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THE POLITICAL ECONOMY OF REDISTRIBUTION, COHESION POLICY AND INEQUALITY IN THE EUROPEAN UNION: an exploratory analysis

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Dissertation

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Biographic note

Cristiana Maranhão Araújo was born on the 25th of May 1989, Póvoa de Varzim. She holds a bachelor's degree in Economics by the Faculty of Economics of the University of Porto (2012). Currently, she is attending the master's degree of Economics at the Faculty of Economics of the University of Porto.

Her career as a Financial and Industrial Controller began in 2012 at Kirchhoff Automotive Portugal and then in Kathrein Automotive Portugal. At the moment, she works as a Financial Controller of Continental Advanced Antennas (Vila Real), while also being responsible for the month closing of segment 7 (including 4 production plants: Portugal, Brazil, China and Germany).

In October 2020, she will take up a new challenge, in Laird Thermal Systems, as Global Business Controller as she will be responsible for the month closing, Budget and Forecast processes of all production and non-production plants of the segment.

It is also worth to point out that during the year of 2019, she was invited by Miguel Pinto, managing director of Continental Advanced Antennas, to join a project in collaboration with University of Trás-os-Montes e Alto Douro and lead by Professor Anastassios Perdicoulis, named "Continental KPI Cockpit (System–Process–Plan)". This project approached the interaction of dynamic systems, monitoring how the main operational and non-operational variables contribute to the main KPI´s of the Company.

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Abstract

Despite the political efforts that have been implemented, namely at the level of the European Union cohesion policy, there are significant territorial imbalances among European regions. Political intervention through redistribution measures can be a strong mechanism for diminishing income and growth gaps. These policies can improve the channels to create more dynamics areas, developing infrastructures in more isolated areas, investing in human capital and improving the transmission channels among all areas (Iammarino et al., 2019).

The present dissertation systematizes first research steps towards the main research goal which is twofold: (i) to describe how regional asymmetries have been evolving at the European Union level in the last decade and (ii) What seems to be the main determinants of income inequality in the EU, particularly based on the contributions of the political economy of redistribution.

A state of play on the existing related literature is presented, focused on inequality, convergence, economic growth and redistributions policies. We have used statistical descriptive measures based on cluster analysis to answer the first research goal, whereas econometric techniques were used to do a first exploratory approach to the causality between redistribution policies and inequality in the European Union.

Our main results are in line with the literature since it seems that, despite all the effort and investments made at the EU level, namely with the Cohesion policy, there is no sustainable evidence that EU regions have been converging. On the contrary, it seems there is enough evidence in favour of the increase of income inequality between European regions, being possible to conclude there is inequality of opportunities just due to the geographical location. In fact, our results show the more favourable trend of economic growth of the Western-Central Europe and Northern Europe regions, which are already the areas with higher GDPpc and the most developed regions, in comparison with the regions located in the South and East, most notably in the South during the last decade. This evidence makes clear the need to create redistribution policies more efficient in order to improve the capacity of the different regions and promote more cohesion in the European Union

JEL codes: R11, R12, R58, O47

Keywords: Inequality, Economic policy of redistribution, Cohesion policy

Resumo

Apesar de todo o esforço politico desenvolvido, nomeadamente ao nível da política de coesão da União Europeia (UE), continuam a existir desigualdades territoriais significativas entre as regiões europeias. A intervenção política, através de políticas de redistribuição, pode representar um mecanismo forte para diminuir a desigualdade de rendimento e promover o crescimento económico. Estas políticas podem melhorar os canais de distribuição, promovendo a criação de áreas mais dinâmicas, desenvolvendo infraestruturas em áreas mais isoladas, aumentando o investimento em capital humano e melhorando os canais de transmissão no território (Iammarino et al., 2019).

A presente dissertação sistematiza os primeiros passos de investigação tendo em conta o seu principal objetivo, que é duplo: (i) descrever como as assimetrias regionais têm evoluído ao nível da UE na última década e (ii) Quais parecem ser os principais determinantes da desiguldade de rendimento, especialmente ao nível das medidas da política de redistribuição.

É apresentada uma revisão de literatura sobre o tema, com foco na convergência, no crescimento económico e nas políticas de redistribuição. Para dar resposta ao primeiro objetivo de investigação foram usadas medidas de estatística descritiva com base na análise de "clusters" e técnicas econométricas para uma abordagem exploratória da causalidade entre as políticas de redistribuição e a desigualdade na UE.

Os nossos principais resultados estão em concordância com a revisão de literatura uma vez que, apesar de todo o esforço e investimento que se tem feito na UE, nomeadamente com a Política de Coesão, não existe evidência sustentável de que as regiões da UE tenham convergido. Pelo contrário, parece existir evidência a favor do aumento da desigualdade de rendimento nestas regiões, sendo possível concluir que existe desigualdade de oportunidades devido à localização geográfica. De facto, os resultados mostram a tendência de crescimento económico das regiões da Europa Central e Ocidental e Norte da Europa, que já são as áreas mais desenvolvidas e com maior PIBpc , em comparação com as regiões localizadas no Sul e no Leste, mais notavelmente no Sul durante a última década. Esta evidência deixa clara a necessidade de criar políticas de redistribuição mais eficientes a fim de melhorar a capacidade das diferentes regiões e promover mais coesão na UE.

Códigos JEL: R11, R12, R58, O47

Palavras-chave: Desigualdade, Política económica de redistribuição, Política de coesão

Contents

List of acronyms

CAP	Common Agricultural Policy
CF	Cohesion Fund
EAGGF	European Agricultural Guidance and Guarantee Fund
EC	European Commission
EEC	European Economic Community
EMFF	European Maritime and Fisheries Fund
ERDF	European Regional Development Funds
ESF	European Social Funds
ESIF	European Structural and Investment Funds
EU	European Union
GDP	Gross Domestic Product
GDP pc	Gross Domestic Product *per capita*
GMM	Generalised Method of Moments
EUR	Euro
MS	Member States
NUTS	Nomenclature of Territorial Units for Statistics
RCI	Regional Competitive Index
R&D	Research and Development
SME	Small Medium-Sized Enterprise

List of figures

List of tables

Chapter 1. Introduction

The European Union (EU) is featured by substantial social and economic inequalities within its territory, despite all the efforts and political interventions that have been taking place, particularly since 1975, when the European Regional Development Fund (ERDF) was created. This inequality is visible at several dimensions at the country and regional levels. As (Dawid, Harting, and Neugart, 2018, pp.241) state: "*There are persistent and considerable gaps in income per capita across European countries…end sizable resources are spent on a transfers to weakly performing regions under the umbrella of ERDF.*"

On one hand, the high-income countries register high levels of innovation and promote employment, attracting the most skilled workers. People tend to move for these areas due to more jobs opportunities, especially in territories where services are relatively more important. These countries and regions are mostly located in the central Alpine Area of Europe and include almost all European city capitals (Iammarino, Rodriguez-Pose, and Storper, 2019)

On the other hand, low-income countries face low rates of productivity and are less attractive for the population. These areas have lack of capacity for producing and keeping innovation. It is important to note that even high-educated jobs are less competitive in these areas than in agglomeration centres. Areas affected by isolation have weaker transmission channels that do not allow fair opportunities. In fact, their peripheral nature is a strong constrain that does not allow such regions to benefit from agglomeration. This scenario affects mainly South and East Europe. These vicious circles must be interrupted to allow these regions to converge to the level of the above-mentioned regions ones. *"When the economy moves from dispersion to agglomeration, innovation follows at a much faster pace"* (Iammarino et al., 2019, pp12).

Political intervention through redistribution measures can be a strong mechanism for diminishing income and growth gaps. These policies can improve the channels to create more dynamics areas, developing infrastructures in more isolated areas, investing in human capital and improving the transmission channels among all areas (Iammarino et al., 2019). Currently, 75% of the persistent and significant differences in the regional economic levels are driven by differences in productivity. This evidence suggests that, even with all the efforts that have been applied, there is a bottleneck in the transmission channels, especially in

the spatial diffusion of technology and efficient production practices (Beugelsdijka, Klasing and Milionis 2018).

