thomas Bassetti per avermi seguito nel mio lavoro.
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INTRODUCTION

The aim of this thesis is to investigate the effect of education on income inequalities by analysing the impact of the Slovakian "Law No. 131/2002 on Higher Education and on Changes and Supplements to Some Laws" (hereinafter referred to as "Higher Education Act" or "Act") on the market Gini coefficient.

According to Galor and Zeira (1993), the level of growth of a country is affected by the amount of wealth inherited by individuals. Large amounts of wealth enable individual to invest in human capital and, accordingly, to contribute to the development of their society. Individuals with low initial wealth have difficulties accessing education. Therefore, children from low-income families will become unskilled workers, whereas high-income families, which can invest in their children's education, will raise educated workers. Hence, earnings are correlated across generations. The government can deal with this issue by subsidizing education through a tax levied on skilled workers in the following period. In such a way, families will have lower costs of education, educated workers will increase and the country will experience sustainable growth patterns. As reported by Borck and Wimbersky (2014), student numbers can be increased using traditional tax subsidies. Specifically, these kinds of social support raise the utility of studying, lower top incomes and boost wages of low-income individuals. Therefore, governments can adopt these financing schemes to reduce income inequality.

The Higher Education Act has been approved by the Slovak Republic on February 21st, 2002 but came into force on April 1st, 2002. This Act changed the rules governing higher education financing starting from the academic year 2002/2003. Public universities were transformed from State budgetary organizations to public higher education institutions with non-profit characteristics. Thus, institutions can now keep their revenues, own their assets, and are free to utilise the government's subsidy as they see fit. The subsidy is based on both inputs and outputs reflecting factors such as the number of students and graduates, and the number of publications. In this way, universities are incentivised to improve their performances. Reforming the higher education system, the Slovakian government sharply increased the amount of funds paid for student's social support. In fact, from 2001 to 2003 social scholarships increased by more than 400 percent, going from 37 056 thousand SKK (1.230 million EUR) in 2001 to 108 805 thousand SKK in 2002 (3.612 million EUR), and 201 018 thousand SKK (6.673 million EUR) in 2003.

The effect of the Higher Education Reform on income inequality in Slovakia is measured using the Gini coefficient of market income inequality. This analysis exploits data from 1995 to 2012. First, traditional panel regressions are estimated, then the impact of the Act is assessed adopting the synthetic control method. The first approach uses three estimation techniques: ordinary least squares, random effects, and fixed effects. Interestingly, results show that government expenditure positively affects market income inequality using panel estimation techniques. Furthermore, services have an ambiguous effect on market income inequality. It yields positive and negative statistically significant coefficients in the first two specifications, while it is not significant when using fixed effects. Then, the synthetic control method is used to estimate the effect of the reform on market income inequality. The synthetic Slovakia is built using data from four countries: the Czech Republic, Estonia, Finland, and Germany. Results confirm the initial hypothesis and show that the Act successfully decreased market income inequality in the country by approximately 9 percent.

This work proceeds as follows. Chapter 1 presents preliminary considerations on income inequality and education. It explains the need for these two measures and shows the situation in the European Union. Chapter 2 reports the existing literature on this topic, dividing theoretical and empirical literature. Chapter 3 provides the econometric framework by explaining the Higher Education Act in details, the data, and the two approaches. Finally, Chapter 4 describes the results obtained from the empirical analysis.

CHAPTER 1 – EDUCATION AND INCOME INEQUALITY: INTRODUCTORY NOTIONS

1.1 New measures of economic performance

Statistical indicators are important tools for assessing the impact of policies. Thus, policy makers aiming at improving the living conditions of societies use these data in order to understand the effectiveness of reforms. However, standard measures of socioeconomic variables, such as economic growth and inflation, seem to be distant from the actual perceptions of the population. There are many debates about what are the appropriate concepts to use in order to measure these socio-economic phenomena. In fact, large changes in the income distribution are not captured by the common per capita aggregates. Considerable increases in inequality relative to the average per capita GDP may worsen most people's living conditions even though average income has risen. Therefore, these commonly used statistics are not appropriate when the aim is to measure the increase in the wellbeing of citizens.

In 2008, the French President Nicholas Sarkozy created the Commission on the Measurement of Economic Performance and Social Progress led by Stiglitz, Sen and Fitoussi (2009). The government was unsatisfied with the current statistical information regarding the economy and the society and wanted to produce more relevant indicators of social progress. The Commission prepared a Report identifying the limits of GDP and defining new measures of economic performance focusing on people's well-being rather than on economic production. The authors identified eight key dimensions:

1) Material living standards;
2) Health;
3) Education;
4) Personal activities;
5) Politics and governance;
6) Social connections and relationships;
7) Present and future conditions;
8) Economical and physical uncertainty.

The report is addressed to four distinct groups. First of all, political leaders should emphasize these measures when considering new political directions. Then, these new measures are useful for policy-makers which aim at assessing the effectiveness of wellbeing-enhancing policies. Thirdly, the academic community and statisticians will become more cautious using certain statistics and will hopefully develop new indicators based on the author's suggestions. Finally, the Report addresses users and producers of statistics, and more generally the public at large, which will hopefully better understand the available statistical indicators and will be able to make better evaluations of the issues emerging in their societies.

1.2 Measures of living standards

This section follows the classical GDP issues of the Report by Stiglitz, Sen and Fitoussi (2009).

Economic activity is mostly evaluated using GDP. Though it is mainly a market production measure, this quantity has been broadly used to assess the economic wellbeing of citizens. Confounding GDP with wellbeing can yield misleading indications about people's contentment and bring about wrong policy decisions. Therefore, in order to capture material living standards, measures of consumption and real income are more suitable.

Income and consumption may also be coupled with information on wealth. This measure is obtained by looking at the financial status of an economy. Such a report can be constructed using information on its assets (such as physical, natural, human and social capital) and on its liabilities (as the amounts owed to other countries). Therefore, the performance of an economy can be assessed also considering the amount of resources which are carried over into the future.

Average income measures must be accompanied by distributional information in order to evaluate living conditions. The distribution of income can be simply assessed by looking at median values. The median individual is considered as the "typical" individual, therefore examining the gap between the median and the mean person will yield a measure of income inequality in the population.

Hence, the distribution of income is a meaningful statistic to evaluate changes in socio-economic conditions of populations. However, there have been changes in how societies function. In the past, people received many services from other family members, whereas now

these are purchased on the market. Another important feature of economic activity comprises the services auto-produced by households which are not recognized in official production measures. National accounts do not record these economical aspects and therefore, do not reflect the actual living conditions of the population. Thus, this problem can be dealt with by broadening income measures including both market and non-market activities. Nonetheless, focusing on non-market activities reveals the importance of leisure activities. Living standards are improved if one sees a reduction in its working hours, but the individual will continue to consume the same amount of goods and services. Therefore, living standards are better evaluated taking into account leisure activities.

Nonetheless, running cross-country comparisons of living standards is problematic when considering leisure. Typically, a society with a given real income and more leisure will have higher living standards than one with the same level of income but more leisure. Leisure is measured considering its relative enjoyment between groups, and its relative occurrence. Therefore, country's societal regulations and union bargaining which impact relative enjoyment and occurrence of leisure make leisure inappropriate when one wants to compare citizen's well-being across countries.

1.3 Income inequality

Income is considered as a proxy for wellbeing, therefore we analyse its distribution if we are interested in the population's contentment. The economic literature has put much focus on income inequality. One reason is that it may be related to economic growth, to the existence of cyclical movements and to aggregate consumption. A second reason for measuring inequality is a normative motivation. The distribution of income is a social concern independently of its impact on other variables, therefore it is important to estimate it in order to guide policies. (Decancq et. al, 2015).

There exist many measures to reflect the distribution of income. One of the most immediate ones is the difference between the average and median values of the distribution. Other standard measures of income inequality include: the Lorenz curve, the Gini coefficient, the Theil index and the Atkinson index. Furthermore, another common approach to measuring income inequality is the income quantile share ratio which divides the population into quantiles and then looks at the share of resources in each group over time. Some studies, such as that by Yitzhaki (1979), use combined measures of income inequality by calculating the

product of the Gini coefficient and the mean income in order to reflect the concept of relative deprivation (Stiglitz et al., 2009).

The World Bank (2005) defines a set of six criteria that must be satisfied in order to get a good measure of income inequality:

1) Mean independence: the measure must not change if incomes double.
2) Population size independence: the measure must not change with the population.
3) Symmetry: if incomes are switched the measure must not change.
4) Pigou-Dalton Transfer sensitivity: this criterion states that when income is transferred from the rich to the poor the measure of inequality must decline.
5) Decomposability: according to this principle, the inequality measure may be broken in different dimensions such as population groups or sources of income.
6) Statistical testability: it should be possible to test whether the changes in the index are significant over time.

The Lorenz curve is a graphical representation of income inequality. In order to plot its trajectory, the population must be ordered according to the size of their incomes. Then, the curve is drawn by considering the percentage of total income which is earned by the different fractions of the population (Gastwirth, 1971). The Lorenz curve is used to estimate both the size of the distribution of income and inequality measures such as the Gini coefficient. Each point *(x, y)* on the curve indicate that *y* percent of the income in the country goes to the first *x* percent of the population. Therefore, the Lorenz curve lies below the 45-degree line and it intersects it at 0 and 1. However, one of its important drawbacks is that the curve is considered as lacking of satisfactory fit over the range of the income distribution (Sylwester, 2002; Heshmati, 2004).

The Gini coefficient is the most used index of income inequality. It is a good measure to acquire information on the variations in income inequalities because it is based on people's income levels. This index defines the area between the Lorenz curve and the 45-degree perfect equality line. Therefore, if the Lorenz curve rests upon the 45-degree line, there is no space between the two curves meaning that there is perfect income equality. On the other hand, as the two curves move away from one another, the Gini coefficient increases. A Gini index of 1 indicates that all income is held by one individual and it is denoted perfect income inequality. Formally this measure of income inequality is expressed using the following formula:

$$Gini = 1 - \sum_{i=1}^{N} (x_i - x_{i-1})(y_i - y_{i-1}) \quad (1.1)$$

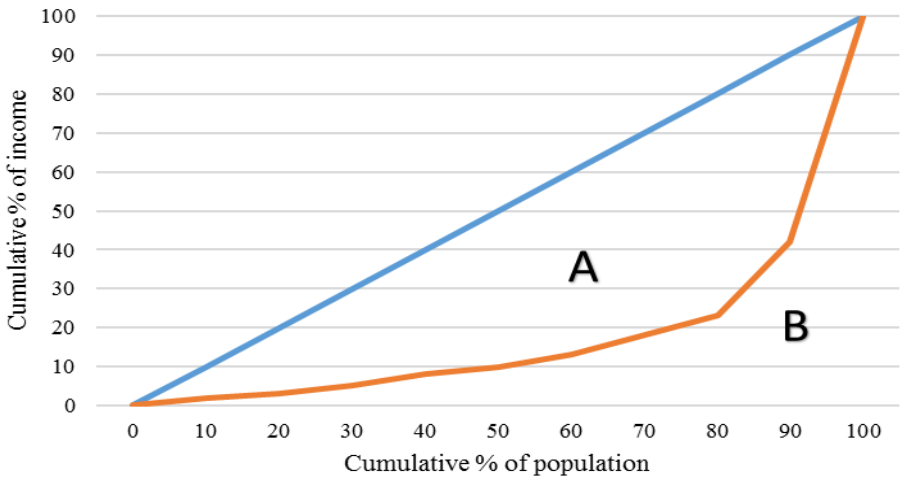
where x_i is the cumulative percentage of population and y_i is the cumulative percentage of income in the society.

The main advantage of this measure is its widespread use, which is explained by the availability of the data. A second benefit is that it is strongly correlated with other income inequality measures. However, a limitation of this index is that the same Gini coefficient can be derived by different Lorenz curves. Hence, a small change of value does not necessarily mean that there has only been an irrelevant change in the distribution of income (Sylwester, 2002).

According to the World Bank (2005) criteria, the Gini coefficient is not an entirely satisfactory criterion because it does not satisfy the decomposability and statistical testability principles. In fact, the total Gini of a population does not correspond to the sum of all the Gini coefficients of the subgroups. Furthermore, the statistical testability problem may be eluded by using bootstrap techniques to generate confidence intervals.

Figure 1.1 shows the Lorenz curve for global income in 2008. The cumulative percentage of households are represented on the horizontal axis while the vertical axis denotes the cumulative percentage of income. As explained above, the diagonal line indicates perfect equality and the underlying orange line is the Lorenz curve. Therefore, the Gini coefficient is calculated using the following formula: $\frac{A}{A+B}$ where areas A and B are shown in the graph.

Figure 1.1: The Lorenz curve for global income distribution in 2008



Source: Milanovic, 2013

As mentioned above, in order to plot the Lorenz curve, the population must be ordered by level of income. The figure shows that in 2008, the first two-thirds of the world's population received 12 percent of the world's income. In fact, the majority of income was held by the upper one-fifth of the population, which detained about 80 percent of the global income. Furthermore, the top 1 percent of the population received almost 15 percent of the world's income. Hence, in 2008 the distribution of income was quite unequal. Nowadays, the upper third of the population keeps rising amounts of income while the level of income of the world's poorest 5 percent continues to stagnate (Milanovic, 2013).

A measure of income inequality that satisfies all six World Bank criteria is the Theil (1967) statistic. It is part of a class of inequality measures which have significant consequences for policy makers and are knows as Generalised Entropy measures. The values of this index can vary between 0 and ∞, where zero represents an equal distribution and greater values represent higher income inequality. The main advantage of this class of measures is that they are decomposable, therefore within-group and between-group inequality can be estimated. A second advantage of this group is that researchers can assign a weight parameter α to the distances between incomes of the distribution. Commonly, α is equal to 0, 1 or 2. Lower values of α indicate that the Generalised Entropy measure is more sensitive to variations in the lower part of the income distribution, whereas higher values of α are defined when the measure is more sensitive to changes in the upper tail. For $\alpha = 0$ the index is denoted as the "Theil L" measure. Then, when $\alpha = 1$ the index is defined as the "Theil T" or, commonly, the "Theil index". Lastly, the "coefficient of variation" defines the Theil statistic for $\alpha = 2$ (World Bank, 2005; Afonso et al., 2015).

The measure of inequality designed by Atkinson (1970) is represented by a number between zero and one. This index defines the share of actual income that could be eliminated leaving total social welfare unaffected if the remaining income were equally distributed. Therefore, in very equal societies the index will tend to zero, while in unequal societies, the more averse are people, the larger will be the value of this index (Kaplow, 2002).

Furthermore, ratios are the most basic measures of income inequality. They are simple and direct, and they need few data computations. Accordingly, they do not present as much information as the measures described above. The income quantile share ratio divides the average income of the richest part of the population by the average income of the poorest part of the population. Therefore, the income of the rich is expressed in terms of that of the poor.

The most commonly used ratio is the D9/D1 which divides the income of the richest 10 percent of the population by the income of the poorest 10 percent (Afonso, et al., 2015).

Moreover, the inequality indicators discussed above can be decomposed in order to assess their major contributors. Average income levels may vary across regions, implying there exists "between group" inequality. Then, incomes may vary inside each region thus suggesting there is also a "within group" factor. These decompositions are important in order to create policies focused on the correct areas of development. Specifically, the presence of mainly "between group" inequality suggests policy makers should design regional economic development policies to help the poorer regions.