Redistribution plays a crucial role in promoting security and lowering crime since it helps to create more homogenous areas by avoiding extreme poor areas and decreasing the probability of illegal activities. Therefore, it contributes decisively for a safer environment that it is necessary to attract investments (Saint Paul and Verdier, 1996). For instant, public education has a direct impact in the creation of qualified human capital, leading to higher levels of productivity and innovation (Saint Paul and Verdier, 1996).

There are several studies related to redistribution policy and also related to regional policy (cohesion policy) in the EU. However, it is pertinent to keep analysing this subject since, as above mentioned, despite all the efforts at this level, there are substantial asymmetries among the EU territories. Moreover, a new programmatic period, 2021-2017, is being discussed at the highest political level and it is fundamental to systematize past achievements.

Hence, the present dissertation aims to answer the following research questions: (i) How have been evolving regional asymmetries at the European Union level in the last decade (after the 2008 Great Recession)? (ii) What seems to be the main determinants of income inequality in the EU, particularly redistribution policies?

By discussing the above-mentioned issues, this research ultimately aims at contributing for the improvement of the efficiency levels associated to the redistribution policies, which are fundamental instruments for promoting convergence among EU territories.

To answer to the first research question, we are going to adopt a statistical descriptive analysis, based on a cluster approach, to account for the evolution of inter-regional asymmetries in the EU. In order to answer to the second research question, a deep literature review will be developed in order to identify the relationship between the two policy frameworks, starting by integrating them in the relevant theoretical approach, the political economy of redistribution. Lastly, econometric techniques will be employed to develop an exploratory exercise on the causality between redistribution policies, selecting main variables affected by these policies as identified in the related literature, and regional inequality in the European Union.

This dissertation is organized as follows. After the Introduction, Chapter 2 offers a review of the relevant literature on the political economy of redistribution, regional policy and inequality. It starts with a brief review of the different concepts of inequality and is

then focused on the concept of income inequality, economic growth, redistribution policies and cohesion policies. In Chapter 3 the methodology and main results associated with the statistical descriptive analysis are presented, whereas Chapter 4 systematizes the methodological approach and main results related to the analysis of the relationship between redistribution policies and inequality in the EU. Chapter 5 concludes with the findings and the main limitations of this dissertation.

Chapter 2. The political economy of redistribution, regional policy and inequality: a literature review

2.1. Inequality: main concepts and measures

Over the years, economic growth and inequality have been analysed in a very significant number of studies. Inequality can be understood under distinct perspectives namely income inequality, gender inequality in wages, education, access to employment and others (*e.g.*, (Neves and Silva, 2014)).

Starting by income, there is enough empirical evidence that it is unevenly distributed, a feature particularly since the 1980s when income started to be highly concentrated in small segments of the population. When we analyse the income distribution chain, the main drivers are (i) the inequality in the "market income" that is, income inequality is mainly driven by differences in individual earnings which occurs at several levels such as country, labour market, contract arrangements, *etc.*; and (ii) unemployment and loss of wages (Raitano, 2016).

Since workers are heterogeneous, working under different types of technologies and generating different types of productivities and experiences, there is substantial wage inequality (Dawid et al., 2018), which corresponds to a distinct type of inequality.

Inequality is also related to human capital and, at this level, it is important to highlight that investment in human capital promotes converge, with evidence showing that the highest the capital ratio, everything else constant, the higher wages tend to be. As Galor and Wiel (1996) show, areas with the same output level but with a different initial capital accumulation face different convergence patterns, being always observed a positive correlation between human capital accumulation and economic growth. When there are restrictions in endogenous individual investments, this will lead to a decrease in the average of human capital formation that is negatively related with economic growth (Dawid et al., 2018).

Inequality in education can be driven by inequality in regional agglomeration opportunities since agglomeration induces knowledge spill overs that affect a significant part of the population, providing more experiences-based that can only be acquired by "being there" (Iammarino et al., 2019). The skills associated to "learning-by-doing" have also a relation with human capital formation but they depend on the actual contact with the tech-

nology and activities that are implemented in the more developed areas. This polarization effect leads to an increase in wages inequality between areas (Dawid et al., 2018).

Another fact that contributes to the inequality associated to education is the parental-environmental. Parental human capital is one of the determinants of human capital accumulation. Once again, it is important to highlight that the parental- environmental can be itself influenced by location (Galor, 1996).

Regarding gender inequality, job segregation plays an important role. Over the years, women tend to be allocated to more intensive-manufacturing jobs. This type of jobs have relatively lower wages ratio, independently if the job is taken by a female or a male. These jobs are typically featured by productivity levels lower than jobs allocated to non-intensive-manufacturing sectors and so the wages are lower. The segregation between types of jobs contributes to lower wages for women, which leads to a gender gap (Seguino, 2011).

There are several measures for inequality associated to distinct concepts. Hereafter our focus will be on income inequality, which most common measures are the Gini coefficient and the ratios between the richest and the poorest segments of the population.

The Gini coefficient allows identifying economies where income distribution is more equal (unequal) with values close to 0 (to 1). The coefficient measures the distance between the real distribution of income (represented by the Lorenz Curve[1]) and the line of perfect equality. Thus, the lower (higher) the Gini coefficient, the more (less) equally distributed income is (for example Gastwirth, 1972.)

In the next section we will address the importance of economic growth theories to explain the emergence of income convergent or divergent patterns between economies and through time.

2.2. Economic growth and inequality: a brief sum up

Economic growth theories are fundamental for understanding the evolution of income divergences between economies by analysing how the use of inputs and their efficiency explain the evolution of output *per capita* and income convergence dynamics between different economies (Nogueira, 2019).

David Ricardo (1817) *apud* (Silva and Silva, 2002) was pioneer in the study of economic growth. He identified the physical constrain of land as a limit for economic growth,

[1] Graphic chart that shows the income distribution within a certain region (Gastwirth, 1972).

leading to a "steady state" in the very long run. This effect would generate a higher concentration in the land rent instead of promoting capital accumulation. At the time, the author defended that the one possible solution to postpone growth stagnation was to invest and develop policies that would help the migration of production factors from the primary sector to industrial activities (Silva and Silva, 2002).

The main studies on economic growth started with the neoclassical contributions around the 1950s, introducing new concepts that go further than the classical approach. Concepts like aggregate capital stocks, aggregated production function and utility function started to appear in the subject arguments of neoclassic authors (Barro and Sala-i-Martin, 2004).

Most of the economic growth models are based on "supply side models", sustaining that in the long run the output will reach a stable equilibrium that will be near to the potential income.[2] This stationary level with depend on the available production factors and in the level of technology (Silva and Silva, 2002).

Some contributions around the topic of economic growth inspired by the Keynesian approach have appeared such as Harrod (1939), Myrdal (1957) and Kaldor (1961). These contributions, based on circular and cumulative causality models, sustained that, in a certain moment of time, there are areas that present some kind of advantages that can be "strategic advantages" for economic growth. These advantages will generate a virtuous cycle that will act in favour of long-term economic growing for those regions.

According to the above-mentioned contributions, the lack of those virtuous advantages would explain the incapacity of the poorest areas to grow and develop. These approaches support the state intervention in order to overcome the difficulties of lagging regions to grow, by creating policy instruments able to promote economic growth in a balanced way through the territory (Silva and Silva, 2002).

Despite the above contributions, the core of the literature on economic growth evolved around neoclassical contributions, in particular the Solow model (Solow 1956, Solow 1975). In the model with technological progress (Solow, 1957), it is concluded that this input is the crucial determinant of economic growth and is exogenous. There is empirical support, namely provided by Solow (1957), that the United States of America was able to increase its output due to changes in productivity and technology.

[2] The maximum income level that an economy can reach given the available production factors and the exogenous technological level.

Based on Solow's model with technological progress,[3] the literature explored the argument that the poorer economies should grow at higher rates than the richer ones, and so output *per capita* would converge (Silva and Silva 2002). However, this model leaves an important part of the economic growth unexplained since it is focused on economic growth *per se* and not on the causes that contribute to growth. This is what the literature calls the Solow´s Residual (Nogueira, 2019).