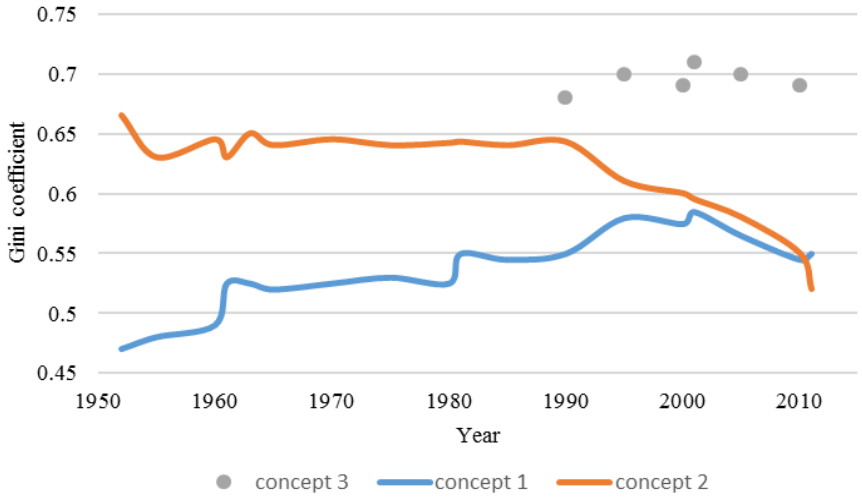
Income inequality is widely used by economist to grade the performances of economies. Therefore, there is a tendency to examine the trend in inequality when willing to evaluate how well countries are doing or to see if policies have been supportive. However, researchers should keep in mind that inequality is not equal to social welfare, thus ranking countries in such a manner does not indicate their actual level of performance (Kaplow, 2002).

Milanovic (2013) states that in order to calculate global inequality, we can break it down into three different concepts. The first one considers inequality between nations. This statistic may be represented by the Gini coefficient because it is based on GDP or mean incomes without weighting the population. The second concept is also based on country averages; however, this measure takes into account countries' population sizes. The third approach is individual-based and it is the most important measure for researchers interested in individuals rather than in nations. Therefore, each person enters the calculation with their actual level of income and not with that of their country. The difficulty of using this concept is that calculations require data from household surveys on individual incomes which must be measured in as many countries as possible using the same methodology.

Figure 1.2 displays the trends in the three types of inequality concepts in the period between 1952 and 2011. From 1960 to 1980 inequality 1 followed a quite steady trend meaning that both poor and rich countries had almost the same growth levels. In the 1980s globalization started, therefore rich nations saw higher growth levels than the poorer ones, making global income inequality surge. The figure shows a clear difference between the lines of inequality concepts 1 and 2. In the 1980s, when inequality 1 rose, inequality 2 dropped dramatically. Therefore, taking into account population sizes, the figure suggests that globalization made the world become a less unequal place.

These movements can be explained considering two success stories of that period. China and India, the two most populated countries in the world, had extremely low-income levels in the 1980s. During the past three decades, these nations grew very quickly and converged on the rich world. Therefore, these high growth rates are the major factors explaining the downturn of inequality 2. Furthermore, since inequality 3 is calculated using household surveys, it can be computed only starting from the 1990s. The figure shows that using this approach we obtain the highest income inequality levels. Hence, the index declines when averaging the population's income inequality as in the first two concepts (Milanovic, 2013).

Figure 1.2: Global inequality concepts from 1952 to 2011



Source: Milanovic, 2013

Concluding, in order to calculate the "true" level of global income inequality, Milanovic (2013) states that people's incomes must be adjusted with price levels. The real welfare of people will be measured using purchasing power parity dollar. In this way, populations of "cheaper" countries will see their income in terms of nominal dollar increase

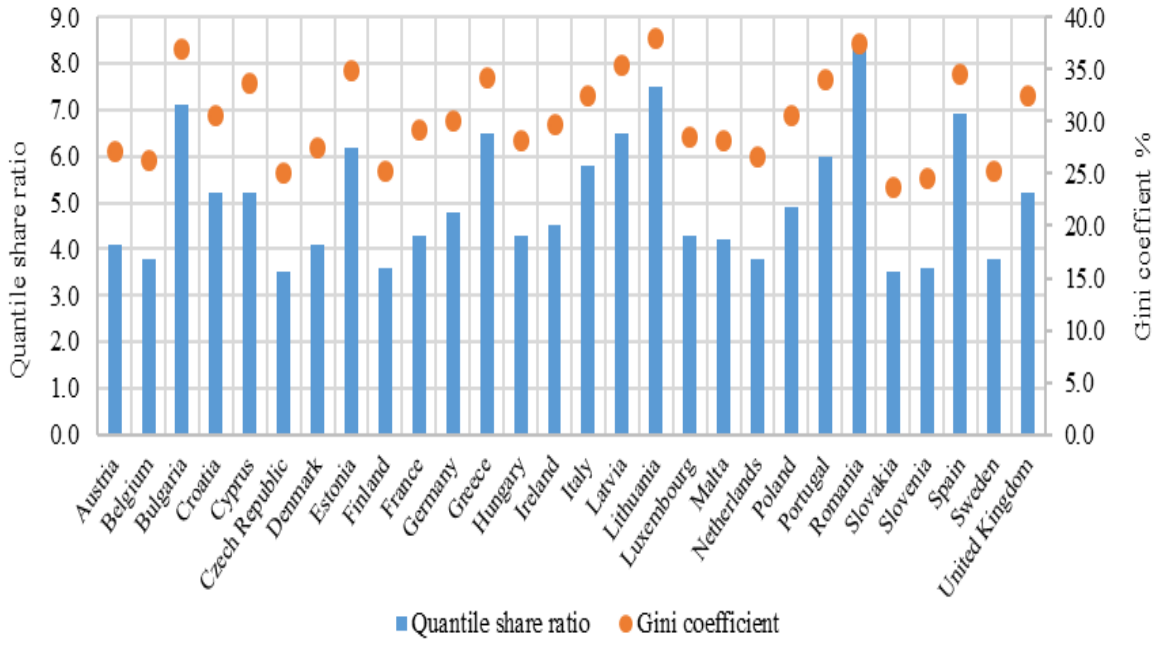
1.4 Inequality trends in the European Union

In this section is examined the distribution of income in the 28 Member States of the European Union (EU-28). Following the Eurostat statistical book on "Income and living conditions in Europe" (2010), income inequality in the EU is measured using mainly the income quantile share ratio and the Gini coefficient. The first measure refers to the ratio between the share of income owned by the top 20 percent of the population and that held by the bottom 20 percent.

Figure 1.3 displays the two inequality measures for the EU-28 in the year 2015. The graph shows some interesting patterns. The income quantile share ratio, named S80/S20, varies from 3.5 to 8.3 across all EU Member States. The lowest ratios are observed in the countries which have recently joined the European Union (the Czech Republic, Slovenia, and Slovakia). Then come Austria, the Benelux, France, Hungary, Malta and Nordic countries with values that go from 3.6 to 4.3. In Southern Europe countries (except Malta) values go from 5.2 in Cyprus to 6.9 in Spain. Furthermore, the highest ratios are those seen in Bulgaria, Lithuania, and Romania, going from 7.1 to 8.3. The EU-28 has a total S80/S20 ratio of 5.2. This measure is found by weighting each country by its population size, and not by considering the area as a whole, otherwise, it should yield a higher ratio.

The second indicator of income inequality shown in the figure is the Gini coefficient of disposable income. Its values are shown on the graph's secondary horizontal axis. The index varies a lot across countries, it goes from 23 percent in Slovakia to 38 percent in Lithuania. The trend in the Gini coefficient is similar to that of the income quantile ratio. In fact, Southern countries have some of the highest indexes, of about 35 percent; while the maximum values are attributed to Bulgaria, Lithuania and Romania. Furthermore, the total weighted average of the index for the EU-28 is 31 percent.

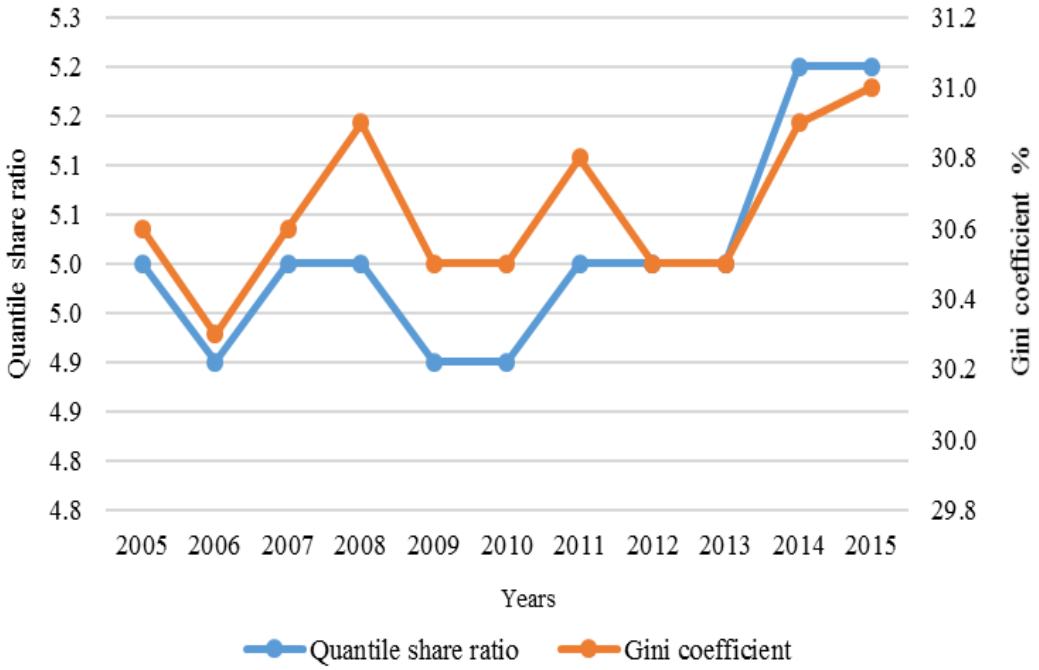
Figure 1.3: Income inequality in the EU, Survey Year 2015



Source: Eurostat

Figure 1.4 plots the trend in the two income inequality indexes used above during the period between 2005 and 2015. The measures are calculated as a weighted average of the 28 Member States of the European Union. The graph clearly shows that the two indicators follow a quite similar trend during the period. The Gini coefficient reached its highest level of almost 31 percent in the year 2008 and then sharply decreased in the following year. A second peak was observed in 2011. Then, the index declined, reaching the value of 30.5 percent, and started increasing again in the year 2013.

Figure 1.4: Income inequality in the EU from 2005 to 2015



Source: Eurostat

The quantile share ratio is expressed by the blue line in figure 1.4. It follows almost the same trend of the Gini index, taking on a value of 5 in 2008 and then decreasing by a tenth in the following years. Differently from the previous measure, in 2011 the ratio did not decline but it remained constant until 2013 when it then started increasing similarly to the Gini coefficient.

As explained above, high values of the two indexes indicate high levels of income inequality meaning that policy makers should research new ways to smooth these disparities in the distribution of income. Looking at the figure it is evident that the two measures take on the lowest values during the years of the financial crisis and have started increasing only during the past three years. Hence, income inequality in the European Union has decreased with GDP during the 2008-2012 period. These data confirm the French government's theory

according to which new wellbeing enhancing policies are needed because these new economic measures of performance suggest that populations are worst off in periods of high economic growth.

1.5 Education

The European Commission (2014) states that the objective of education is to train individuals for life and to impart them a sense of democratic citizenship. This should be done for all learners regardless of their culture and socio-economic background. Then, producing quality education yields a productive and innovative labour force, which accordingly generates sustainable growth patterns.

Education is one of the eight key dimensions of well-being identified in the Report by Stiglitz et al. (2009). In fact, economic research suggests that skills embodied in the population are one of the determinants of economic production and quality of life. There exist three main factors that determine this level of human capital, namely:

1) Investments in education and training;
2) Parental inputs: such as supervision and mentoring;
3) Societal resources: such as libraries and museums.

Moreover, better-educated people develop more positive evaluations of their life, they generally have better health, lower unemployment, greater engagement in civic life and more social connections. Therefore, education investments benefit both the person acquiring it and the society in which they live.

Furthermore, the distribution of education has an impact on both economic growth and the distribution of income. In fact, limited opportunities to invest in education, differences in quality of education or in educational attainment may lead to increasing income inequalities if coupled with poor redistributive policies (Heshmati, 2004).

There exist educational indicators that refer to both inputs and outputs. Measures of education input include school enrollment numbers, educational expenditures, and school resources; while measures of outputs consist of graduation rates, years of schooling and literacy, and numeracy achievements. However, these indicators may highlight contrasting patterns. For instance, some countries may combine excellent achievements for university students with large under-achievements for youths from low-income families. Hence, using summary

measures, such as mean years of schooling, one would not identify these disparities though they are significant in terms of quality of life.

A significant limitation of these measurement tools is that many of these measures were not developed to measure the population's capabilities, but for assessing educational policies. Therefore, they focus on a narrow set of competencies. Secondly, knowledge is not determined only by schooling but there exist a variety of inputs that lead to increases in skills. Increasing evidence shows that experiences and "soft" skills acquired during childhood matter for people's schooling and quality of life. Thus, measuring education levels does not provide the full picture (Stiglitz et al., 2009).

The World Bank (2005) states that analysing household living standards, there are three classes of commonly used indicators of education:

1) The household level of education measured by the rate of literacy and the years of completed education;
2) The availability of educational services such as proximity to schools;
3) The level of adoption of these services measured using registration numbers, dropout rates and average educational spending per child.

The level of education in the household is an important indicator of the ability of the poor people to exploit income-earning opportunities.

1.6 Trends in education in the European Union

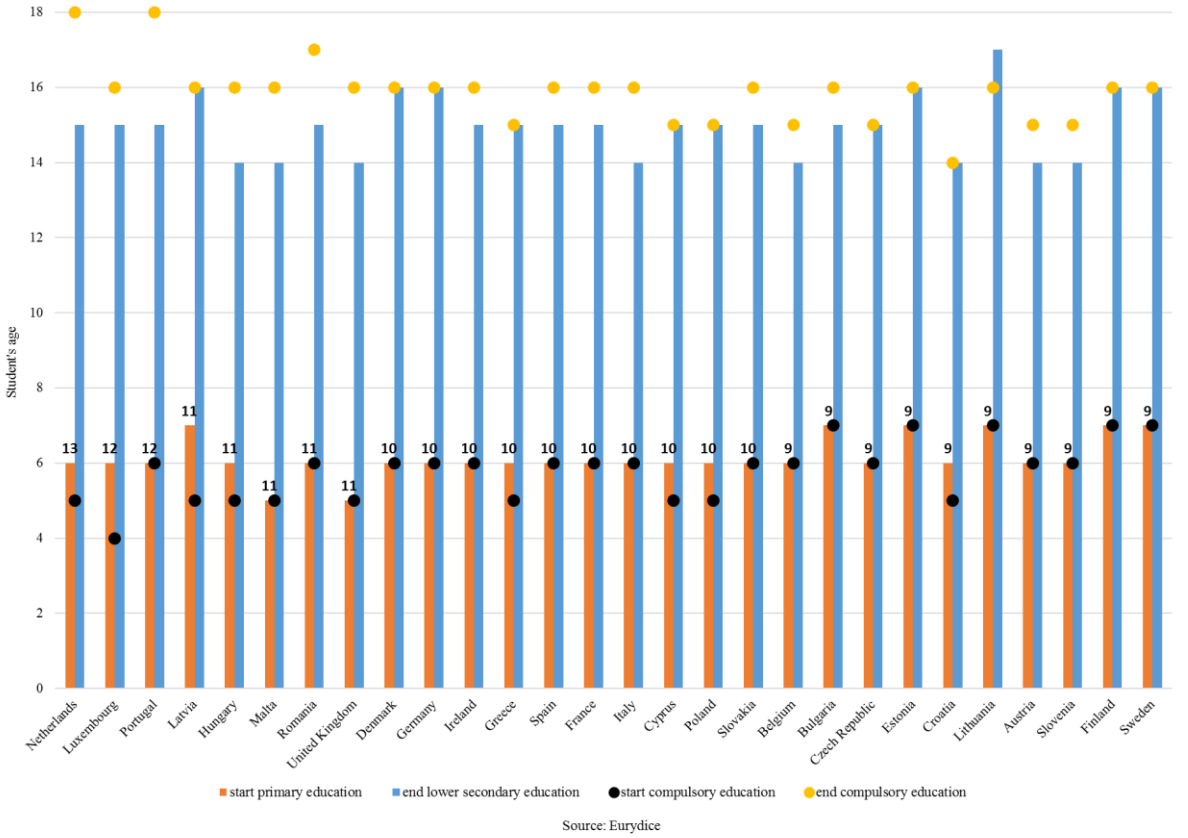
The Eurostat Database for European statistics offers a wide range of education measures that enables researchers to evaluate the educational level of the population of the 28 European Union Member States. In this section are discussed the indicators of education providing information on educational attainment, participation, personnel and educational expenditure.