Convergence can be measured in two ways: absolute and conditional. Regarding absolute convergence, it means that the richer areas are growing at a faster pace than the poorest ones. On the other hand, conditional convergence means that an area grows as fast as it is away from its steady state. The *steady state* of each area depends on the structure of the economy and only if two areas share exactly the same structure, they could have the same steady state. If it is not the case, different economies will have different *steady states*. Therefore, a richer area can grow at a faster pace that a poorer one if it is further away from its steady state and conditional convergence is occurring (Barro and Sala-i-Martin, 2004).

Inspired by the neoclassical growth model but including mechanisms that made endogenous the determinants of economic growth, one of the fundamental contributions in the field corresponds to neoclassical endogenous modelling. There are several contributions such as Romer (1986) that argues that technological progress results from the externalities of learning-by-doing generated through physical capital accumulation. Lucas (1988), a major contribution in this literature approach, explains endogenous growth based on the externalities associated to the accumulation of human capital, whereas Romer (1990) identifies as the main determinant for endogenous growth Research and Development (R&D) (1990).

According to Barro and Sala-i-Martin (2004), the above mentioned models are focused on the "AK-type production function", $Y=A.K$, where Y represents output, A is the technological level and K corresponds to capital (Nogueira, 2019).

On what regards the empirical studies that analyse the relationship between growth and inequality, a topic that will be further explored later on this work, as Dawid *et al.* (2018, p.223) argues: *"All these studies have provided a fairly robust body of evidence in favour of a negative relationship between income inequality and growth"*.

[3] $Y(t) = F [K(t), L(t), A (t)]$, where $Y(t)$ is the output produced at time t; $K(t)$ corresponds to capital; $L(t)$ is labor and $A(t)$ is technological progress (Barro and Sala-i-Martin, 2004).

In the next section the main contributions on the attempts to fight against the unbalances in the distribution of the benefits of growth is going to be addressed within the field of political economy of redistribution.

2.3 The political economy of redistribution: main contributions

Persson and Tabellini (1992) emphasize that the growth of a region results from the interaction of its economy and its policies. In fact, they prove that a lower growth can be explained by the implementation of inappropriate policies. The main "endogenous Growth Theories" also consider that economic policies play an important role (Persson and Tabellini, 1992).

According to Alesina and Perotti (1994) there are two main channels that explain the link between inequality and growth: the fiscal and the political stability channels.

The model of distribution based on the fiscal channel was first developed by Meltzer and Ricardo (1991) *apud* Persson and Tabellini (1992), which argued that a linear income rate tax would benefit redistribution and lower inequality (Persson and Tabellini, 1992). The level of taxation is defined as result of a vote process where the median voter, less favoured in income terms, will vote in favour of higher level of taxes. Hence, the population with lower income would have fewer taxes to pay and would get the great majority of the benefits of the government spending. The main conclusion is that a society with high inequality income distribution would discourage investments due to the high taxation chosen by the median voter and, consequently, would have lower economic growth (Alesina and Perotti, 1994).

Other studies such as Perroti (1990) and Saint- Paul and Verdier (1991) have focused on the fiscal channel. As far as the median vote income is associated with the average income, the more willing he/she will be to vote for more taxation, according to these studies, the slower will be economic growth. These studies sustain the idea that the transference of income from capital to labour or any other kind of distribution is the relevant determinant in this framework and not in particular the type of policy. Redistribution policies will then lower inequality but compromise economic growth (Alesina and Perotti, 1994).

However, the measures that will be implemented will always depend on a political compromise. The individuals' wills and needs are replaced by the political parties. The party that is in power can decide the allocation and the focus of the instruments (Dixit and

Londregan, 1995).

The power of the parties is related with the electoral success, not only with the current success but also the previous success that bring politicians to be elected. Therefore, the "optical compromise" depends on popularity. It is also important to highlight that the options and actions will also affect the survival probability of the leaders (Dixit and Londregan, 1995).

The social stability or instability channel above mentioned also appears as a determinant of income inequality in this framework. If we face a scenario where there is a large group of impoverished citizens against a small group of rich citizens, it is more likely that this scenario is not stable since the majority of the people are not satisfied with their current situation. This can bring the demand of radical changes, violence and other problems that will not favour economic growth. This instability will also affect the popularity of the parties (Alesina and Perotti, 1994).

The political of economic redistribution is one example of how it is possible to lower inequality, despite eventual collateral effects. This type of policy is referenced and well explained by the economic literature, being an important tool to reduce income inequality and promote a more balanced regional development pattern. The main concept is based on the possibility to balance the natural redistribution across sectors and individuals. In others words, on creating changes by transferring income from sectors that produce high income to sectors that produce lower-income (Vannoorenberghe and Janeba, 2016).

As Barro and Sala-i-Martin (2004) argue, if we just look at economic growth in global terms overlooking indicators as inequality, we will witness that the poverty levels for some regions will increase significantly, putting them below the poverty level.

Alesina and Perotti (1994) focus precisely the interaction between endogenous growth and the new political economy, enhancing this interface at the level of variables such as education, infrastructures, allocation of government expenditures and institutions, with huge impact from political stability and income inequality.

Redistribution policies involve matters of choice and moral, namely questions such as: Is the adopted redistribution insufficient for population with lower income? Alternatively, is it excessive for the population with high income? The balance of this policy is critical to keep the democracy and allow economic growth (Benhabib and Przeworski, 2006).

According to redistribution policies, preferences are connected with the perception of inequality: when forecasts reveal an increase in inequality, there is a higher focus on the

subject and, commonly, more willingness to accept measures of public redistribution. Since very frequently there is imperfect information about the real measure of inequality, its perception is usually used to address the topic (Ballard and Duff, 2017).

This willingness is also related with the baseline of redistribution policies: more focused on transferring income from riches to the poorest or from capital to labour (Persson and Tabellini, 1992).

Finally, it is important to acknowledge that several criticisms have been addressed to the majority of the literature focused on redistribution because most contributions do not address why redistribution is usually socially inefficient. (Acemoglu and Robinson, 2001) contributes for this issue by proposing a model that explains the attractiveness of social inefficient redistribution: it is attractive to belong or to enter a group that receives subsidies and so inefficient redistribution is a tool for sustaining political power and the parties that want to stay in the power. If inefficient redistribution is chosen and includes a group with significant size, parties increase their probabilities of a successful political future for the party.

In the present dissertation we will analyse how this theoretical strand supports cohesion policy in the EU and how inequality has been evolving since the emergence of regional policy. As Raitano (2016, pp. 72) states: "*While a thorough assessment of the impact of public policies on income inequality since the onset of the crisis should consider all possible links between income distribution and each type of policy introduced, the evidence shows that welfare states – at least through cash transfers – retain a crucial function in Europe*".

Transferences from the original income to redistribution levels that can promote economic growth and reduce inequality differs intra and inter – countries. The EU has different tools to promote the strengthening of economic and social cohesion through distribution, for example policy funding through instruments as the European Regional Development Fund (ERDF) and the European Social Fund (ESF) (Raitano, 2016). In the next section a brief overview of these policies is going to be presented.

2.4. Cohesion policy in the EU: a brief sum up of its history, main concepts and instruments

EU cohesion policies aim at lowering social and economic inequalities in the EU, in order to promote economic growth and improve the opportunities in all the Community (Agovino, Casaccia, Crociata, and Sacco, 2019). To fulfil these targets, the European Commission allocates several funds to the EU regions, with member states (MS) aligning the

guidelines of their national policies to increase the welfare of EU citizens and improve the market integration (Nogueira, 2019).

Historically, the first programme that emerged to fulfil the above target was the European Social Fund (ESF), which creation was related with the funding of the European Economic Community (EEC) through the Treaty of Rome[4] in 1957: "*in order to promote its overall harmonious development, the Community shall develop and pursue its action leading to the strengthens of its economic and social cohesion*" (Eur- Lex, 1957). The main goal associated with this endeavour was to promote a common area of trade based on the four freedoms: goods, people, capital and services. Regional funds were not included in the Treaty of Rome since member states were, by that time, against the main target of a common and integrated economic area (Nogueira, 2019).

According to the "*Official Journal of the European Communities*", the European and Regional development Fund (ERDF) was established in 1975, aiming to improve the integration of the common market and to promote cohesion and reduce unbalances between regions in the EU (Giordano, 2017). In the 1970s the so aimed "market integration" was not so successful and Europe was dealing with an oil crisis that contributed to the increase of disparities between the regions (Nogueira, 2019).

In the 1990s, the EU became more focused on reducing the inequality across and within EU countries, emerging the concept of territorial cohesion. It was created the Cohesion Fund (CF) with the target to support the low-income areas in the EU (Giordano, 2017).

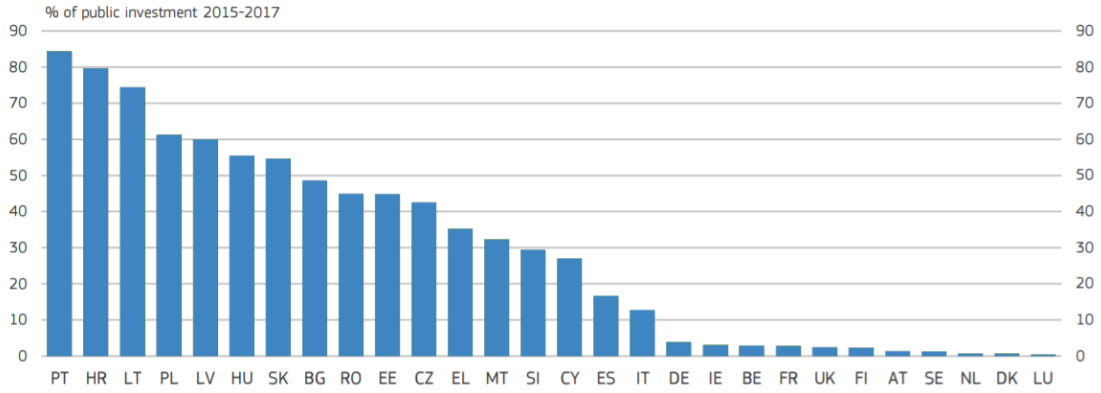
It also started to be developed other European Structural and Investment Funds (ESIF) aiming a specific area of action, such as the European Agricultural Guidance and Guarantee Fund (EAGGF) that was set to provide financial and guidelines specific support to the Common Agricultural Policy (CAP) and the European Maritime and Fisheries Fund (EMFF) (Nogueira, 2019).

Since then, different measures and programmes have been created to achieve the major goal mentioned above such as: INTERREG I (1990-1993), INTERREG II (1994-1999), European Spatial Development Perspective (ESDP) (1999), INTERREG III (2000-2006), INTERREG IV (2017-2013) and INTERREG V(2014-2020) (European Commission, 2019).

[4] The Treat of Rome established the EEC on the 25th of March 1957 by six countries (Germany, Belgium, France, Italy, Luxemburg, Netherlands) (EUR- Lex) https://eur-lex.europa.eu/legal-content/PT/TXT/?uri=LEGISSUM:xy0023, accessed on March 2020

According to the "Seventh report on economic, social and territorial cohesion", the Cohesion Policy still corresponds to the greatest investment policy tool in the EU, "*providing funding equivalent to 8.5% of government capital investment in the EU, a figure which rises to 41% for the EU-13 and to over 50% for a number of countries (see Figure 1)*" (European Commission, 2017, p.23). EU public investments in Cohesion Policy aim to support the less developed countries to be able to catch up with the most developed ones (*ibid.*). Countries such as Portugal and Hungary are at the top of the ranking considering the importance of cohesion funds on public investment in the current period 2015-2017 (see Figure 1)

Figure 1. Cohesion policy funding as an estimated share of public investment by member States, 2015-2017



Source: "Seventh Report on economic, social and territorial cohesion" from Eurostat, DG REGIO.

The effort of the EU funds is based on 3 fundamental topics: (1) reducing the disparities not only in terms of income *per capita* but also in the fields of social inclusion and job opportunities; (2) develop the EU digital innovation infrastructure, new job opportunities and qualification and also focus on topics like climatic change; (3) spread these effects to promote cohesion across EU countries through the creating of inter-regional programmes (European Commission, 2017).

Funding of technology-oriented investments is other example of the actions associated to ERDF. This kind of investment is implemented to increase physical capital stock in low-tech areas, by providing subsidies to the firms located in those depressed areas, with directed or non-directed guidelines. For subsidies with non-directed guidelines, firms have the freedom to implement the technology they consider to be more effective for their effi-

ciency and growth. On the opposite, firms that receive directed guidelines subsidies have to follow a certain technology standard which was predefined for the location area. There is empirical evidence that the directed subsides are more effective (*e.g.*, Dawid et al., 2018).

The Cohesion Policy is also focused on the creation of social infrastructures such as transports that decrease the time of travelling, allowing more people to be able to move among different areas. It generates the possibility of new job opportunities in more remote areas by improving mobility, promoting the development of regions by the increase of new needs and so new offers, which will leave once again to the creation of new job opportunities (European Commission, 2017).

However, despite all the efforts that have been undertaken, research and fund investments, as above mentioned, there are still important gaps on economic and development levels across and within EU countries, with authors stressing the need to improve the effectiveness of policies (Beugelsdijka, 2018). *"Innovation in the EU remains highly concentrated. In north-western EU countries States, however, good regional connections, a skilled labour force and an attractive business environment have enabled surrounding regions to benefit from proximity to highly innovative ones. In southern and eastern EU countries, the most innovative regions are less strong and, accordingly, other regions close to them enjoy little benefit."* European Commission (2017, p. 5).

Therefore, another aspect that was been criticized is the relationship between the geographic specification and the programmes' orientation. It has been proved that the geographical specification matters, not only because domestic policies should also be aligned with it but mainly because the EU programmes need to be more focused on the specific aspects of each region. The guidelines need to include these specifications and identify its opportunities instead of only indicating handicaps, establishing concrete actions that may increase the growth rates in depressed areas and promote cohesion (ADE, 2012).

In 2010 it was launched the "Regional Competitiveness Index" (RCI), defined as the following: "*Regional competitiveness is the ability of a region to offer an attractive and sustainable environment for firms and residents to live and work*" European Commission (2019, p.1). This index is updated each 3 years and it is based on Nomenclature of Territorial Units for Statistics (NUTS) 2[5] (European Commission, 2019).

This can be criticised with the example of the problems that may be associated with the lack of focus on geographical specificities at the territorial level. In fact, most

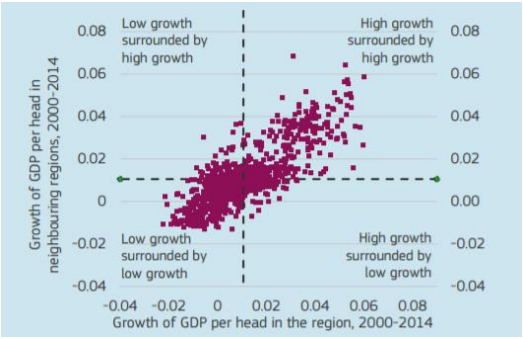
[5] *"The NUTS is a three-level hierarchical classification. Since this is a hierarchical classification, the NUTS subdivide each Member State into a whole number of NUTS 1 regions, each of which in turn is subdivided into a whole number of NUTS 2 regions and so on"* (Policy Research Corporation, 2008, p. 2).

ERDF instruments are focused on NUTS 2 leaving behind a delimited figure of 320 areas, with different geographical specifications, on NUTS 3. As Benito Giordano (2017) argues, if the focus changes to NUTS 3, there is the chance to develop more dedicated programmes, instead of the "one size fits all", having a better alignment with the domestic policies.

The current focus on NUTS 2 means that programmes are more generic and strongly orientated to hard investments. They are effective in hard investments like basic infrastructures, transports and road, diminishing this key gap. These general investments benefit the development of economic areas with low value added like tourism and culture. They are not focused on soft measures that could increase business productivity, lead to innovation and fix more population in these areas and so they keep being characterized by low added economic value and face the risk of the out-migration of the youngest and more qualified, which increases the inequality among territories (ADE, 2012).