The "International Standard Classification of Education" (ISCED) adopted by UNESCO (2012) is used to allow cross-national comparisons of data. ISCED serves as a framework to organize education programs into nine internationally agreed levels:

1) Level 0: early childhood education;
2) Level 1: primary education;
3) Level 2: lower secondary education;
4) Level 3: upper secondary education;

5) Level 4: post-secondary non-tertiary education;
6) Level 5: short-cycle tertiary education
7) Level 6: bachelor degree or equivalent;
8) Level 7: master degree or equivalent;
9) Level 8: doctoral degrees or equivalent.

Figure 1.5: Compulsory education in the EU

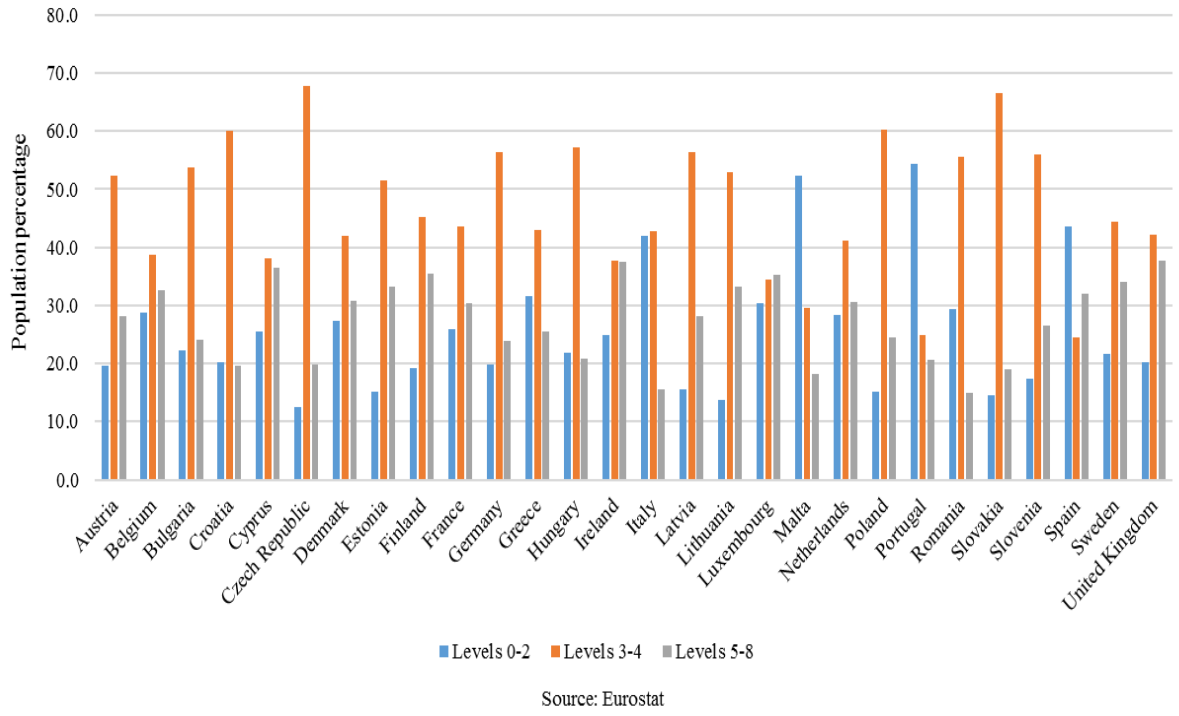


Source: Eurydice

In order to understand the educational indicators in this section, it is important to explain the structure of education in the European Union. Figure 1.5 shows the years of compulsory education, the age at which students start primary school and the age at which they end lower secondary education. The nations are ordered by the duration of compulsory education, which ranges from 9 to 13 years. The two bars indicate the age at which children start primary education and the age at which they end lower secondary education, while the two dots display the starting and ending age of compulsory education. The Netherlands has 13 years of mandatory schooling; thus it is the country with the highest number. Differently from the majority of the European countries, in this nation children are obliged to participate in the last year of childhood education and to attend school until the age of 18. In the EU there is an average of 10 years of compulsory education. In fact, the figure shows that in most countries

students must attend school from 6 to 16 years old. Furthermore, looking at the graph we notice that, in the majority of nations, primary schooling starts at the age of 6, whereas lower secondary education ends at various ages throughout the member countries. In Italy, Hungary, the United Kingdom and Belgium students start ISCED level 2 education at the age of 14, whereas in Lithuania students are obliged to attend school until the age of 16 but lower secondary education ends when they are 17.

Figure 1.6: Educational attainment levels in the EU, Survey Year 2015



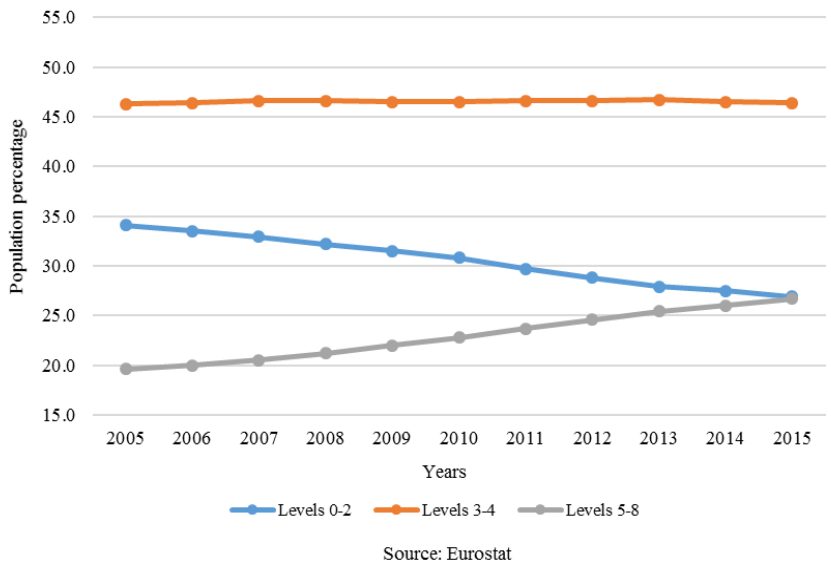
Source: Eurostat

Figure 1.6 shows the level of educational attainment of the population in the European Union aged 15-64 for the year 2015. On the horizontal axis are the countries of the EU, whereas on the vertical axis are indicated the population percentages. The graph groups the ISCED levels into three classes: levels 0-2, levels 3-4 and levels 5-8. The majority of the population in the EU-28 holds an upper secondary or post-secondary level of education. In fact, the figure shows that the bar referring to this level of education carries the higher population percentages among all countries except Malta, Portugal and Spain. Accordingly, in these three countries most individuals hold a lower secondary education diploma at best. More than half of the population in Portugal holds only a 0-2 level qualification. Therefore, it is the country with the least educated population. Furthermore, we notice that in the United Kingdom, Ireland, Cyprus and Benelux countries there is about the same percentage of population holding upper-secondary and tertiary qualifications. In fact, almost 40 percent of the

population in the United Kingdom has a university degree, therefore it can be defined as the EU-28 most educated country. As suggested by the European Commission (2014), these countries with high educational attainment levels should see higher growth rates in the succeeding years. Then, the Czech Republic has almost 70 percent of the population holding an upper-secondary and post-secondary qualification. This can be considered as being the country with the most uniformly educated population. Furthermore, despite the 13 years of compulsory education in the Netherlands, almost 30 percent of its population hold only a level 0-2 qualification.

Figure 1.7 shows the trend in education in the European Union. As discussed in the previous section, in order to get the total EU-28 statistic, the values of each country are weighted by their population index. The graph clearly shows that the percentage of individuals with upper secondary or post-secondary qualifications remained stable, fluctuating around 46 percent over the entire 2005-2015 period. However, the proportion of individuals with at most lower secondary qualifications sharply decreased with the rise in the percentage of individuals holding a tertiary degree. In fact, the level 0-2 line decreased by about 20 percent during the ten-year period. In 2005, 34 percent of the EU population held a low educational level, the evident increase in the European's education made the 2015 value drop to 27 percent. Moreover, the individuals holding a university degree in the EU increased by 36 percent between 2005 and 2015. The 5-8 level line starts at 20 percent in 2005 and arrives at 27 percent in 2015, suggesting there has been a strong increase in the level of qualifications obtained by the population of the EU-28 Member States.

Figure 1.7: Educational attainment in the EU from 2005 to 2015

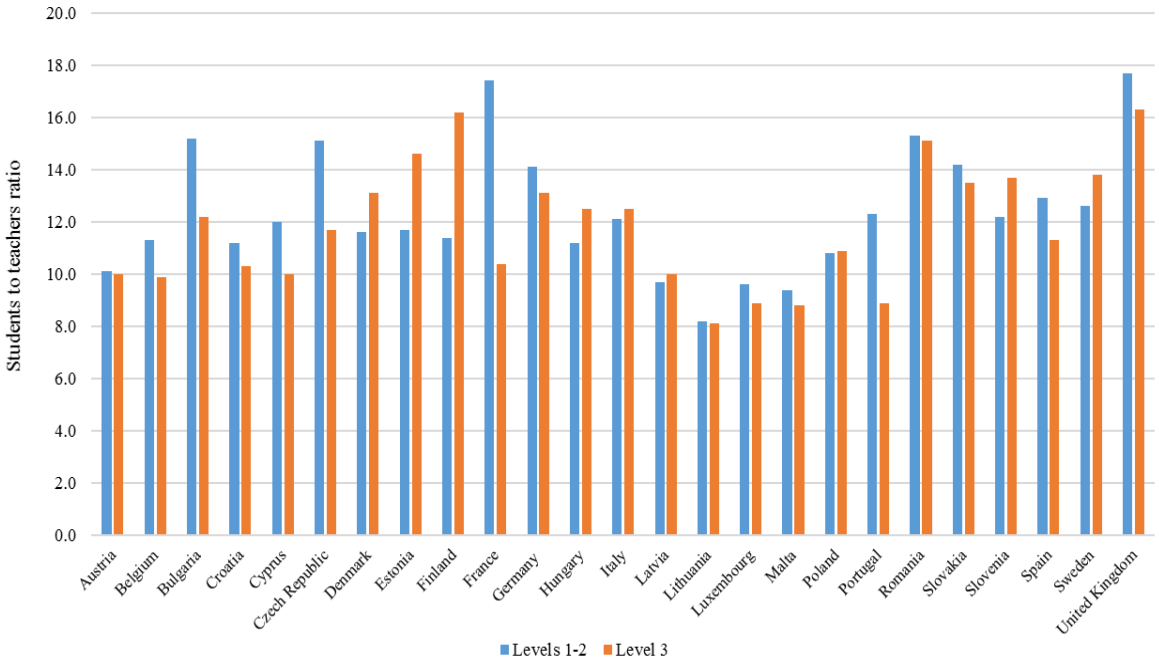


Source: Eurostat

Furthermore, according to the EU statistical office report on participation in education, one out of ten individuals aged 18-24 have completed lower secondary education at most and are not attending further schooling. The countries with the highest rate of early leavers, measured as a percentage of the total young population, are Romania, Malta, and Spain, which have rates of about 20 percent. On the contrary, in Croatia and Slovenia, less than 5 percent of the young population leaves school after completing lower secondary education (Eurostat, 2017).

Figure 1.8 presents a measure of adoption of the educational services. Due to data availability, the graph plots the students to teachers ratio in 2014 for all EU-28 countries except Greece, Ireland, and the Netherlands. It groups the educational levels into two classes: primary and lower-secondary education, and upper-secondary education.

Figure 1.8: Ratio of students to teachers in in the EU, Survey Year 2014



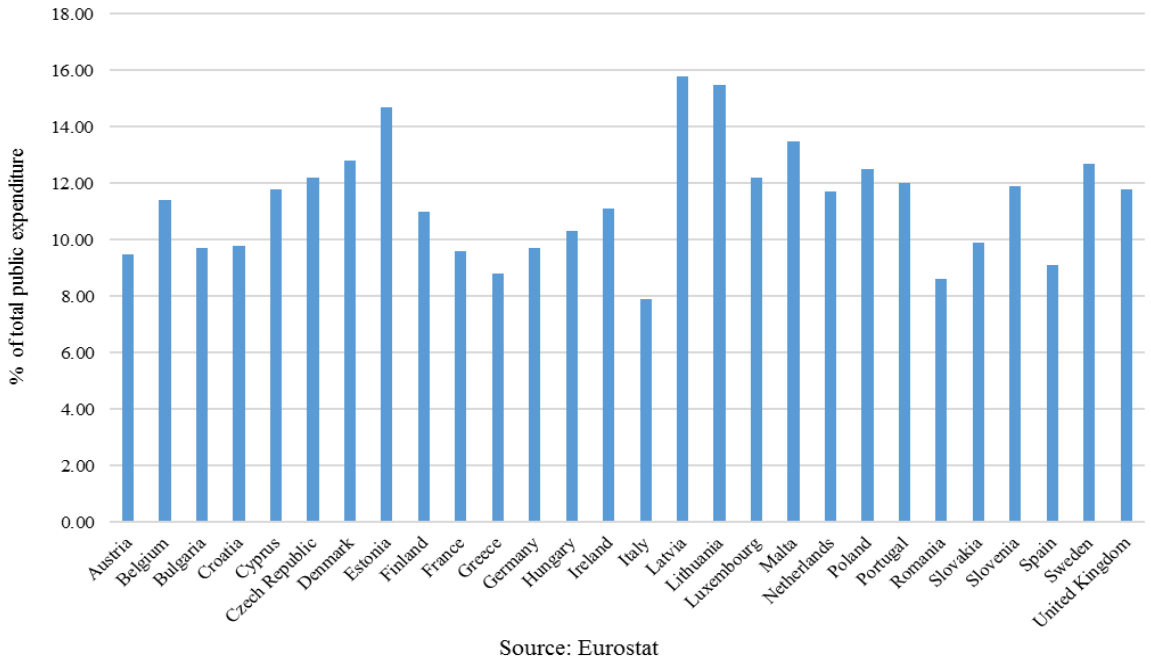
Source: Eurostat

The figure does not show a precise pattern. Some countries have a higher student to teacher ratios at lower educational levels while others have the highest value in upper-secondary education. Moreover, countries as Austria, Italy, Lithuania and Portugal maintain the same ratio for the two levels of schooling. Then, the lowest ratios are seen in Lithuania for both classes, where it is equal to about 8 percent. Furthermore, Latvia, Luxembourg, and Malta have an average of fewer than 10 students per teacher in the lower educational class. These values suggest that the countries have high educational funding enabling them to pursue high

performances in education through a low student-teacher ratio. Furthermore, Austria, Belgium, Cyprus, France, and Portugal have a mean value of fewer than 10 students per teacher in upper-secondary education. Then, the highest ratio is seen in the United Kingdom. It is equal to almost 18 percent for levels 1 and 2, and to 16 percent at level 3. However, as mentioned above, this country is among the most educated EU nations. Therefore, this does not imply that the country gives little attention to education but rather that there are high numbers of students.

Education in Europe is mostly funded by the public, therefore educational systems must be adequately resourced in order to be successful. Starting from the year 2011, the EU-28 public expenditure on education has declined by about 1 percent per year. After three years of contraction, the budget starting growing again from the year 2014. In fact, two-thirds of Member States register a rise in that year. The biggest increase was seen in Bulgaria, Latvia, and Hungary where the budgets rose by more than 5 percent. Moreover, Portugal and Cyprus experienced the largest decrease in the EU between 2010 and 2014, having a cumulative drop of about 18 percent in that period.

Figure 1.9: Expenditure on education as % of total public expenditure in 2014



Source: Eurostat

The share of public expenditure dedicated to education can be interpreted as quantifying the public's commitment to the sector. During 2014 the EU average was about 10 percent. Figure 1.9 displays these percentages for each member state, showing that two-thirds of the countries devote more public resources than the EU average. On the other hand, the large economies

Germany, France, and Italy, invest fewer public money than the EU average. Italy dedicated less than 8 percent of its public budget to education and is thus the country with the lowest education investments (European Commission, 2016).

Concluding, the European Commission (2016) states that improving education is a complex task. Policymakers use the previously mentioned indicators to drive reforms aimed at improving educational outcomes. Each EU country is in charge of its own education system. However, EU policies support national actions by helping nations to address common challenges. Member countries participate in the Education and Training forum. During this conference, nations exchange best practices, mutual learning and gather information for policy reforms. In 2009, the forum set the following six common EU education targets to attain before 2020:

1) Children aged 4 or more participating in early childhood education should be at least 95% of the population;
2) Under-skilled 15-year-olds in reading, maths, and sciences should be below 15%;
3) Early leavers from education and training aged 18-24 should be less than 10%
4) Tertiary education attainment levels of the population aged 30-24 of at least 40%;
5) Employed individuals aged 20-34 with at least an upper secondary education level should be a minimum of 82%;
6) The proportion of adults participating in lifelong learning should be at least 15%.

CHAPTER 2 – LITERATURE REVIEW

2.1 Theoretical Literature

The inheritance of each individual influences its tendency to invest in education. There is much literature stating the importance of parental background in determining children's education and, consequently, shaping income distributions. Galor and Zeira (1993) construct a two-period model with inter-generational altruism and overlapping generations. Individuals are assumed to be identical. They differ only with respect to their inherited wealth and they prefer investing in human capital as it pays back more than working as unskilled individuals. They can produce a good through an unskilled-intensive or skill-intensive process. In the first period individuals can invest in human capital or work as unskilled. All individuals will work, consume and leave bequest in the second period. Therefore, depending on their educational level they will be skilled or unskilled individuals. Authors assume a higher borrowing interest rate than lending rate. As a result, individuals with lower initial wealth will have difficulties accessing investment in education. Hence, high income families, where all individuals invest in education, will be skilled workers and leave a large bequest. Differently, individuals from low income families will be unskilled workers and leave a small bequest to their children. Thus, the distribution of wealth affects the amount of investment in human capital, and has short-run and long- run implications.

Evidence supports the idea that earnings are positively correlated across generations. One explanation is that during youth individuals acquire characteristics which may be productivity enhancing depending on parental income. Loury (1981) builds a model in which individuals live for two periods and families are made up of one parent and one offspring. In this model, abilities and background of parents are diverse, therefore families will have different incomes. Parents are altruistic, hence, they will invest in consumption and training of their offspring. They produce a perishable good in a certain quantity depending on their ability and training. The income derived from this good will be used for consumption and training of their child. Altruism is modelled in the parent's utility function as it depends on family consumption and on its child's future earnings. Earnings of the child depend on the production possibilities of the parent and on its ability. There exists an optimal investment function which considers parental income and training of their offspring. Parents are indirectly affected by their child's income, thus, in case of high intergenerational mobility, individuals will consider high

incomes as less an advantage and low incomes as less a disadvantage than in cases of little social mobility. The author also considers a model in absence of loans and insurance markets. Due to these market imperfections resource allocation may not be efficient. Consequently, children in low-income families may have a limited access to training due to their parents' restricted resources.

Intergenerational mobility is determined by a variety of factors. Becker and Tomes (1986) discuss these determinants by formulating a systematic model relying on utility-maximizing behaviour of all participants, stochastic forces and equilibrium in markets. Parents are concerned about their children. Thus, the analysis comprises altruism, investments in human capital, assortative mating, demand for children, parental treatment of handicapped children and expectations about future events. The degree of inheritability is defined in the relation between parents' and children's endowments, while cultural and genetic inheritances are transmitted automatically from parents to children. Borrowing capacity is an important determinant of intergenerational mobility in earnings. Thus, poor families will have difficulties accessing the lending market to finance human capital investments for their children, and intergenerational mobility in earnings will depend on their willingness to self-finance their children's education. Moreover, assets act as buffers to counteract regressions to the mean in children's earnings. Low and middle income families who do not leave bequests have higher equilibrium marginal rates of return on human capital investments of children and consumption will regress upwards. Differently, consumption in high income families that bequeath to their children will regress down to the mean.

There exist also economic development patterns which are affected by the composition of human capital. Interactions between the externalities from the home environment and externalities from global technology determine the distribution of income, human capital and economic growth. In developing countries home environment externalities are dominating and polarize the distribution of income whereas in advanced economies the global technological externality dominates and contracts the distribution of income. Polarization is an essential ingredient for economic growth. In fact, economies that implement equality enhancing policies prematurely may be trapped at low levels of development. The paper by Galor and Tsiddon (1997) analyses these interactions in the distribution of human capital across generations and demonstrates its significance. They develop a model with a small overlapping generations economy in which individuals have same preferences and human capital. They differ only in the level of human capital of their parents and therefore investments in education will have different efficacies. Parents influence the level of human capital of their

children directly, through home environment, and indirectly, through the level of education of the society. This externality will then affect the level of technological progress. Technological progress raises the rate of return on investments in children's education and, accordingly, stimulates further investments in education. In other words, individuals within a dynasty interact through the home environment externality whereas interactions across dynasties take place through the global technological externality. These externalities play an essential role in the distribution of human capital, in inequalities of income and in the development of economies.

Moreover, the distribution of wealth of a population has a macroeconomic impact and therefore determines the amount of aggregate output of the economy. There is much literature in political economy suggesting the best policies in order to deal with these issues. The model of family behaviour described by Becker and Tomes (1986) offers an explanation of the determinants of intergenerational mobility and suggests that public policies can be used to solve these matters. Loury (1981) states that inefficiencies in resource allocation due to market imperfections could be reduced by the government redistributing incomes more equally through a redistributive tax. Because of intergenerational altruism, if such a program were to be implemented permanently parents would consider their children's' income as less risky and this policy would have a welfare effect. The excess burden represented by the redistributive tax will be dominated by this insurance activity, as long as the redistribution is not too extensive, making parents better off. Then, the model by Galor and Zeira (1993) shows that the cost of education can be subsidised by the government applying a tax on skilled workers in the next period. In such a way, both investments and outputs would increase in the short and in the long run.

The presence of market imperfections and externalities supports interventions in education. Defining the best policies to deal with these problems depends on the characteristics of individuals. Many studies have concluded that public support for tertiary education concerns a transfer of resources from lower income families to higher income families. Fernandez and Rogerson (1995) develop a model on the political economy of educational subsidies and explain this mechanism as being the result of a vote on the subsidization of education. Public education is only partially publicly provided. Hence, poorer individuals cannot benefit from it. The argument is developed formally in a model with imperfect capital markets and individuals differing only in their initial income. The cost of education can be subsidized by means of a proportional income tax imposed on the general public. The tax rate is established through a majority vote. The subsidy is available only to whom chooses to acquire an

education. In such a way, individuals will choose to invest in it depending on their income and on the share of subsidization of education. Subsidization, however, has different efficiency consequences depending on the economy. In a poor economy educational subsidies have a positive effect: they will increase attainment and in turn enhance efficiency. To the contrary, in a wealthy economy educational attainment may be reduced and efficiency is never enhanced. Economies with higher income inequalities are more likely to maintain this unequal distribution of income over time. Furthermore, making education more costly may benefit wealthy individuals because they will be the only benefiting from it and they will extract resources from the others.

Fernandez and Rogerson (1998) construct a second model considering education financing decision of different communities. Financing education is a form of human capital investment because it will yield higher returns in later life. If there are no borrowing opportunities to finance current educational expenditures, low income families may make inefficiently low investments in their children's education. The authors consider intergenerational dynamics using a two-period model with overlapping generations. In each period there exist a large number of families made up of one parent and one child. The income of the parent is given by the education received as a child and by an idiosyncratic random shock. Given their income, parents decide in which community to live in and each community decides the amount of resources to assign to public education via a majority vote. This mechanism yields the income distribution of the next generation of adults. In this analysis incomes are heterogeneous across households and there is mobility across communities which provide education. Therefore, public education funding is determined locally in that spending on education is correlated with the income of the community. Richer communities will benefit from a higher quality of education than lower income communities, such that children raised in higher income families will have a higher expected income than children raised in lower income families. Furthermore, Fernandez and Rogerson analyse a reform substituting locally financed educational systems with a state financed one which divides educational expenditure equally among all students. Results demonstrate that using a centralized system offers efficiency gains by providing a higher average income, higher average educational expenditure and higher welfare.

Education finance policies remove barriers to the acquisition of education by publicly funding education or by removing liquidity constraints. In such a way, individuals paying for their education with money received by their parents will be less liquidity constrained. Owen and Weil (1998) show that there exist multiple steady state equilibria meaning that economies

with same preferences and technologies but different initial wealth distributions can reach different steady states. Policies lead to changes in the share of educated workers and yield different benefits. Increases in educated labour force causes changes in relative wages and economic growth. In fact, educated and non-educated labour force are complementary, meaning that in an economy with high levels of educated workers there will be higher relative wages for non-educated workers. Consequently, children from these families will be more likely to afford an education. There will be a smaller wage gap between the two types of workers decreasing the incentive for children from educated families to become educated workers. Contrarily, in an economy with low levels of educated workers the wage gap between the two individuals will be larger. This will decrease the number of children from non-educated families able to afford an education and will increase the incentive for children from educated families to become educated workers. In other words, we can define two steady states: one with high education, mobility and income; and the other with lower education, mobility and income and with higher income inequality. Furthermore, these differences in mobility will transform into differences in the efficiency of education, meaning that in economies with high mobility individuals with high ability will be those receiving the larger share of educational resources.

A strand of literature aims at explaining the role of the state and of the political process in income inequalities. Countries with similar economic and political conditions may not give the same importance to factors such as social insurance and fiscal redistribution resulting in different social contracts. Policies that redistribute wealth from richer to poorer individuals have a positive net effect on growth, output and ex ante welfare. Net efficiency gains deriving from these policies have very popular support which decreases when inequality rises. In fact, such a practice meets a high consensus in homogeneous society but not in an unequal one. In unequal societies a lower rate of redistribution will increase future income inequality because individuals will continue to be wealth constrained. Therefore, temporary shocks to the income distribution or to the political system may have permanent consequences. Bénabou (2000) describes these mechanisms in a stochastic growth model with heterogeneous agents and incomplete asset markets. Agents vote for redistributive fiscal or educational policies. In the short run redistribution is U-shaped relative to income inequality while they are negatively correlated in the long run. Furthermore, the model shows that there exists a critical level for gains in ex ante welfare due to redistribution. Below this threshold, there is a single social contract and no political influence can sustain more than one contract. Above this threshold

multiple social contracts arise provided that the rich exercise a political weight which is neither too large nor too small.

Individuals from low income families may rely on public schooling and the quality of public schools is determined by the amount of public spending in education. Therefore, individuals with different wealth have different educational opportunities. Ferreira (2001) develops a two-period model in which policies are determined endogenously and studies the interactions between educational, political and wealth inequalities. Households are ex ante identical in every aspect except for initial wealth. In the first period they divide their time between studying or working as unskilled and in the second period agents consume and bequeath the good produced. According to this model there may be persisting inequalities in education due to missing credit markets which force poor individuals to attend schools of lower quality and have lower lifetime wealth. Persisting educational inequalities are influenced also by the voting equilibrium. This equilibrium may determine levels of public expenditure which are not sufficiently high and cannot increase the quality of schools attended by the poor. A transitory increase in taxes or public expenditures will eradicate the poor from the trap of low education-low productivity and increase aggregate output. Higher taxes, however, will make richer agents worse off. In order to escape this inefficiency, the political regime will need to transfer the power from the rich to the poor.

Literature distinguishes between the effect of public and private education on income inequalities. Public education generates greater decreases in income inequalities but private education allows individuals to have higher per capita incomes except for situations in which income inequalities are initially large. When income is below average individuals will choose public education over private. Therefore, the distribution of income affects agents in their choice between public and private education. Glomm and Ravikumar (1992) obtain these results building a two-period model with an overlapping generations economy. The education of the child depends on that of the parent, on the quality of schools and on the time spent in school. The authors differentiate between public and private education. Parents have a bequest motive defined in the quality of schools of their offspring. Under the public education system, parents' bequest is the same across agents since school quality is common to all. The government uses tax income levied from the old to provide free public education and the schools' quality will depend on the amount of taxes collected. The tax rate is determined through a majority voting. Under the private education regime, parents' bequest is specific to each household. Hence, parents' income is distributed between consumption and quality of education received by their children.

Glomm and Ravikumar (2002) developed a second model using the basic framework of that in 1992. The aim of their analysis was to study the distribution of income under public education and to evaluate the behaviour of economies under different levels of public education funding. All agents have the same access to public education expenditures and they use identical learning technologies. Agents are provided with the same quantity of public input to the learning technology, therefore income should converge. The authors consider access to public education to be equal, but in these cases the income gap between high income and low income individuals in the short run may widen. Contrarily, in the long run publicly provided education decreases income inequality. Income inequality depends on the elasticity of substitution between leisure and consumption and on the elasticity of human capital of parents in the learning technology. Results show that under certain conditions, incomes below a certain level diverge, while those above this critical level converge. Hence, despite the fact that public education is identical across individuals, income inequality may initially increase but it will eventually decline. Furthermore, the effect of taxes on the distribution of income is ambiguous. When tax rates are sufficiently small, a raise in the tax rate decreases the income inequality. The opposite applies in situations when tax rates are high. Finally, tax rates have an indirect effect on the incentives to acquire human capital.

Table 2.1: Synthesis of theoretical literature

Authors	Topic	Conclusions
Galor and Zeira (1993)	Education and income inequality	Individuals' level of wealth affects their tendency to invest in education.
Loury (1981)	Education and income inequality	Earnings are positively correlated across generations.
Becker and Tomes (1986)	Intergenerational mobility	Children from families that do not leave bequests have higher marginal human capital returns and higher incomes than individuals from bequeathing families.
Galor and Tsiddon (1997)	Development, education and income	Home environment externalities and global technological externalities affect individual's level of education and income.
Fernandez and Rogerson (1995)	Development and educational subsidies	Educational subsidies have a positive effect in poor economies but may reduce efficiency in wealthy states.
Fernandez and Rogerson (1998)	Development and education	Public education funding is determined locally, thus richer communities have higher education quality.
Owen and Weil (1998)	Education finance policies and income inequality	Educational policies, yield more educated workers, higher wages to non-educated workers, lower income gaps and give lower incentives to children from educated families to become educated workers.
Benabou (2000)	Redistribution and income inequality	In the short run redistribution is U-shaped relative to income inequality while they are negatively correlated in the long run.
Ferreira (2001)	Education quality and income inequality.	Individuals with different wealth have different educational opportunities and, accordingly, different lifetime wealth.
Glomm and Ravikumar (1992)	Public/private education and income inequality	Public education generates greater decreases in income inequalities but private education allows individuals to have higher per capita incomes.
Glomm and Ravikumar (2002)	Public education and income inequality	Public education may initially increase the income gap between low and high income individuals, but it decreases income inequality in the long run.

2.2 Empirical Literature

De Gregorio and Lee (2002) investigate the relation between education and income inequality looking at empirical cross-country evidence. The paper uses an internationally comparable panel data set of income distribution and human capital. Authors consider a wide number of countries measured from 1960 to 1990 at five-year intervals. Specifically, data on income distribution is taken by Deininger and Squire (1996) and measures of education are build up from the Barro and Lee (1996) data set on educational attainment. Both intertemporal and cross-national relations between education and income are investigated. The analysis uses the Gini Coefficient, a measure of income distribution, as the dependent variable and includes factors of educational inequality, education dispersion and GDP per capita. Using a model with "seemingly-unrelated-regression" (SUR) techniques, results show that countries with higher levels of educational attainment have lower income inequality. Thus, policies in the educational field can help reduce inequalities through higher educational spending. Furthermore, the model comprises a set of dummy variables to distinguish between certain regional characteristics that determine different income distributions. Findings show that income distributions in African and Latin American countries are less equal than in other regions.

The model by Sylwester (2002) shows that countries allocating higher percentages of GDP to public education have higher levels of human capital. Consequently, higher investments in education will lower income inequalities and boost economic growth. The author runs a cross country analysis during the period between 1970-1990, and uses a sample of 50 countries from all over the world. Running least square regressions, the model demonstrates that countries with higher levels of average educational attainment have lower income inequality. Furthermore, evidence shows that there is a greater effect in OECD countries than in less developed countries.