"Spatial spill-overs are the effect of economic growth in one region on growth in neighbouring ones" European Commission (2017, p.37). This means that the development and growing of one region have a positive effect on all the regions that surround it. As we can see in the figure below, growing rates predominate when surrounded by other high growth rate regions (European Commission, 2017).

Figure 2. Spatial spill overs of economic growth between regions in EU, 2000-2014



Source: "Seventh Report on economic, social and territorial cohesion".

In Figure 2 supports the spatial model of growth based in formal model $Y=\varrho W.Y+X\beta+u$ where Y is the growth rate of GDP per head; X is a vector that represents the set of regional-specific features and W is a matrix that describes the spatial link between regions. This model advocates that the growth of the regions are determined by the average growth

rate of the regions around, showing the relevance of spatial spill over benefits, as above mentioned. This effect can lead to the development of the less developed areas (European Commission, 2017).

On the following chapters we will present our empirical analysis developed in two phases: a descriptive statistical exercise to show the evolution of regional income disparities in the EU since 2009 (Chapter 3) and the proposal and estimation of an econometric exploratory model focused on the determinants of income inequality, particularly redistribution policies, in the EU.

Chapter 3. Methodology and main statistical descriptive results

3.1 Methodological notes

In the literature review discussed in the previous chapters several factors that influence income inequality and economic growth were presented. The discussion was oriented in order to answer our main research questions: i) How have regional asymmetries been evolving at the European Union level in the last years? (ii) What seems to be the main determinants of income inequality in the EU, particularly redistribution policies?

In order to answer the above-mentioned questions, we will move forward the literature review by developing an empirical study focused on the evolution of the European regions since 2009 to 2018 on several dimensions.[6]We have gathered data from the Eurostat to cover the main indicators discussed in the literature review: Gross Domestic Product *per capita* (GDP pc), Employment in technology and knowledge, gross fixed capital formation, among others that will support the exploratory empirical analysis that will be developed next.

We started by implementing a cluster analysis using regional GDP *per capita* (GDP pc) as an indicator of the relative position of regions. The main objective of this analysis is to categorize the different regions according to their proximity in what concerns GDP pc. Each NUTS 2 must share a certain degree of similarity of the GDP pc level within the cluster and clusters are compared to each other. In order to implement this methodology, it was defined a hierarchical algorithm which was used as the criterion to allocate each region to the clusters. Therefore, we have calculated the average GDP pc and created two different clusters*:*

- "Low GDP pc" – includes all NUTS 2 regions that have a GDP pc lower that the average of all regions;
- "High GDP pc" - includes all NUTS 2 regions that have a GDP pc higher that the average of all regions.

Each region was allocated to a cluster based on its annual GDP pc in comparation to the average GDP pc of all NUTS 2 in the analysis. As a second step, and in order to support

[6] In the data collected from Eurostat there was some information missing, for example for Jihozápad (Czech) in what regards the indicator at the "risk of poverty rate". Therefore, this region was excluded from our analysis.

the analysis, each NUTS 2 was again allocated to a second cluster. For this, partitioning algorithms were used, and each region was allocated according to the geographic area that its country belongs:[7] Eastern Europe; Northern Europe; Southern Europe and Western-Central Europe.

This simple analysis allows us to do a comparison between regions and describe the evolution patterns for the chosen variables, namely in terms of convergence, as it will be presented in more detail in this chapter.

By adopting this approach, it was possible to systematize the data collected for 280 NUTS 2 regions, allowing to map the evolution of main indicators for the whole regional setting.

We have also done a regional convergence analysis based on the concepts proposed by Barro and Sala-i-Martin (2004): beta convergence and sigma convergence, both presented in the previous chapters.

The β (beta) convergence is based on the idea of *catching up:* regions with lower GPD *per capita* need to growth at a higher rate than the highest GPD *per capita* regions in order to diminish the regional income gap (Barro and Sala-i-Martin, 2004).

The σ (sigma) convergence corresponds to an absolute concept of convergence by measuring how income dispersion between regions evolves through time. This approach allows us to check if regions are converging using a simple method which is just the measurement of the standard deviation of main indicators (for example, Silva & Silva, 2002).

To test the consistency of the income gap based on the above categorization by clusters, it was performed the "Farthest Neighbour Method" intra and inter cluster. This method measures "*the distance between their two most distant members*." (Malheiro, 2019, p.27). In order to do it, we have calculated the difference between the lowest and the highest value within the cluster and between clusters. Results are presented in Section 3.2.

[7] Eastern Europe: Bulgaria, Estonia, Hungary, Latvia, Lithuania, Poland and Romania; Northern Europe: Denmark, Finland and Sweden; Southern Europe: Croatia, Cyprus, Greece, Italy, Malta, Portugal, Slovenia and Spain Western- Central Europe: Austria, Belgium, Czechia, France, Germany, Ireland, Luxembourg, Netherlands, Slovakia and United Kingdom (see Annex 2).

3.2. Statistical description of the main variables

Choosing EU regions NUTS2 as the baseline unit for our analysis, we have considered the database from Eurostat and gathered the following information: in 2009, for 236 regions, distributed between 26 MS; from 2010 to 2014 for 253 regions in 27 MS and from 2015 to 2018, 280 regions in 28 MS (see Annex 1).

In order to have an overview of the regional evolution (NUTS 2), we start by presenting the evolution of statistical descriptive measures for GDP pc, calculated by the ratio between the two following indicators gathered from Eurostat:

- GDP:[8] Gross Domestic Product at current market prices by NUTS2 regions;
- Population by NUTS2:[9] includes statistics on the population at the end of the calendar year.

We have calculated the statistical descriptive measures for GDP pc and present the results on Table 3: the mean[10] of GDP pc *per* region and the standard deviation (SD). [11] It is possible to confirm that from 2009 to 2018 there was an increase on the average of the regional GDP pc of 5 125 Million euros, corresponding to an average growing rate of 2% for this time period. Between 2014 and 2015 GPD pc showed a greater growth rate, 5%.

However, standard deviation increases between 2009 and 2018, which means that economic growth was accompanied by an increase in the gap of regional GDP pc, that is by more regional income inequality. For this analysis, we have used sigma converge (explained above) to measure how the gap among regions evolves through time. Table 3 shows that, although GPD pc is increasing over the years, the regional gap is also increasing.

[8] https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=nama_10r_2gdp&lang=en, June 2020.

[9] https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=demo_r_d2jan&lang=en, June 2020.

[10] AV GDPpc= ∑ GDPpc,i / *n*; where " ∑GDPpc,i" is the sum of all GDP *per* NUTS 2 region and "*n*" is the number of NUTS2 regions.

[11] Std. Var GDPpc= √ ((∑ (GDPpc,i – AV GDPpc)^2) / *n*); where "GDPpc,i" is the sum of all GDP *per* NUTS 2 region , AV GDP is the mean for NUTS2 regions GDP and "*n*" is the number of NUTS2 regions.

Table 1 GDP pc NUTS2 regions: average, standard deviation and annual growth rate from 2009 to 2018

Year	Average GDP *pc*	Growth rate of average GDP pc	Std. variation of GDP pc	Number of countries	Number of NUTS 2 regions
2009	24 799		13 647	26	229
2010	25 132	1%	14 655	27	239
2011	25 834	3%	15 198	27	241
2012	26 526	3%	16 113	27	246
2013	26 635	0%	16 297	27	246
2014	27 085	2%	17 452	27	253
2015	28 475	5%	18 376	28	280
2016	28 457	0%	17 787	28	280
2017	29 103	2%	17 628	28	280
2018	29 924	3%	18 073	28	280

Source: own elaboration based on data from Eurostat on GDP at current market prices (million euros) and population by NUTS 2 regions.

For a sample of 229 NUTS 2 regions,[12] we have computed annual growth rates for GDP pc. In Table 2 it is possible to see the top 5 higher and lower GDP pc in 2009 and the GDP pc growth rate of the elected regions from 2019 to 2018. The average growth rate of the selected NUTS 2 regions was approximately 47% between the years.