Abdullah et al. (2015) examine the effect of education on inequality using a comprehensive meta-regression analysis (MRA) of the existing empirical literature to estimate the average effect of education on income inequality. The analysis uses 64 econometric studies and results show that education is an effective tool to reduce income inequality. The greatest effects can be seen on the low and high income distributions. Specifically, education reduces the proportion of income of the rich, but it has a greater impact increasing that of the poor. Moreover, some of the results show that secondary education is more effective in reducing

inequality than primary and higher education. This suggests that governments should redirect funds towards secondary schooling.

Education finance reforms increase aggregate spending on education. Murray et al. (1995) analyse the impact of court-ordered finance reforms on school resources. The authors use data from 16,000 school districts from 46 states during the period between 1972-1992. Education finance reforms have been forced by State supreme courts in 11 states, therefore the model uses fixed effects to exploit time series data for each state and assess the effect of reforms on the distribution of resources. Outcomes reveal that states which were forced to implement finance reforms saw a 19 to 34 percent reduction in within-state income inequality. Specifically, reforms increased spending in the poorest districts while spending in the richest districts remained unchanged. Therefore, raising aggregate spending on education.

Checchi and Van de Werfhorst (2014) investigate the importance of educational policies looking at the distribution of quantity and quality of education and at their link with income inequality. Quality of education is studied looking at student performance on standardized tests, while education quantity is measured referring to educational attainment. Furthermore, the authors look at the distribution of income to study the effect of educational reforms. Data is taken for countries from the European Union and the model focuses on individuals born between 1950 and 1981. The model is developed controlling for country-specific and time fixed effects, and presents OLS, IV and GMM estimations. Results show that distributions of quantity and quality of education are affected by educational reforms, and that inequality in education affects income inequality. Therefore, educational policies are part of an effective strategy to deal with inequalities in income distributions.

Furthermore, literature focuses on the relations between family background, education and wages. The paper by Altonji and Dunn (1996) aims at examining whether the payoff between working and spending a year in school changes with family background. The empirical model examines wage equations and considers the educational slopes as being influenced by family background. The authors use data from two surveys conducted in the US. The first survey focuses on the population aged 14 to 24. Young men were surveyed in the period between 1966-1981, whereas young woman were surveyed from 1968 to 1988. The second survey uses data from 1968 to 1989 and is based on the population aged 24 to 55. Family background is measured considering father's and mother's education. In the preferred specification, the authors consider siblings' education in order to take into account family fixed effect and to control for unobserved differences in household environment. Results differ for men and

women. For men, parents' education has a significant positive effect on the education slope, especially mother's education. For women, mother's education has a significant effect when using data from one survey, but not considering the other. The effect of siblings on returns to education, that is inferred by parental education, has a limited importance. Thus, parental characteristics have a significant effect on the income level of children. Notably, an extra year of education for parents would increase the monetary value of one school year for children.

Moreover, children's skills depend on inputs they receive by parents and on the ethnic environment in which their parents have invested, the "ethnic capital". Studies hypothesize that ethnicity may be considered as an externality in the process of human capital accumulation. Therefore, ethnicity is included in economic models of intergenerational mobility and results show that differences in ethnic skills of children are likely to persist along generations if ethnicity is sufficiently strong. Borjas (1992) runs an empirical analyses using data from the US during the period between 1977-1989 and looks at the effects of ethnicity on the education and wages of the population aged 18-64. Ethnic capital is measured as the mean in skills of the ethnic group of parent's generation. The estimation is done using generalized least squares and findings show that ethnicity has a positive and significant effect on educational attainment of participants. Coefficients of ethnic capital and parental education have similar magnitudes, suggesting they are equally important in determining the skills of future generations. Regressing occupational attainment, results show a strong link between that of parents and of children. Furthermore, coefficients increase when including ethnic capital in the regression. This demonstrates it is more important than parental occupation in the transmission of occupational success between generations. In other words, children belonging to ethnic groups with low levels of human capital will have limited occupational and educational outcomes because of the low average in the quality of the group. Therefore, there is an important link between skills across generations.

Simon Kuznets (1955) hypothesized that workers transferring between sectors at different income levels will initially raise inequality because the share of high income workers will increase. Eventually, income inequality will decrease as the share of low income workers shrinks. The expanding sector, however, may have more inequality, and therefore will delay the peak in aggregate inequality. Knight and Sabot (1983) analyse this Kuznets effect referring to the transfer of worker from low income rural areas to high income urban areas. Changes in the income distribution arise in response to increases in the share of educated workers in low-income countries. The analysis is conducted using three comparable surveys of wage employees carried out in Kenya in 1980 and in Tanzania in 1971 and 1980. Authors

estimate an earnings function including educational categories as independent variables. They claim that the expansion of education has a "composition" and "wage compression" effect. The "composition" effect initially raises the size of the educated group and will initially increase income inequality, but it will eventually lower it. Then, the "wage compression" effect reduces the premium on education, because the supply of educated workers has risen, and therefore lowers income inequality. Since this mechanism occurs within the expansion of the urban sector, it accelerates the arrival at the point above which economic growth decreases overall inequality.

Skills mismatch is also an important source of income inequality. Slonimczyk (2013) analyses the distribution of wages in the US for a 30-years period, from 1973 to 2002. The model is developed using an extended earning function which decomposes education into: required, deficit and surplus qualifications, and analyses skill mismatch using OLS estimation. Results show that these factors of skill mismatch explain the variance of earnings and the Gini coefficient. In particular, surplus qualifications have been one of the main drivers in the increase of income inequality in the second half of the income distribution. Thus, increasing education requirements would eliminate the mismatch and reduce inequality in real earnings. Furthermore, evidence suggests that there has been an increase in over-qualification rates while under-educated workers have decreased.

Lastly, politics influences income inequality not only through state redistribution but also through markets. Morgan and Kelly (2013) argue that governments can influence income inequality through redistributive taxes and transfers and through a mechanism known as "market conditioning", where the state influences the behaviour of individuals. This mechanism is important particularly in the developing world. In their model, the authors analyse whether governments use policies to shape markets and, hence, influence income inequality. The sample includes data from 19 Latin American and Caribbean (LAC) countries measured from the year 1980 to 2000. The model is estimated using OLS and Rogers (1994) robust-cluster standard errors. Results show that market inequality is affected more by political power than by redistribution and that investments in human capital decreases inequality. Hence, countries should prioritize investments in social spending when seeking to fight inequality.

Table 2.2: Synthesis of empirical literature

Authors	Topic	Data	Estimation	Conclusions
De Gregorio and Lee (2002)	Education and income inequality	49 countries, 1960-1990	SUR	Countries with higher levels of educational attainment have lower income inequality.
Sylwester (2002)	Education and income inequality	50 countries, 1970-1990	OLS	Countries allocating higher percentages of GDP to public education lowers income inequality and boosts economic growth.
Checchi and Van de Werfhorst (2014)	Educational policies and income inequality	EU, 1950-1981	OLS, IV, GMM	Educational reforms affect the quantity and quality of education and inequality in education affects income inequality.
Murray et al. (1995)	Education finance reforms and income inequality	US, 1972-1992	FE	States that were forced to implement finance reforms saw a 19 to 34 percent reduction in within-state income inequality.
Altonji and Dunn (1996)	Family background, education and income	US, 1966-1989	FE, RE	An extra year of education for parents increases the monetary value of one school year for children.
Borjas (1992)	Ethnicity, education and income	US, 1977-1989	GLS	Ethnicity has a positive and significant effect on occupation of children. It is more important than parental occupation in the transmission of occupational success between generations.
Slonimczyk (2013)	Skill mismatch and income inequality	US, 1973-2002	OLS	Surplus qualifications have been one of the main drivers in the increase of income inequality in the second half of the income distribution.
Morgan and Kelly (2013)	Market and income inequality	LAC countries, 1980-2000	OLS	Market inequality is affected more by political power than by redistribution and that investments in human capital decreases inequality.

CHAPTER 3 – ECONOMETRIC FRAMEWORK

3.1 The Higher Education Act

Developed countries have seen higher education in continuous change over the last decades. The unceasing increases in student numbers created pressures on the institutions and on the public which had to finance most of the costs. Concerns about efficiency and outcomes of public universities starting growing and contributed to the belief that an organisational and financial change was needed (Beblavy et al., 2010).

The Slovak Republic responded to these developments through various initiatives which aimed at strengthening universities' private resources. Innovations in the financing of higher education in Slovakia started in 2000 with the government's White Paper "Concept of Further Development of Slovak Higher Education in the 21st Century". The publication stated the need for a profound change in the governance, financing and legal framework of higher education. During 2000 and 2001 some of these changes were implemented, but the new system was adopted only in 2002 when the Slovak Republic introduced the Higher Education Act 131/2002. The reform has transformed public universities from state institutions into organisations with a non-profit management structure. At most, 90 percent of their expenditures are now covered by the state budget, and the rest is sustained by universities. In fact, higher education institutions (HEIs) manage both their tangible and intangible assets to adapt to these new conditions. Moreover, with this major higher education reform, the government decided to transform the rules related to the spending of public subsidies by creating a strong set of incentives that would make universities eager to pursue these objectives. Lastly, Slovakia signed the Bologna Declaration in 1999 but it was only with the Higher Education Act that all its components were implemented into Slovakian HEIs (Beblavy et al., 2010; EHEA, 2003).

The reform is now described in details following Beblavy et al. (2010) and Mederly (2006). Before 2002, public HEIs in Slovakia had funding and financial management systems characterised by the following features:

1) All revenues of HEIs had to be transferred to the central budget;

2) HEIs used mostly incremental budgeting[1], taking into account underspending, but did not consider outputs such as students, graduates, and publications;
3) Subsidies given to HEIs were internally structured by the government and could not be modified;
4) The government owned property and assets of HEIs and invested in them by providing discretionary and targeted subsidies, by that controlling capital budgets' of HEIs;
5) HEIs used cash-based accounting systems.

This funding mechanism was problematic because it did not encourage public universities to improve their performances. Specifically, increases in the number full-time students did not convert into higher subsidies. However, there was a lack of clarity regarding the treatment of part-time students. Therefore, universities decided to charge fees for these students and to work to increase these numbers. Moreover, the funding formula did not consider publications, so HEIs were not encouraged to improve research. Then, if institutions managed to have savings, these were removed from the budget of the next year. In this way, any incentive for efficient asset management was removed. Finally, these management problems and the lack of long-term planning were coupled with political interference.

Following the new system in place since 2002, the budgeting of government subsidies considers both inputs and outputs. HEIs receive funds based on a publicly known funding formula which reflects the following elements:

1) Number of students (weighted by a cost coefficient for each area of study);
2) Number of graduates (weighted);
3) Number of Ph.D. students and graduates (not weighted);
4) Education and professional structure of teachers;
5) Research publications (weighted by category coefficients which represent quality and importance);
6) Number of domestic and foreign research grants.

Furthermore, changing the rules governing higher education management, HEIs may now efficiently and effectively utilise their tangible and intangible assets. Particularly, after 2002 HEIs can:

1) Keep their own revenues;

[1] Incremental budgeting, as described by Layzell (1998), is done by considering an institution's base budget of the prior year and allocates increases or decreases to that statement according to a set of budget guidelines.

2) Own their assets and employ them freely to generate revenues;
3) Receive subsidies from government in an unstructured grant;
4) Carry over to the following years any unspent funds.

Lastly, HEIs introduced more long-term, strategic and sustainable management techniques by switching to accrual accounting and converting capital grants into regular subsidies.

Higher education and research systems have a limited ability to rapidly respond to these changing incentives because of the length in these processes. In fact, students can be accepted immediately, papers can be written and grants can be submitted but it takes from one to three years before results are seen. Moreover, tangible assets, such as equipment and buildings, take years to build, and new teachers and staff need several years to be trained.

The Act specifies that financial support to public HEIs is granted from the State budget in the form of four subsidies:

1) Subsidy for running accredited study programmes: the allocation is done considering the number of students and graduates, the economic demand of the programme, the classification of the HEI and the quality of the teaching.
2) Subsidy for research, development or artistic activities: the amount is decided on the basis of the capacity of the public HEI, on its achieved results and on the evaluation of its creative activities performed by the Accreditation Commission.
3) Subsidy for the development of HEIs: it is established through the selection procedure of development programmes carried out by the Ministry. The procedure considers the quality of the projects and the long-term strategy of both the institution and the Ministry.
4) Subsidy for student's social support: it is based on students' eligibility and on the availability of funds.

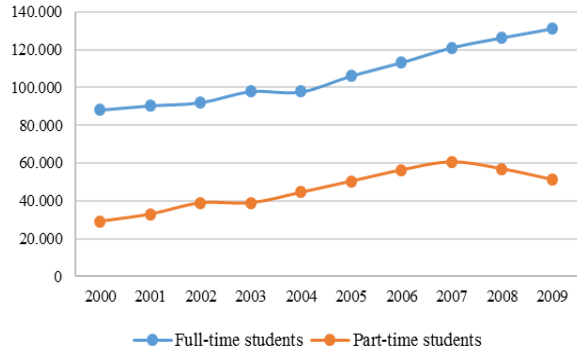
The allocation of these subsidies is carried out referring to the guide which is annually updated by the Ministry. The guide is then mandatorily submitted to the representative bodies of HEIs in order to obtain their opinions.

Figure 3.1 shows that the new system successfully increased the number of full-time students. In fact, after 2002 there is a surge in the number of full-time students with the only exception in the year 2004 where the curve slightly declined due to reasons not related to the reform[2]. The number of part-time students follows an upward trend since the year 2000 and

[2] In 2004 the size of the class graduating from secondary education was small because four years before primary and lower secondary education shifted from eight to nine years, thus creating this small gap in the population.

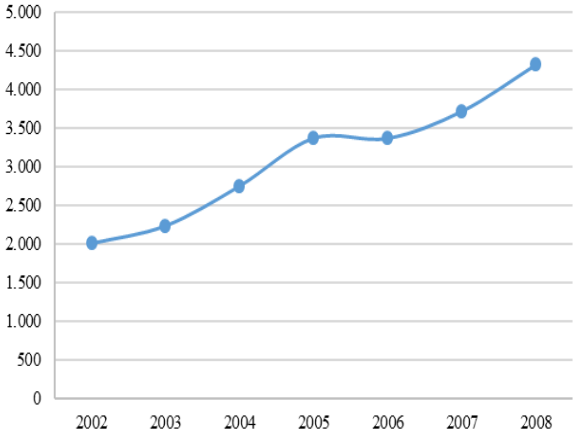
enrollments surge starting from the year 2003. It is only in 2008 that part-time student numbers drop. Therefore, the reform did not succeed in shifting students from the part-time fee-paying system to the full-time system.

Figure 3.1: Evolution of student



Source: Beblavy, Mederly, Beblava, 2010

Figure 3.2: Developments in full-time PhD student numbers



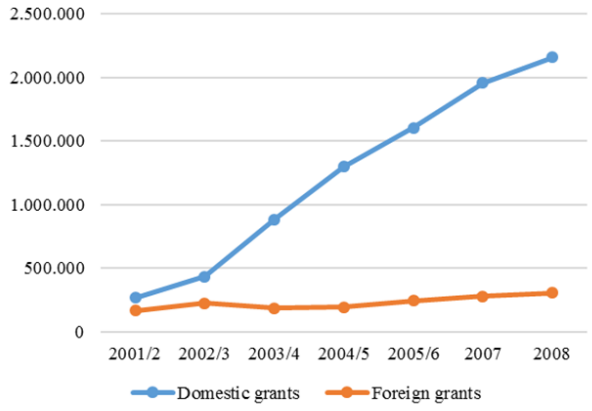
Source: Beblavy, Mederly, Beblava, 2010

The formula for payments to Ph.D. students consider the costs of the different fields of study. They are divided into three categories: medicine; natural, agricultural and technical sciences; and others. Furthermore, there are additional bonus payments for all students and graduates. These prices fluctuate considerably over the years, but there remains a significant premium between payments for Ph.D. students compared to payments for undergraduate and graduate students. Its objective was to raise the number of Ph.D. researchers. Figure 3.2 clearly shows the increase in Ph.D. enrolments starting from the year 2002. From 2003 to 2008, students almost doubled, with the exception of the year 2006. Therefore, we can definitely state that the reform succeeded in this respect.

Furthermore, the funding formula considers the number of research grants received from Slovakian sources and from abroad. The only eligible Slovakian grants come from official government agencies. Instead, now international grants are obtained from National Institutes of Health in the US, the European Science Foundation, and the EU Framework Research Programme. Figure 3.3 shows the increase in foreign grants after 2005. The jump is due to a structural break in the data because the ministry relaxed eligibility conditions in that year. In

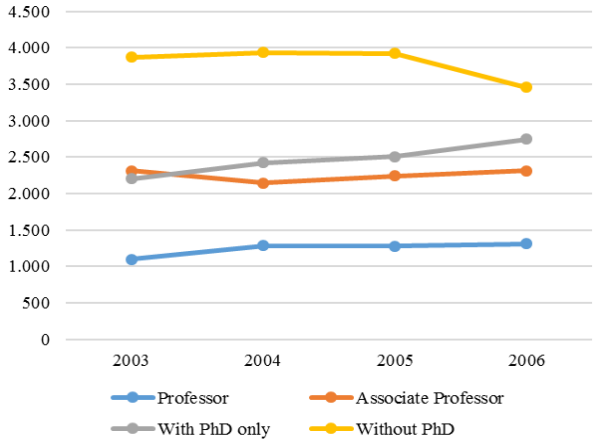
contrast, the evolution of domestic grants accelerated after 2003. Outputs increased by almost 800 percent and were ten times more than foreign grants[3]

Figure 3.3: Eligible research grants in Sk1000



Source: Beblavy, Mederly, Beblava, 2010

Figure 3.4: Number of teachers in individual categories



Source: Mederly, 2006

Government's policy was to reduce the number of teachers without a Ph.D. and therefore improve the qualification of staff. To do so, the reform included a coefficient of qualification structure of teachers into the funding formula. Slovakia has a regular career ladder: teachers' qualifications go from lecturer to senior lecturer and from associate professor to professor. Associate and full professors must meet nationally determined criteria while the appointment process is carried out by the institution. Figure 3.4 shows that the academic staff's qualifications have increased after 2003: the number of teachers without a Ph.D. fell in 2005, while the number of full professors kept an upwards trend after the reform.

Furthermore, after the reform subsidies are assigned from the State budget to public higher education institutions according to six allocation criteria:

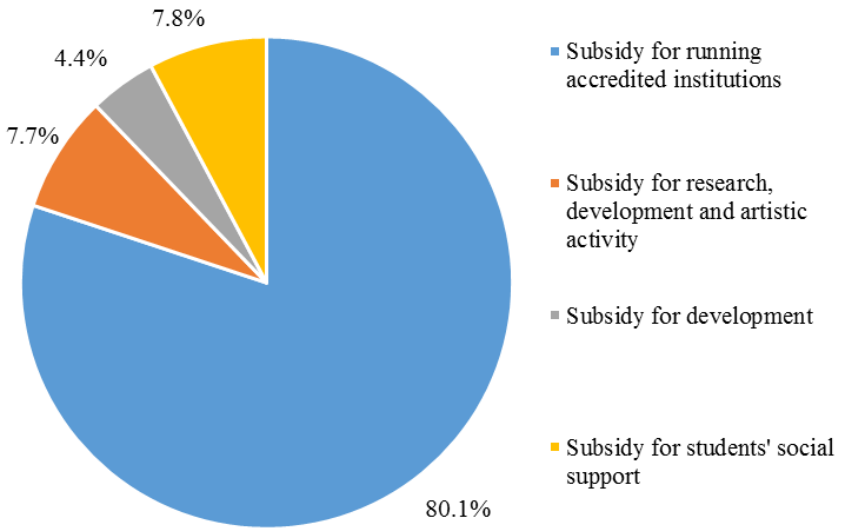
1) Historical principle,
2) Performance in education,
3) Performance in research,
4) Specificities,
5) Project quality,
6) Other criteria.

[3] Numbers from 2001 to 2006 are based on the volume of grants over the preceding two years, therefore the 2007 and 2008 numbers are doubled to allow comparison.

Figure 3.5 shows the percentage rates of the four subsidies in the approved budget for 2003. As obvious from the figure, the subsidy for running accredited institutions has the biggest portion. It covers costs sustained by universities for the provision of higher education. Specifically, this subsidy covers costs for students, employees, operational costs and costs for specificities.

Furthermore, from 2002 to 2006 the weight criteria for performance in research and project quality strengthened, suggesting that greater volumes of subsidies were allocated according to the number of successful Ph.D. researchers and to the importance of projects.

Figure 3.5: Structure of allocation of subsidies in 2003



Source: Mederly, 2006

3.2 Data

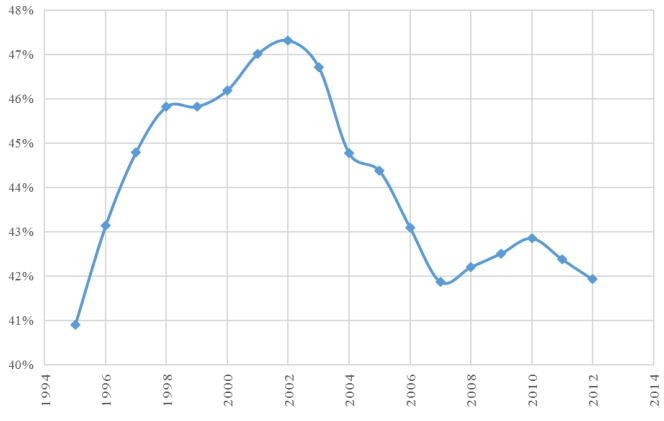
The aim of this work is to estimate the effect of the Slovakian Higher Education Act on market income inequalities using a synthetic control approach. The model uses annual country-level panel data for the period going from 1995 to 2012. The Act reformed the financing of public universities starting from the academic year 2002/2003. Therefore, 2003 is considered as being the treatment period giving 8 pre-intervention periods and 9 post-intervention periods. The synthetic Slovak Republic includes 21 European countries: Austria, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Netherlands, Norway, Poland, Portugal, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Based on the theory, a set of market inequality predictors are identified: human capital, government expenditure, unemployment, taxes, trade, services and participation to trade unions. Furthermore, the model controls for population in order to make the synthetic Slovak Republic reproduce at best the values of the country. This measure considers all residents regardless of citizenship or legal status and is estimated at midyear. Population data are taken from a variety of sources: the "United Nations Population Division. World Population Prospects", "Census reports and other statistical publications from national statistical offices", "Eurostat: Demographic Statistics", "United Nations Statistical Division. Population and Vital Statistics Report", "U.S. Census Bureau: International Database", and the "Secretariat of the Pacific Community: Statistics and Demography Programme".

3.2.1 Dependent Variable

The outcome variable is market income inequality in the Slovak Republic. Market inequality measures the distribution of income before taxes and transfers. In this work, inequality is estimated using the market Gini coefficient retrieved from the "The Standardized World Income Inequality Database" constructed by Solt (2016). The Database provides comparable data on income inequality covering a wide number of countries and years. Estimates of the market Gini index are available in Stata format. In order to capture uncertainty in the estimate, data are represented by 100 separate variables and are summarized to conduct the analysis. Figure 3.6 shows the trend in the market Gini coefficient in Slovakia from 1995 to 2012. The graph clearly shows that inequality plummeted after 2002. The objective of this work is to demonstrate that the Higher Education Act contributed to this drop using a synthetic control approach.

Figure 3.6: Trend of the market Gini coefficient in the Slovak Republic



Source: Solt (2016)

3.2.2 Independent Variables

Education is essential in reducing income inequality. Educated individuals will have larger occupational choices and will be more competitive in the labour market. By consequence, their level of pay will be higher acting as a signal of their ability and productivity in the market. Empirical studies show that increases in average educational attainment appear to be one of the most important factor contributing to the reduction in wage dispersion (Afonso et al., 2010; OECD, 2011; Checchi and Van de Werfhorst, 2014; Dabla-Norris et al., 2015). In this analysis education is measured using the human capital index from the "Penn World Table - international comparisons of production, income and prices 9.0" constructed by the University of Groningen. In order to avoid problems of reverse causality, the measure is kept fixed at 1995 levels for all countries. The Penn World Table contain real national accounts data in U.S. dollars and are useful for research on development and growth. The human capital index is intended per person and is based both on years of schooling and on returns to education.

Public spending has an impact on income inequality. It can directly affect the distribution of income by transferring resources to individuals that are worse-off. Redistributing to the poor may allow parents to pay for their children's education, enabling them to afford better schools (Afonso et al., 2010). Generally, empirical studies using government spending as a proxy for redistributive policies, show that increases in such expenditures are associated with a decreases in income inequality (Dabla-Norris et al., 2015). However, political economy literature suggests that governments redistribute when societies are unequal, proposing a positive relation between inequality and redistribution. This explanation derives from Meltzer and Richard's (1981) theory on median voter preferences, according to which when the income gap between the median and mean voter is large, the median voter will require government's intervention (De Mello and Tiongson, 2006). Furthermore, evidence shows that government spending seems to be neutral for the top income groups, while it has a negative effect on the middle and lower income groups (Roine et al., 2009). In this work general government consumption is measured as a share of GDP. It includes all government's current expenditures for goods and services, and most of government's investments on national defence and security. Data are obtained from the "World Bank national accounts data" and from the "OECD National Accounts data files".

Unemployment positively affects inequality. Increases in unemployment aggravate the position of low-income families because workers at the basis of the income distribution are

less educated and more at risk during economic recessions (Rodriguez-Pose and Tselios, 2008). In order to consider this effect, this model uses national estimates of total unemployment as a percentage of total labour force. It refers to the share of workers without a job and actively seeking for an employment. The data is collected from the International Labour Organization, specifically from the "Key Indicators of the Labour Market database".

Reforming tax policies yields significant redistributive effects. During recessions, low-income groups experience losses emphasizing the need for government income-support policies (OECD, 2011). In his speech on "The Rise and Consequences of Inequality in the United States", Krueger (2012) highlights the important role of tax policies. Tax changes benefitting the very rich more than taxpayers will aggravate the widening gap in pre-tax income. Evidence shows that economies do not perform better after cutting tax rates of the very wealthy, rather there are jobs increases across businesses when taxes are stricter on top earners. According to the American economist, differences between before-tax income inequality and after-tax income inequality measures the extent to which the tax system reduces inequality. Therefore, in order to construct this measure of tax, data are taken from "The Standardized World Income Inequality Database".

High trade and financial openness between countries enabled technological advances. But globalization has mixed effects. In advanced economies, firms adopt labour-saving technologies and offshoring techniques leading to the decline in manufacturing and increases in skill premium. The rise in skill premium makes non-educated workers worse off and society more unequal. On the other hand, trade openness and technological advances could raise the demand of less educated workers, increasing their wages and lowering income inequality (Dabla-Norris et al., 2015). In OECD countries, globalization has been considered as the main cause of increasing income inequalities. Evidence suggests that trade integration rises the gap between wages of the high and low skilled and, therefore, contributes to greater income inequality (OECD, 2011). In the model trade is the sum of imports and exports of goods and services measured as a share of GDP. Data are collected from the "World Bank national accounts data" and the "OECD National Accounts data files".

Controlling for sectoral composition yields different results. Empirical evidence shows that agriculture, industry and services negatively affect income inequality. Nevertheless, decomposing services into finance, trade and public administration yields various results (Rodriguez-Pose and Tselios, 2008). Motonishi (2006) investigate the ambiguous effect of financial services on income inequality. More developed financial services allow the poor to

borrow from the wealthy, reducing income inequality. However, due to credit constraints, financial services are usually not available to the poor. Hence, these market failures increase income inequality. To avoid problems of multi-collinearity, the model uses only the services sector as a proxy of this determinant. Services are measured in terms of value added and are computed as a percentage of GDP. They correspond to divisions 50 to 99 of the "International Standard Industrial Classification of All Economic Activities" (ISIC), including activities such as transports, government and personal services. This variable is also retrieved from the "World Bank national accounts data" and from the "OECD National Accounts data files".

A drop in trade union membership may reduce the bargaining power of labour. Lower union density may weaken workers' influence on corporate decisions regarding compensations of top managers. Therefore, income inequality rises because de-unionization may increase the income share of the very rich and weaken earnings of middle and low-income workers (Jaumotte at al., 2015). In order to build a measure of participation to trade unions, this work uses an indicator which is built weighting the active trade union members on the number of employed individuals. Data on union members are collected from the "OECD Labour Force Statistics", while employment numbers are taken from "The International Financial Statistics" of the IMF.

Table 3.1: Data Description

Variable	Data Source	Expected Effect
Human Capital	The Standardized World Income Inequality Database	-
Government Expenditure	World Bank national accounts data, and OECD National Accounts data files.	+/-
Unemployment	International Labour Organization, Key Indicators of the Labour Market database.	+
Taxes	The Standardized World Income Inequality Database.	+
Trade	World Bank national accounts data, and OECD National Accounts data files.	+/-
Services	World Bank national accounts data, and OECD National Accounts data files.	+/-
Trade Union Participation	OECD Labour Force Statistics and the International Financial Statistics	-

3.2.3 Descriptive Statistics

This analysis estimates the effect of the Higher Education Act on income inequality. The regression model uses market income inequality as the dependent variable and a set of estimates which capture the effect of education, labour market, government policies and sectoral composition as the independent variables. The dataset contains 396 observations from 22 countries for the period between 1995 and 2012. The summary statistics are reported in Table 3.2.

The mean Gini market coefficient is 46% and has a standard deviation of 4%. Differently, trade has a mean of 87% and a standard deviation of 36%. This measure has the largest gap between the minimum and maximum value, it goes from 37% to 197%.

Furthermore, the table shows a wide gap between the minimum and the maximum value of participation to trade unions. Countries experience different patterns. In fact, values go from 4% to 75% of participation. Due to globalization, union density declined in most advanced economies after 1995 (OECD, 2012). Globalization increases competition, improves education levels and reduces workers' incentives to enter unions. However, Nordic European countries continue to have high participation levels to trade unions (Jaumotte et al., 2015). Furthermore, taxes have a negative minimum value. This is due to income inequality in Estonia. The country has a slightly larger net Gini coefficient than market Gini in 1995 and 1996. These values suggest that the government was able to largely redistribute to its population, and reduce inequality after taxes and transfers.

Table 3.2: Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Gini Market	396	46.524	3.975	35.127	56.300
Human Capital 95	396	2.961	0.409	1.854	3.498
Government Expenditure	396	19.500	3.469	10.177	28.064
Unemployment	396	8.378	4.081	2.100	24.800
Taxes	396	17.337	5.080	-0.441	26.890
Trade	396	87.347	35.981	37.108	197.218
Services	396	67.286	5.898	50.474	81.079
Trade Union Participation	396	27.117	18.262	4.526	75.327

3.3 Linear Regressions

In this work, we will estimate the model first using panel data estimation techniques and then adopting the synthetic control method. The empirical model to analyse the impact of the Higher Education Act on market income inequality is based on the following regression:

$$Gini_{it} = \beta_0 + \beta_1 Hc95_{it} + \beta_2 GovExp_{it} + \beta_3 Unem_{it} + \beta_4 Tax_{it} + \beta_5 Trade_{it} + \beta_6 Services_{it} + \beta_7 Unions_{it} + \beta_8 Pop_{it} + \varepsilon_{it} \quad (3.1)$$

for country *i (i = 1,..., J+1)* at time *t (t = 1,..., T).* Hc95 is the stock of human capital in 1995, GovExp is the total amount of government expenditure as a share of GDP, Unem is the unemployment rate, Tax is the measure of taxes, Trade is the sum of imports and exports of goods and services measured as a share of GDP, Services is the value added of services as a percentage of GDP, Unions is the share of active trade union members on the number of employed individuals, Pop measures population, and ε_{it} is the error term.