On one hand, the above-mentioned table shows that regions like Nord-Est (Romania), Severozapaden (Bulgaria) and Severen tsentralen (Bulgaria) grow at a higher rate than the average, experiencing a period of catching up.

On the other hand, it is also possible to observe that Inner London-West (United Kingdom), characterized by a very high GPD pc in 2009, had also a growth rate higher than the average, which has a negative impact on the reduction of regional inequalities.

[12] From the complete set of 280 NUTS 2, NUTS 2 regions that did not belong to the EU in 2009 were excluded from the analysis. Also excluded were the regions with missing information: Chemnitz and Leipzig from Germany; Eastern and Midland, Northern and Western, Southern from Ireland and Eastern and Midland and Southern Scotland from the United Kingdom.

Table 2. Top 5 and bottom 5 NUTS2 regions: GDP pc and average growth rate between 2009 and 2018

Top 5 - Higher GPDpc NUTS 2	Country	GPD pc in 2009 (in Million Eur)	Growth rate from 2009 to 2018
Inner London - West	United Kingdom	147 929	48%
Luxembourg	Luxembourg	74 927	33%
Région de Bruxelles-Capitale / Brussels Hoofdstedelijk Gewest	Belgium	60 305	16%
Hovedstaden	Denmark	51 730	30%
Hamburg	Germany	51 537	26%
Bottom 5 - Lower GPDpc NUTS 2	**Country**	**GPD pc in 2009 (in Million Eur)**	**Growth rate from 2009 to 2018**
Nord-Est	Romania	1 186	54%
Severozapaden	Bulgaria	3 211	62%
Severen tsentralen	Bulgaria	3 468	56%
Yuzhen tsentralen	Bulgaria	3 531	59%
Severoiztochen	Bulgaria	4 122	55%

Source: own elaboration based on data from Eurostat on GDP at current market prices (million euros) and population by NUTS 2 regions.

In order to map the evolution of regional income in the EU for the period 2009-2018, we will use a "clustering method", closely following Iammarino, Rodriguez-Pose and Storper (2019), that proposed groups of clusters considering the GDP pc of each areas.

For this analysis only two groups will be used for the clusters:

- High GDP pc: if the GDP pc of the region is equal or higher than the mean value for GDP pc.
- Low GDP pc: if the GDP of the region is lower than the mean GDP pc value considering all regions.

This classification can change from year to year depending on the evolution of each regional income in comparison with the mean GDP pc value. The relative weight of regions of low income is around 41%-43% during 2009-2018, which means that there is a smaller percentage of regions with lower GDP pc (see Table 3).

Table 3. Clusters of GDP pc NUTS2 regions from 2009 to 2018

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Number of regions in "High GDPpc"	131	138	140	142	142	143	165	165	164	165
% High	57%	58%	58%	58%	58%	57%	59%	59%	59%	59%
Number of regions in "Low GDPpc"	98	101	101	104	104	110	115	115	116	115
% low	43%	42%	42%	42%	42%	43%	41%	41%	41%	41%
Total regions	**229**	**239**	**241**	**246**	**246**	**253**	**280**	**280**	**280**	**280**

Source: own elaboration based on data from Eurostat on GDP at current market prices (million euros) and population by NUTS 2 regions.

As explained in Section 3.1, we performed the "Farthest Neighbour Method" intra and inter cluster in order to test the consistency. For instance, if we execute this analyse for clusters in 2009, the difference between the absolute value of the region with the highest GDP pc (Inner London – West – United Kingdom) and the lowest (Nord-Est– Romania) is 146 743 million euros. This measure shows the highest gap between the regions. When we calculate the same measure intra clusters, the amplitude is still significant, particularly in the "highest GPD pc Cluster": in 2009, the region with the highest GPD pc (Inner London-West (United Kingdom) with a GDP pc of 147 929 million euros, representing more 137 329 million euros than the bottom GDP pc region, Kontinentalna Hrvatska (Croatia) with 10 600 million euros from. Based on this evidence, it seems that a small number of regions produce the bulk of GDP in the entire EU.

The above-mentioned conclusion also seems visible in Table 5. In fact, despite the increase in the average GDP pc from 2009 to 2018 for both clusters, income inequality – measured by the standard deviation – have also increased, particularly in the "High GDP pc cluster". This conclusion is also evident when we calculate the amplitude of the "High GDP pc cluster" like in the previous paragraph but for 2018. The region with the highest GPD pc still is Inner London-West (United Kingdom) with a GDP pc of 217 084 million euros (growth of 46% in comparation with 2009) and it represents 207 852 million euros

more comparing with the 9 232 million euros from regions with the lowest GDP pc in the cluster that now is represented by Macroregiunea patru (Romania).

Therefore, based on this mapping, it seems that despite all the political instruments focused on redistribution that have been adopted through time within the EU Cohesion policy framework, there is no evidence to support that NUTS 2 regions have converged. On the opposite, for the period under analysis the income gap has increased.

Table 4. Average and standard variation GDP pc *per* cluster (high and low) 2009-2018

Year	Average "Low GDPpc"	Std. variation "Low GDPpc"	Average "High GDPpc"	Std. variation "High GDPpc"
2009	18 484	11 999	29 523	14 759
2010	18 208	12 882	30 200	15 827
2011	18 268	13 186	31 292	16 498
2012	18 431	13 761	32 455	17 638
2013	18 412	13 863	32 657	17 871
2014	18 166	14 177	33 946	19 602
2015	18 947	14 671	35 116	20 568
2016	19 509	14 449	34 694	19 783
2017	20 247	14 408	35 367	19 589
2018	20 974	14 609	36 162	20 138

Source: own elaboration based on data from Eurostat on GDP at current market prices (million euros) and population by NUTS 2 regions.

Also following Iammarino, Rodriguez-Pose and Stoper (2019), we have considered the division of Europe in 4 regions: Western-Central Europe (10 countries – 153 NUTS 2 regions), Eastern Europe (7 countries – 43 NUTS 2 regions), Northern Europe (3 countries – 18 NUTS 2 regions) and Southern Europe (8 countries – 66 NUTS 2 regions) (details in Annex 2).

In Table 5 we can see that all the 4 areas grow from 2009 to 2018 in terms of GDP pc. However, it is also possible to observe that the standard deviation increases in all the 4 groups of regions.

The "Eastern Europe" was the region with the largest growth rate during the period under analysis, around 40%, followed by "Northern Europe" (23%), "Western- Central Europe (20%)" and "Southern Europe" (6%). In Table 5 it is possible to see that all regions increase the absolute value of GDP pc since 2009: the average GDP pc of all the

regions increases around 20%, from 24 799 to 29 924 million euros.

However, if we do the same analysis intra-groups of regions (Table 5) divergence has increased since all the regions increase the standard variation from 2009 to 2018, which leads to the conclusion that although there was an increase in the income absolute value, the dispersion has also increased.

Table 5. Average and standard deviation of GDP pc per group of regions

	Average GDPpc 2009	Std. variation 2009	Average GDPpc 2018	Std. variation 2018
Eastern Europe	7 064	18 180	11 766	18 981
Northern Europe	34 690	12 568	44 782	17 200
Southern Europe	21 689	7 151	23 134	10 370
Western- Central Europe	28 903	15 294	36 208	20 379

Source: own elaboration based on data from Eurostat on GDP at current market prices (million euros) and population by NUTS 2 regions.

Taking another perspective on the construction of the two clusters ("High GDP pc" and "Low GDP pc") (Table 6), now considering the above categorization proposed for the EU regions, it is possible to show that all the groups of regions except the Southern, mainly due to the poor Greece regions' performance in the period of analysis (Voreio Aigaio, Anatoliki Makedonia, Thraki, Kentriki Makedonia, Attiki, Kriti), have increased the number of regions above the average of EU GDP. This evidence is in line with the previous conclusions that GDP pc has globally increased, but income inequality also has risen, as explained before in Table 6 with the increase of the standard variation in all areas between 2009 and 2018.