Hausman (1978) presents a specification test for measuring whether the regressors are uncorrelated to the disturbance term. Under the null hypothesis, there is no misspecification and there exists a consistent and asymptotically normal and efficient estimator. Under the alternative hypothesis, there is misspecification and the previous estimator will be biased and inconsistent. Thus, there must exist an alternative estimator which is consistent under the null and alternative hypothesis, but not asymptotically efficient under the null.

This test may be used to identify the best estimator between random effects and fixed effects. The test measures whether $E(\mu_i|X_{it}) = 0$, which is a crucial assumption for the random effects model. Thus, in this instance, under the null hypothesis $\hat{\beta}_{GLS}$ and $\hat{\beta}_{FE}$ are both consistent estimators, but the latter is not efficient. If the assumption is violated, we reject the null hypothesis and random effect is inconsistent while fixed effects is the consistent and preferred estimator.

Furthermore, the null hypothesis can be tested by measuring the difference between the two estimators given by the following equation:

$$\hat{q} = \hat{\beta}_{FE} - \hat{\beta}_{GLS} \quad (3.2)$$

If there is no misspecification the variable $\hat{q}$ should be near zero, then $\hat{\beta}_{FE}$ and $\hat{\beta}_{GLS}$ should be approximately the same. In this case, we accept the null hypothesis that no misspecifications exist and, therefore, the random effects estimator is correct.

Moreover, under the null hypothesis the test measures whether the covariance of the efficient estimator and its difference from the inefficient estimator is zero using the following matrix algebra formula:

$$(\beta_{RE} - \beta_{FE})' \hat{\Sigma}^{-1} (\beta_{RE} - \beta_{FE}) \sim \chi^2(k) \tag{3.3}$$

The Hausman test statistic is distributed as χ^2 with k degrees of freedom, indicating the number of endogenous variables. If this measure is significant, then the random effects estimator should not be used.

This analysis first evaluates the empirical model using ordinary least squares, random effects and fixed effects. Then the Hausman specification test will be discussed, suggesting which of these techniques yields the best estimations.

3.4 The Synthetic Control Method

The Synthetic Control Method was initially explained by Abadie and Gardeazabal (2003) in their study on the economic effects of conflicts. The article focuses on the Basque ETA terrorist organization, which began in the late 1960's, and assesses its impact on the regional economy. Results show that after this period, GDP per capita in the Basque region decreased by about 10 percent compared to its synthetic control region without terrorism. Then, this methodology is used by Abadie et al. (2010) for comparative case studies. The authors study the effects of the tobacco control program, known as Proposition 99, which has been implemented by California in 1988. With the use of the Synthetic Control Method, they were able to recreate a synthetic California in absence of the program and analyse the trend of tobacco consumption in this region. Results reveal that in the year 2000, yearly per-capita cigarette sales in California had decreased by about 26 packs compared to its synthetic control region.

This approach constructs a weighted combination of the outcome's predictors, representing what would have occurred in the absence of the statute. In contrast to the Difference-in-differences (DiD) approach, the synthetic control method admits changes over time in the

observed and unobserved effects of the predictors. In fact, DiD estimations assume that time effects, as macro shocks, are common to all treated groups. In this way, it removes the confounding factors in the unobserved covariates, which are due to fixed differences between the groups, by assuming that they do not change over time. These two assumptions are referred to as "parallel trends assumption", implying that the trajectories of the treated and control groups follow a parallel trend over time (Kreif et al., 2016).

The methodology adopted firstly by Abadie and Gardeazabal (2003) is used to investigate the effects of the Higher Education Act on market income inequalities in the Slovak Republic. This approach aims at measuring the effect of the reform on post-intervention outcomes, examining the trend of the market Gini in the absence of the reform. In order to do so, it is important to build a counterfactual which approximates the values of the predictors of the market Gini before the reform. Next, the synthetic control method is described following Abadie et al. (2010) and Abadie et. al (2015).

Suppose that there are $J+1$ countries indexed by j, where the treated unit is $j = 1$ and units $j = 2$ to $j = J+1$ are countries used as controls, the "donor pool". Market inequality in donor countries is considered as being driven by the identical structural process of that in Slovakia, and must not be subject to structural shocks during the sample period. This method uses longitudinal data sets observing all units from $t = 1$ to $t = T$. There are a positive number of pre-intervention periods, denoted as T_0, and a positive number of post-intervention periods indicated as T_1. Therefore, $T = T_0 + T_1$. Then, the synthetic control is a weighted average of the j countries in the donor pool, where all the weights sum to 1. In other terms, for $j = 2, \ldots, J$ weights $w_2 + \ldots + w_{J+1} = 1$ and it can be represented by a $(J \times 1)$ vector of weights $W = (w_2, \ldots, w_{J+1})'$, where $0 \leq w_j \leq 1$. The outcome observed in the absence of the intervention for country i at time t is the market Gini coefficient and it is denoted by Y_{it}^N. Then, the outcome observed if country i is exposed to the intervention at time $T = T_0 + 1$ is indicated by Y_{it}^I. Therefore, the outcome observed in country i at time t is given by the following formula:

$$Y_{it} = Y_{it}^N + \alpha_{it} D_{it} \tag{3.4}$$

where the causal effect of the treatment is given by:

$$\alpha_{it} = Y_{it}^I - Y_{it}^N \tag{3.5}$$

As in Average Treatment Effects, $D_{it} = 0$ in all countries up to time T_0 and from time $t = T_0 + 1$ to T in the donor pool countries. Then, $D_{it} = 1$ for the Slovak Republic from period $T_0 + 1$ onwards.

Differently from the DiD approach, the synthetic control model admits region-specific trends. Thus, the counterfactual outcome is given by the following regression:

$$Y_{it}^{N} = \delta_t + \theta_t Z_i + \lambda_t \mu_i + \varepsilon_{it} \tag{3.6}$$

where δ_t, θ_t and λ_t are unknown time-specific parameters, while Z_i and μ_i are respectively observed and unobserved country-specific characteristics.

Following the Method of Differences, the value of W is chosen such that the characteristics of the donor pool best resemble the features of Slovakia. X_1 is the $(k \times 1)$ vector including the pre-intervention values of the market Gini predictors for the treated country, while X_0 is the $k \times J$-matrix containing the same values for the donor pool. Thus, the vector $X_1 - X_0 W$ represents the difference between the pre-intervention characteristics of Slovakia and its synthetic control, which is chosen using the vector W* which minimizes this difference. Defining X_{1m} as the vector containing the values of the m-th predictor for the treated unit and X_{0m} as the $(1 \times J)$ vector containing the same values for the donor pool, W^* is chosen as to minimize:

$$\sum_{m=1}^{k} v_m (X_{1m} - X_{om} W)^2 \tag{3.7}$$

where v_m is a weight representing the relative importance assigned to each predictor and $m = 1, \ldots, k$. Furthermore, weights are chosen such that the synthetic control minimizes the pre-treatment "Root Mean Squared Prediction Error" (RMSPE). This index measures the lack of fit between the trend in the Gini market for Slovakia and its synthetic control. It is defined by the following formula:

$$RMSPE = \left(\frac{1}{T_0} \sum_{t=1}^{T_0} \left(Y_{1t} - \sum_{j=2}^{J+1} w_j^* Y_{jt} \right)^2 \right)^{1/2} \tag{3.8}$$

The outcome of unit j at time t is denoted as Y_{jt}. Therefore, Y_1 is the $(T_1 \times 1)$ vector containing the post-intervention values of the market Gini for Slovakia, and Y_0 is the $(T_1 \times J)$ matrix

containing the outcome values for the countries in the donor pool. The effect of the treatment, estimated using the synthetic control, is given by comparing post-intervention outcomes of the treated and not treated countries. It is given by the following equation:

$$\hat{\alpha}_{1t} = Y_{1t} - \sum_{j=2}^{J+1} w_j^* Y_{jt} \tag{3.9}$$

Thus, even if the trend is country-specific, in the pre-intervention period the synthetic control displays the same trend of the treated unit if weights have been correctly chosen. Galiani and Quistorff (2016) state that, in this case, the bias in $\hat{\alpha}_{1t}$ decreases to zero with the increase in the number of pre-intervention periods.

Furthermore, the synthetic control providing a good fit for the treated country may still have a large interpolation bias if the linear model does not hold over the whole set of control units. In order to minimize biases, researchers restrict the donor pool to countries with characteristics which are similar to the treated one. In such a way, biases caused by interpolation are minimized (Abadie et at., 2010). In this analysis Slovakia is the treated unit, therefore we have tried to reduce interpolation bias by including other European countries in the donor pool.

Moreover, Abadie et al. (2015) compare the synthetic control method to regressions. Similar to a regression-based approach, the linear combination of the untreated countries is constructed using coefficients that sum to one. However, regression weights may assume values greater than one or negative values. Therefore, estimating counterfactuals using linear regressions allows the regression weights to produce a perfect fit by extrapolating even if the characteristics of the treated unit cannot be replicated using a weighted average of the countries in the donor pool. Then, regression weights are not actually calculated, therefore analysts usually do not know to what extent regression techniques extrapolate. In contrast to this approach, coefficients of the synthetic control method must be between zero and one, therefore, the comparison group is constructed avoiding extrapolation.

Billmeier and Nannicini (2013) discuss the advantages and limitations of this methodology. Clearly, the main advantage is that the synthetic control allows an estimation of the counterfactual outcome for the treated country. The algorithm uses the chosen predictors to construct a weighted average of the outcome variable. Thus, one of its evident advantages is transparency because the synth command shows the weights assigned to each country and

allows us to understand which units are included in the synthetic control. Then, the identification assumptions of this method are weaker than those demanded by other commonly used estimators. In fact, endogeneity from omitted variable bias is solved by considering time-varying unobservable confounders. This aspect improves the DiD model discussed above. Moreover, a major limitation is that reforms might be motivated by future growth prospect beliefs, thus causing endogeneity problems from reverse causality and biasing the findings of the method. However, this approach does not provide large sample inferential techniques to assess the significance of the results. In fact, in this work inferences are made using the synth runner command in Stata.

3.5 The synth runner Package

This inferential technique is explained following Galiani and Quistorff (2016). The statistical significance of the results is assessed by running multiple synthetic control estimations. The program runs "in-place" placebo tests which assign the treatment to each unit in the donor pool and checks the size of these effects. Performing these evaluations, the Slovak Republic is excluded from the synthetic control group. In order to have statistically significant results, the distribution of placebo tests must not yield outcomes which are as large as those of the treated unit. Otherwise, we can state that the treatment effect has been observed by chance.

Furthermore, p-values are provided by comparing the estimated treatment effect to the distribution of the in-place placebo effects, which is defined as $\hat{\alpha}_{1t}^{PL} = \{\hat{\alpha}_{jt} : j \neq 1\}$. Recalling that the treatment effect for the Slovakia is denoted as $\hat{\alpha}_{1t}$, the two-sided p-value can be formalized using the following formula:

$$p - value = \Pr\left(|\hat{\alpha}_{1t}^{PL}| \geq |\hat{\alpha}_{1t}|\right) = \frac{\sum_{j \neq 1} 1(|\hat{\alpha}_{jt}| \geq |\hat{\alpha}_{1t}|)}{J} \tag{3.10}$$

This is classical randomization inference when treatment is randomly assigned. However, when treatment is not randomized the p-value is interpreted as being the share of control countries having estimated effects at least as large as Slovakia. Abadie et al. (2010) suggest measuring the treatment effects by comparing post-treatment RMSPE of the treated country to those estimated when the intervention is assigned to a unit in the donor pool. Thus, if the unit is not matched well placebo effects will be rather large and p-values will be too conservative.

In order to control for this, we can adjust the treatment effect and the post-treatment RMSPE to the quality of the match in the pre-treatment period. This is done by dividing the causal effects by their corresponding pre-treatment RMSPE which gives the "pseudo t-statistic" measure.

Moreover, the package yields effects graphs and p-value graphs which enable us to capture the significance of the results. Cavallo et al. (2013) suggest visually comparing the synthetic control to the counterfactual in order to check the goodness of fit. The weighted average of donors approximates Slovakia in the pre-treatment period if the treated unit belongs to the convex hull of the control countries. Furthermore, this program enables researchers to use cross-validation techniques to find the optimal weights. The pre-treatment period is divided into two sections: the first one is defined as the "training" period and the latter is denominated the "validation" period. Abadie et al (2015) use this procedure and denote the period from 1971 to 1980 as the training period and the one from 1981 to 1990 as the validation period. Then, they use the predictors of the training period to find the weights of the resulting synthetic control that minimize the RMSPE over the validation period.

Inference is performed both imposing the trend and without imposing the trend. Trends force the program to match the outcome variable by scaling the market Gini of each unit and making it equal to 1 at the end of the pre-treatment period (Galiani and Quistorff, 2016).

Therefore, the synth runner is a valuable tool for researchers because it allows them to estimate the common tasks of the synthetic control model. In fact, the methodology explained by Galiani and Quistorff (2016) automates the process of running-in-place placebos and measuring inference. Specifically, Cavallo et al. (2013) state that this tool allows the initial estimation to be extended and enable multiple units to receive treatment. Then, it matches trends on the outcome variable and automates the splitting of the pre-treatment period into "training" and "validation" periods.

CHAPTER 4 – EMPIRICAL RESULTS

4.1 Traditional Panel Regressions

The results of the panel regression, estimated using ordinary least squares, fixed effects and random effects are discussed in this section. Then are presented the conclusions of the Hausman test statistic.

Table 4.1 shows the outcomes of the econometric model given by the three estimation techniques. They are based on 396 annual observations from 1995 to 2012 on 22 countries. It is evident that results are widely in line with the literature. In all three specifications, the majority of the determinants of market inequality are significant at 1% level. However, trade is not statistically significant. Countries in the sample belong to middle or high-income groups, besides their classification varies throughout the years. This suggests that trade is not significant because countries in the sample have different levels of development and, therefore, this variable impacts market inequality in different ways depending on the classification of economies. This problem could be solved by dividing the countries according to their level of income and running separate regressions.

Estimating the regression with ordinary least squares yields the expected positive effect for unemployment and taxes, meaning that increases in these variables cause market inequality to rise. Then, increases in the level of education of the population and in trade union enrolments decrease market inequality. The interpretation of the coefficient of human capital in 1995 is that a 0.01 unit increase in the Penn World Table indicator reduces market inequality by 4 Gini points. This can be explained looking at the values in the summary statistic. In fact, the predictor goes from a minimum of 1.854 to a maximum of 3.498, and it hardly varies by more than one-hundredth from one year to the other. Next, a 10 percent increase in government spending decreases market inequality by 2.45 Gini points. This result supports the theory stating that public spending may help the poor to afford better schools and, hence, reduces income inequalities (Afonso et al., 2010; Dabla-Norris et. al, 2015). Using OLS estimation techniques, services are positively correlated with market inequality. Specifically, a 10 percent increase in the share of services on GDP makes the market Gini rise by 1.1 percentage points. This is due to the different sub-sectors included in this category, which have various impacts on the market Gini. Furthermore, since the variables impact income inequality both

positively and negatively, inequality would exist even if all the predictors were close to zero. Thus, the constant is statistically significant at 1 percent level.

Next, the regression is estimated using random effects. In this instance, the table shows government expenditure, unemployment and taxes have a positive effect on market income inequality; while human capital in 1995, trade, services and participation in trade unions yield reductions in the market Gini. Specifically, a 0.01 unit increase in the index of education reduces inequality by about 6 Gini points. The positive coefficient for public spending suggests that a 10 percent increase in this variable increases market inequality by 1.5 percentage points. This confirms Meltzer and Richard's (1981) hypothesis on median voter preferences. Contrarily to OLS, in this model, a 10 percent increase in the services sector as a share of GDP reduces the Gini market by 1.4 percentage points. This result is in line with the majority of the literature suggesting that agriculture, industry, and services negatively affect income inequality. Moreover, taxes play an important role in income inequality. A 1 percent increase in taxes yields a 0.844 percent rise in the market Gini.

The third column of table 4.1 estimates the regression using fixed effects. This specification gives the highest coefficient of determination stating that 81 percent of the variation in the market Gini is explained by the variation in the chosen predictors. In this instance, human capital in 1995 is excluded from the model because fixed effects remove any time-invariant factors. Differently from the previous two estimations, services have a negative and not statistically significant effect on market inequality. Furthermore, services and participation in trade unions are the only two determinants that negatively affect the Gini coefficient. Similar to random effects, a 10 percent increase in government spending rises market inequality by 2.1 Gini points.