Table 6. NUTS 2 regions above the average EU GDP pc by cluster in 2009 and 2018

	High GDPpc 2009	Low GDPpc 2009	High GDPpc 2018	Low GDPpc 2018
Eastern Europe	20%	80%	41%	59%
Northern Europe	46%	54%	58%	42%
Southern Europe	51%	49%	49%	51%
Western- Central Europe	43%	57%	45%	55%

Source: own elaboration based on data from Eurostat on GDP at current market prices (million euros) and population by NUTS 2 regions.

As the literature review systematized in previous chapters show, several studies demonstrate the contribution of several variables for economic growth. One of these crucial variables is human capital (for example Lucas, 1988). Hence, in mapping the evolution of EU regions, we collected the indicator "Participation rate in education and training" from the Eurostat. This indicator covers all entrants and enrolments in education levels,[13] education personnel at all different levels of education, formal and non-formal and informal learning. According to Eurostat, this database collects the information from interviews, and it measures the percentage of interviewed population that had any participation in education and training in the four weeks prior to the interview (Eurostat[14]). From this information we depicted an overview of the rate in each geographic area (Figure 3). It is visible that regions of the Northern Europe, with the higher participation in education, around 27,38% in 2018, are the regions with the highest GDP pc, 44 782 Million Euros, in the same time period.

In fact, some regions like Sydsverige, Stockholm, Östra Mellansverige, Västsverige (Sweden) and Helsinki-Uusimaa (Finland) have the highest GDP pc of the Northern Europe area in 2018 and also have the highest investments in education measured as participation rates. Those 5 areas have an average record of 29,84% in 2015 against 11,11% of the average for all NUTS 2 regions. Despite no causality exercise was done yet, this evidence can drive to the hypothesis that investments in training and education were effective for the areas above mentioned and, as a result, it is possible to observe the economic development of those areas and the reduction of the income gaps.

Regarding the Eastern Europe, the levels of participation are still very low. In 2009 69% of these regions still record a percentage equal or lower than 5 %, indeed only Eesti (Estonia) and Warszawski stoleczny (Poland) have a higher percentage than the mean value of all regions. Eesti (Estonia) had always a participation in education and training level record above the global average. For this region, from 2015 to 2019, the percentage was 17,04%, clearly above the average.

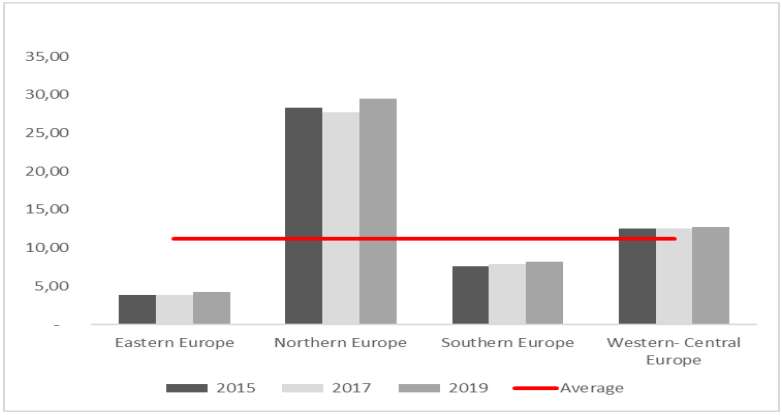
Regarding Western- Central Europe, which has the highest GDP pc, more than 50% of the regions have percentages of participation in education and training education higher than the global average, with a highlight for some regions in France (Midi-Pyrénées, Rhône-

[13] Pupils and students, Learning mobility, Education personnel, Education finance, Graduates and Language learning in percentage of the resident population of each NUTS2 region population aged 25-64 years old.
[14] https://ec.europa.eu/eurostat/data/database, June 2020

Alpes, Bretagne, Pays-de-la-Loire and Limousin) and Netherlands (Utrecht, Groningen and Noord-Holland), which have the highest percentages of the Western- Central Europe).

As it is shown in Figure 3, the Southern Europe is the second European geographic area that records the lowest percentage in education and training. The average rate for the EU, in 2015, was 7,64% and around 40% of the regions were under this average rate. Within the Southern European, the bottom 5 NUTS 2 regions belong to Greece (Sterea Ellada 1%, Peloponnisos 1,2%, Notio Aigaio 1,6% , Ipeiros 1,8% and Kriti 2%), and the top 5 are distributed by Slovenia (Zahodna Slovenija 13,5%), Italy (Provincia Autonoma di Bolzano/Bozen 13,4%) Portugal (Área Metropolitana de Lisboa 13,1%) and Spain (País Vasco 12,9% and Comunidad Foral de Navarra 12,2). For this geographic area the growth area between 2015 and 2019 was 1,03%.

Figure 3. Participation rate in education and training per European region (in%)



Source: own elaboration based on the "Participation rate in education and training (last 4 weeks) by NUTS 2 regions", Eurostat.

Another important driver for economic growth and, potentially, for diminishing the gap among regions by promoting equality, is investment in R&D. The relationship between R&D and economic growth was identified and demonstrated by Romer (1990).

As presented in the literature review, this variable is responsible for creating agglomeration areas that promote the development of the region by stimulating other services and businesses to fix in these areas (Iammarino, Rodriguez-Pose, and Storper, 2019). The total amount of investment in R&D has been increasing over the last years in the European regions under analysis. For instance, in 2014, it was spent around 1.429.356 million

euros and, for the exact same regions, total investments in 2017 reached the value of 2. 631.858 million euros, corresponding to an increase of more than 54%.

However, the growth rate in R&D expenditures is not linear. If we analyse each year separately, we can see that, in some years like 2016, the total amount of investments decreases. This led us to question if there is a consistent and planned R&D policy behind these expenses with the specific goal to develop NUTS 2 regions, creating and developing structures or if investments are done according to short run needs.

The region of Europe that has the highest investment on R&D is Northern Europe, followed by the Western- Central Europe. In terms of absolute investments Germany has the leadership and has also the highest records for GDP pc: Stuttgart, Karlsruhe, Oberbayern, Darmstadt, Köln (Germany) alone are responsible for 23% of the total investments of the Western- Central Europe. However, it is also important to highlight that the United Kingdom also has a high contribution to the amount of investment in R&D, mainly in East Anglia, Inner London – West Berkshire, Buckinghamshire and Oxfordshire, areas responsible for 9% of the total investments in R&D.

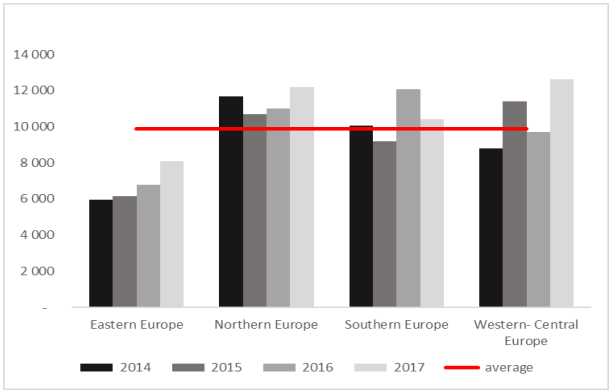
Regarding the Eastern Europe, it is considerable the increase of investments in R&D in the period under analysis. In 2017 the average investments *per* region of the Eastern Europe was only 36% lower comparing to the investments in the Western – Central Europe. It is also important to highlight that, in 2009, regions like Malopolskie (Poland), Bucuresti - Ilfov (Romania) and Budapest (Hungary) had the highest GDP pc of the area and also registered the highest investments in R&D. Despite previous economic growth in some Eastern Europe NUTS 2 regions, there are areas like Severozapaden, Severen tsentralen, Severoiztochen, Yugoiztochen, Yuzhen tsentralen (Bulgaria) that have historical low GDP pc and access to very low investments in R&D, keeping the trend of underperformance, which significantly explains the income gap among the NUTS 2 regions. This gap is even more serious when compared to other regions, for instance Southern Ireland that from 2009 to 2018 was able to increase the GDP pc in 134%. Using the example Southern Ireland it is possible to stress, once again, the theory that investments in R&D helps the area to develop not only by R&D itself but also through the fixation of new services and demands of employments, promoting the creation of knowhow that can be transmitted to other regions like: learning-by-being-there (Iammarino et al., 2019) and learning by doing (Dawid et al., 2018). Eastern and Midland Ireland the nearest geographic area from Southern Ireland has also recorded a development above the average. For the third area, North-

ern and Western Ireland, the transmission channels of these investments were not so efficient which lead to increase the inequality within the country and NUTS 2 regions.