Then, in order to understand which of these estimation techniques is the best for this analysis, we run the Hausman test. First of all, the exogeneity test is done for OLS and RE. The null hypothesis is that the unobserved effects are exogenous and therefore, the two estimations are equivalent. In this case, the appropriate estimator would be OLS. The test statistic rejects the null hypothesis. It is statistically significant at 1 percent level, and it yields a χ^2 (8) = 83.20 and a p-value = 0.000. This means that random effect is the consistent estimator. Next, the Hausman test for FE and OLS is calculated. The null hypothesis is that OLS is the consistent and efficient estimator. Results show a χ^2 (8) = 176.89 and a p-value = 0.000. In words, the null hypothesis is rejected, meaning that the two estimators are not asymptotically equivalent and that FE is the preferred estimator. Lastly, the Hausman test for FE and RE reveals that the

FE is the consistent estimator. The test statistic has a χ^2 (8) = 511.15 and a p-value = 0.000, suggesting these two estimation techniques are largely different from one another.

Table 4.1: Regression results of the Gini market inequality coefficient

Variables	(1) Ordinary Least Squares	(2) Random Effects	(3) Fixed Effects
Human Capital 95	-4.750***	-6.014***	
	(0.385)	(1.455)	
Government Expenditure	-0.245***	0.153**	0.206***
	(0.051)	(0.060)	(0.059)
Unemployment	0.126***	0.098***	0.078***
	(0.032)	(0.025)	(0.023)
Taxes	0.724***	0.844***	0.829***
	(0.038)	(0.029)	(0.028)
Trade	0.007	-0.001	0.002
	(0.005)	(0.006)	(0.006)
Services	0.113***	-0.140***	-0.048
	(0.023)	(0.036)	(0.040)
Trade Union Participation	-0.027***	-0.082***	-0.065***
	(0.01)	(0.017)	(0.018)
Population	0.041***	-0.018	-0.350***
	(0.007)	(0.022)	(0.052)
Constant	43.269***	58.040***	40.645***
	(1.875)	(4.569)	(1.877)
No. of Obs	396	396	396
No. of Countries	22	22	22
R-squared	0.670	0.441	0.810

Note: Standard errors in parenthesis, *p < 0.1; **p < 0.05; ***p < 0.01

4.2 The Synthetic Control Method

In this section, we present and discuss the impact of the Higher Education Act on market income inequality in Slovakia estimated using the synthetic control method. As mentioned in the previous chapter, one of the main advantages of this approach is transparency, because the command yields a table showing the weights assigned to each country in the donor pool. These controls are chosen by looking at the values of predictors which best reproduce the estimators of the treated unit during the pre-intervention period. The effect of the Slovakian Higher Education Act on market income inequality is estimated as the difference between the market Gini in Slovakia and its synthetic version in the years after the reform. The implementation of this experiment is reported both numerically and graphically.

Table 4.2 shows the weights assigned by the algorithm to each control country. The weights are assigned considering the combination of countries that best determine the market Gini coefficient of Slovakia before the reform. Furthermore, this value is chosen as to minimize the pre-treatment RMSPE of the market Gini coefficient. Thus, the trend of the outcome variable in Slovakia before the reform is reproduced at best by merging four countries: the Czech Republic, Estonia, Finland, and Germany. Finland receives the highest weight, thus suggesting it is the country whose predictors best resemble Slovakia before the intervention. Differently, Germany is included in the synthetic control with a 0.005 unit weight, meaning that among the four countries, its variables resemble the least the Slovak Republic. All other countries in the donor pool are given zero weights. By construction, the set of weights for the synthetic Slovakia sum to one and the methodology does not admit negative values, thus it avoids extrapolation.

Table 4.2: Country weights in the synthetic Slovakia

Country	Unit Weight	Country	Unit Weight	Country	Unit Weight
Austria	0	Greece	0	Portugal	0
Czech Republic	0.228	Hungary	0	Slovenia	0
Denmark	0	Ireland	0	Spain	0
Estonia	0.176	Italy	0	Sweden	0
Finland	0.591	Netherlands	0	Switzerland	0
France	0	Norway	0	Turkey	0
Germany	0.005	Poland	0	United Kingdom	0

Table 4.3 provides the values of the predictors of the market Gini in the pre-intervention period and compares the estimates of Slovakia to those of its synthetic control. In this way, the affinity between the treated unit and its synthetic counterpart is proven and it avoids "extreme counterfactuals" as those that fall far away from the data's convex hull (King and Zeng, 2006). Looking at these pre-treatment characteristics it is evident that the synthetic Slovakia is extremely similar to the actual one in terms of government expenditure and taxes. Differently, the data on trade and participation to trade unions assume different values in Europe. This is due to the existing differences among the economies and to the diverse importance assigned to trade unions. Therefore, on average these two predictors do not perfectly match the values of Slovakia. Furthermore, unemployment and human capital predictors are quite close to the country's estimates. This non-perfect fit may be due to the different levels of economic development experienced by the countries during the 1995 – 2012 period.

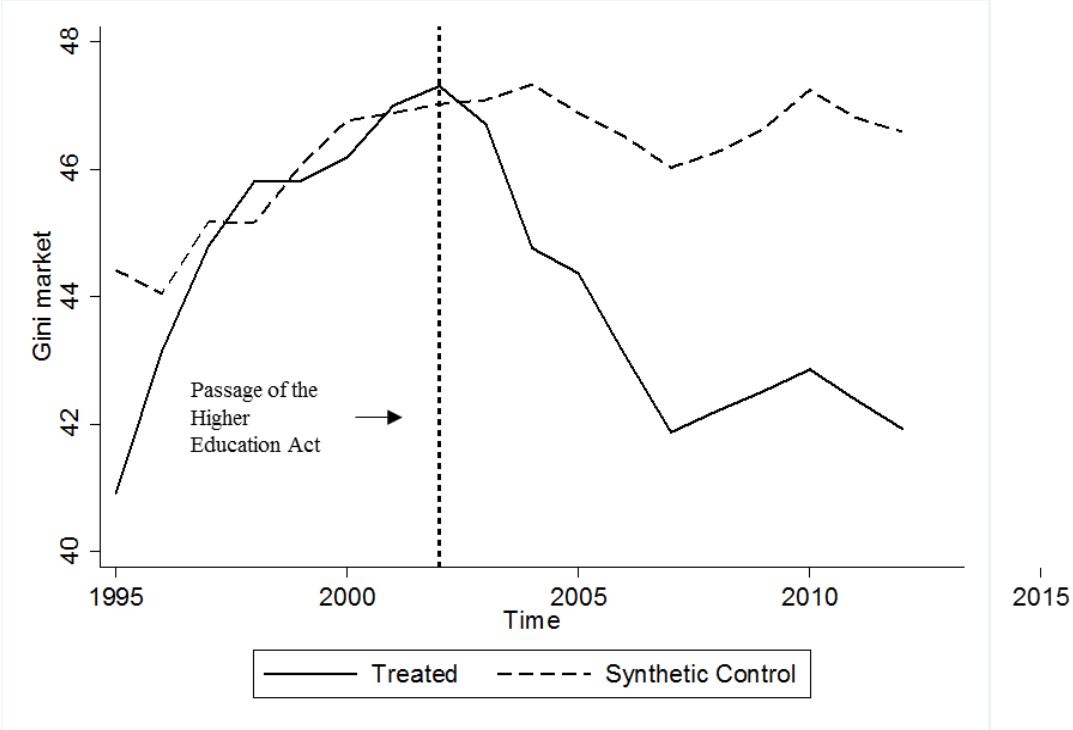
Table 4.3: Market Gini predictor means

Predictors	Slovakia	Synthetic Slovakia
Human Capital 95	3.224	3.120
Government Expenditure	20.330	20.592
Unemployment	15.200	11.112
Taxes	19.691	19.518
Trade	113.224	85.351
Services	59.606	61.786
Trade Union Participation	35.557	48.296
Population	5.381	6.047

Figure 4.1 displays the market Gini coefficient for the Slovak Republic and for its synthetic control during the period between 1995 and 2012. The measure of market income inequality in the synthetic Slovakia closely tracks the trajectory of the variable in Slovakia for the entire pre-treatment period. Thus, given that the line of the Slovak Republic falls within the convex hull of the control units, we can state the synthetic counterpart is a good fit for the country. Therefore, the four countries provide a sensible approximation of market income inequality in Slovakia if the Higher Education Act had not been approved. The figure shows that after 2002, the year of approval of the Act, the two lines clearly diverge. The market Gini in the

country peaked in that year. Next, the curve plummeted until 2007, when it then slightly increased and kept a quite steady trend until the end of the period. Differently, the curve of the counterfactual outcome fluctuates between 47 and 46 Gini points during the entire post-intervention period. Looking at the divergence between the two lines it is evident that the treatment effect increased over time. Specifically, the maximum gap is observed from 2007 onwards, when the synthetic Slovakia differs from its counterfactual by about 4 Gini points, a decline of approximately 9%. Therefore, we can clearly state that the educational reform successfully decreased market income inequality in the country.

Figure 4.1: Trends in the market Gini coefficient: Slovakia vs synthetic Slovakia



4.3 Inference

As mentioned in the previous chapter, the synth runner package enables to run inference both imposing the trend and without imposing the trend. To evaluate the credibility of the results, statistical significance is estimated firstly without imposing the trend. Figure 4.1 clearly shows the match between Slovakia and its synthetic counterpart, and the gap in the market Gini after the approval of the Act. However, in order to ensure the treatment effect has not been generated by chance, it is important to conduct in-place placebo studies where the treatment is reassigned to a country different from Slovakia. If the placebo test yields a large

treatment effect for the countries in the donor pool, our confidence that the decrease in market inequality is due to the passage of the Higher Education Act would be undermined. Furthermore, these results would indicate that the synthetic control lacks of predictive power.

Figure 4.2 shows the gaps in the market Gini for the Slovak Republic and for countries that did not experience the treatment of interest. We will consider that the Higher Education Act generates a significant effect on the index of market income inequality in Slovakia if the effects graph reveals that, after the Act, the treated country has an unusually large downturn compared to the countries in the donor pool. The gray lines show the differences in the market Gini between each country in the donor pool and its synthetic counterpart, while the black line is the gap for Slovakia. Then, the red vertical line indicates the passage of the Higher Education Act. It is apparent from the figure, that the estimated gap in the market Gini coefficient for the Slovak Republic during the 1995 – 2012 period is remarkably large relative to the distribution of the gaps for the countries in the donor. This suggests that the decrease in market income inequality in Slovakia is definitely due to the passage of the Higher Education Act. If the market Gini gap in the country was not extreme compared to the gap experienced by the countries in the donor pool, then this would imply that the treatment effect was due to luck and not to the passage of the reform.

Figure 4.2: Market Gini gaps in Slovakia compared to the countries in the donor pool

Moreover, the synth command yields a pre-treatment RMSPE of 1.335. In fact, looking at the gap in the market Gini index during the pre-treatment period, it is clear that the Slovak Republic fluctuates around zero. Thus, this indicates that its synthetic control approximates well the values of the country. If the synthetic Slovakia did not fit market inequality in the real Slovakia during the pre-intervention period, then the post-intervention gap would be interpreted as being due to the lack of fit between the two countries and not to the approval of the Higher Education Act.

However, some countries in the donor pool have significant pre-treatment gaps. This indicates that for some countries market inequality during the 1995-2012 period cannot be accurately reproduced by a convex combination of market inequality in other countries. Thus, placebo tests with poor fits could be excluded from this test because they do not provide information on the rarity of estimating a large post-intervention gap for a country that was well matched before the reform.

Figure 4.3: Pseudo t-statistics for Slovakia

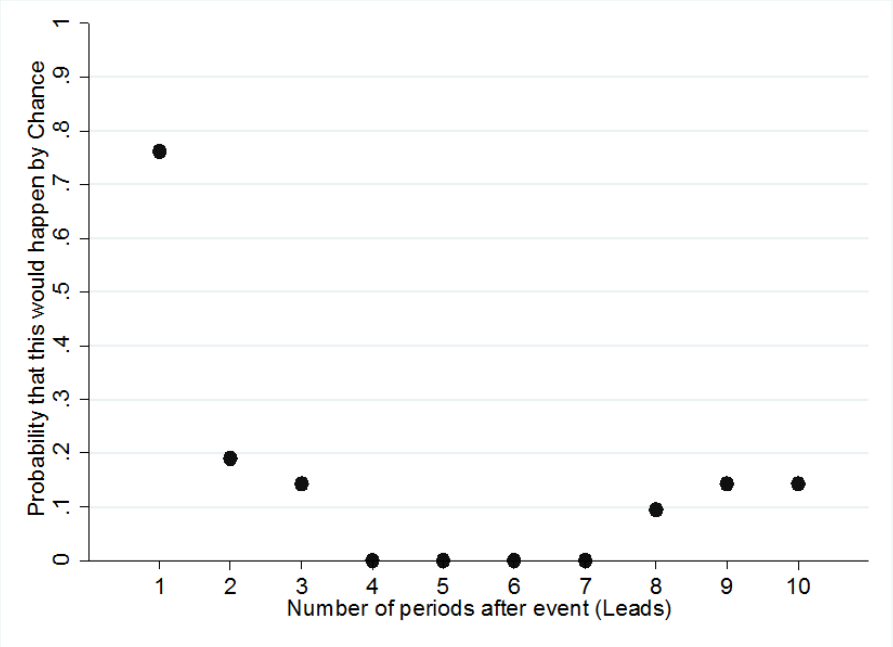


Figure 4.3 displays precise inference for the obtained results. The horizontal axis indicates the number of periods after the event (leads) while the vertical axis specifies the standardized p-values. The figure shows that the probability of observing the treatment effect by chance declines over the years. In fact, the pseudo t-statistic is high one year after the reform but it is equal to zero from leads 4 to 7. Next, the index slightly increases from lead 8 until the end of the period. Thus, on average the probability of observing a decline in the Gini coefficient by

chance is close to zero. This evidence confirms the theory that the reform causes a statistically significant decline in the market income inequality in the country.

Furthermore, the treatment effect has been estimated forcing the synth to match trends in the outcome variable. Results lead to the same conclusions of the synthetic control estimation without imposing the trend which shows that Slovakia and its synthetic counterpart are well fitted and that the treatment effect is statistically significant.

CONCLUSION

The goal of this thesis has been to assess the impact of the Slovakian Higher Education Act on market income inequality. The synthetic control method uses data from four countries during the period between 1995 and 2012 and reveals that education finance reforms can decrease market income inequality.

This work extends the existing empirical literature on education and income inequality by providing a program evaluation approach. The synthetic control method compares a treated country (Slovakia) with an estimated counterfactual (synthetic Slovakia). The synthetic country is a linear combination of units that are similar to Slovakia in the pre-treatment values of the outcome variable, and in the chosen predictors over the entire period. Predictors have been selected looking at the literature and at data availability. Hence, seven determinants of market income inequality have been recognized: education, government expenditure, unemployment, taxes, trade, services, and participation to trade unions. The main advantage of this methodology is that it allows unobserved differences to have time-variant effects, and therefore rejects the parallel trends assumption.

The synth runner program is used to check the robustness of the results. In place, placebos are run by assigning the treatment status to each country in the donor pool. Results show that the gap between the pre-intervention and post-intervention market Gini of Slovakia is extremely large compared to the gap experienced by the control countries. Therefore, the synthetic Slovakia is a good fit for the country and the treatment effect is statistically significant.

The empirical results are in line with the literature suggesting there is a causal effect between education and income inequality. These findings have considerable political economy implications. In fact, governments pursuing sustainable growth patterns should increase the amount of public spending allotted to education. Increasing educational resources will help low-income families escape the poverty trap and raise the share of educated workers. Thus, high skilled individuals benefit the society and have significant short-run and long-run implications.

Moreover, due to data availability, the model analysis 21 countries from 1995 to 2012. Interesting further studies could re-estimate the synthetic control model including all European countries, countries from the former Soviet Union, and countries that belonged to the same income group of Slovakia during 2002.

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