The "Southern Europe" shows the second lowest percentage of investments in R&D. The average for Southern regions in the period 2014-2017 was 10,43% (9,03% in average for the EU regions) and this percentage has grown just 3% (from 10,05% to 10,40%) between 2014 and 2017 (22% in average for the EU regions). The European region with the lowest value for this indicator is Eastern Europe (6,72% in the same period) but this area has grown significantly above the EU average (36%), showing signs of catching-up at this level.

However, on one hand, it is important to highlight that, in 2016, this region recorded the highest values of all the European areas: 12,08% against 9,90% of average rate of all the four areas. This was possible due to the contribution of some particular regions, namely in Italy (Lombardia, Emilia-Romagna, Lazio and Piemonte) and Spain (Comunidad de Madrid and Cataluña), that had a very significant investment in R&D (in million euros) in that year. On the other hand, there are some NUTS 2 regions that contribute for reducing the Southern Europe average of investments in R&D, such as Região Autónoma dos Açores and Região Autónoma da Madeira (Portugal), Valle d'Aosta/Vallée d'Aoste (Italy) and Notio Aigaio and Dytiki Makedonia (Greece)

Figure 4. Average investments of R&D *per* regions (in million euros %)



Source: own elaboration based on "Total R&D personnel and researchers NUTS 2 regions", Eurostat.

Another variable that explains economic growth and convergence is political stability. To analyse its impact, we can use as a proxy the variable "at poverty risk", following

authors such as Alesina and Perotti (1994). For this, we have used EUROSAT database[15]in the domain of "Income and living conditions", that covers "*people at risk of poverty or social exclusion, income distribution and monetary poverty, living conditions and material deprivation, which are again structured into collections of indicators on specific topics*" (Eurostat[16]).

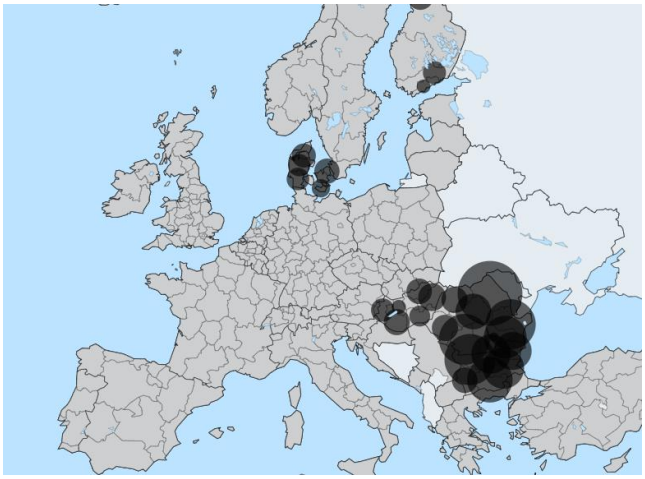
The highest the percentage of population at risk of poverty, the more instable the political environment will be and, therefore, it will be an obstacle to economic growth (Alesina and Perotti, 1994). The population at risk of poverty in percentage to the total population is lower between the reference periods, so it is possibly to conclude that it decreases from 2009 to 2018.

However, the Southern Europe is an exception since it has increased this percentage and, as it is possible to see in Figure 5, it corresponds to the European geographical area with high risk and, therefore, with less opportunities to develop and catch up the previous gap.

It is also possible to observe that some areas in Eastern Europe are also at a high risk like Nord- Est (Romania) 41,1%, Sud-Est (Romania) 31,1%, Yuzhen tsentralen (Bulgaria) 27% Sud – Muntenia (Romania) 26%. In these areas there was some economic growth in terms of GDP pc, but the rate was much lower compared with other EU areas and this evolution has resulted in more inequality.

[15] https://ec.europa.eu/eurostat/cache/metadata/en/ilc_esms.htm, June 2020.
[16] https://ec.europa.eu/eurostat/data/database, June 2020

Figure 5. At risk of poverty rate by NUTS 2



Source: Eurostat "At-risk-of-poverty rate by NUTS 2", accessed on June 2020 [17]

In the following chapter an exploratory analysis on the main determinants of income inequality, namely redistribution policies, in the EU will be presented.

[17] https://ec.europa.eu/eurostat/data/database, June 2020

Chapter 4. Main drivers of income inequality in the European Union: an exploratory exercise including redistribution policies

4.1 Methodological notes: dataset and the econometric model

For the empirical study presented in this dissertation a data set was constructed, as mentioned before, based on an independent source: Eurostat databases.[18]

The econometric model was constructed based on our literature review, considering as dependent variable the "Income inequality ratio", which aims to describe inequality. The information is only available by country and so the allocation to NUTS2 regions was done equally within each country for the period under analysis. This variable was exported by the Eurostat data base and it is represented by the index of "Income and living conditions".

Regarding the independent variables, the following were gathered to support the causal relationship analysis between redistribution policies and income inequality in the EU:

- The first independent variable is "GDP *per* capita", which represents economic activity (Barro and Sala-i-Martin, 2004). We have calculated this variable based on the different GDP of each region divided by the population,[19] and both databases were collected from the Eurostat.
- The second corresponds to "People at risk of poverty or social exclusion", representing the effect of the social stability or instability channel, identified in Chapter 2 (Persson and Tabellini, 1992; Benhabib and Przeworski, 2006). Everything else constant, it is expected a negative estimated coefficient: if people at risk of poverty increase that will have a negative impact on economic growth and increase inequality (Alesina and Perotti, 1994).
- The third independent variable is the "Education rate": Galor and Wiel (1996) established the relationship between the investment in human capital and convergence. The biggest the ratio of capital accumulation, everything else constant, the highest wages will be. The positive correlation between human capital accumulation, economic growth and its polarization effect - this induced economic growth contributes to diminishing inequality – is supported by the literature (*e.g.*, David *et al.*, 2018). This database represents the percentage of

[18] https://ec.europa.eu/eurostat/data/database, June 2020.
[19] Population on 1 January by NUTS 2 region

interviewed population that had any participation in education and training in the four weeks prior to the interview as above explained.

- "Total R&D personnel (researchers) by sectors of performance, as % of total labour force and total employment" and "Employment in technology and knowledge-intensive" are also considered in the model. Romer (1990) identified investment in Research and Development (R&D) as a crucial engine of economic growth and there is robust evidence in the literature in favour of a positive correlation between income inequality and growth (*e.g.*, David *et al.*, 2018).
- "Government expenditure in % of GDP": this variable corresponds to the sum of main expenditure items of the general government sector in percentage of GDP. This variable is introduced in the model in order to capture the impact of redistribution policies on income inequality, using here fiscal policy measures as a proxy. Following (Benhabib and Przeworski, 2006) we assume that, everything else constant, the higher government expenses the lower income inequality will be.

Table 7. Summary of variables' description and their data source

Data set			
Variable	**Long definition**	**Type**	**Source**
Y	Income inequality ratio	Index	Eurostat
gdp_pc	Gross Domestic Product per capita	Million Eur per person	Eurostat
pov_risk	People at risk of Poverty or social exclusion	Number of persons	Eurostat
educ	Education Ratio	Percentage	Eurostat
rd_exp	Total R&D personnel and researchers	Percentage	Eurostat
emp_g	Employment in technology and knowledge-intensive	Thousand people	Eurostat
gov_exp	Government expenditure in %of GDP	Ratio	Eurostat

Source: own elaboration based on data from the Eurostat database.

In order to test the causal relationship between redistribution policies and income inequality in the EU, using several control variables as previously discussed in the literature review, the following econometric model is proposed, and will be estimated using the Generalised Method of Moments (GMM) methodology. This methodology was chosen since it can be applied to problems using cross section, time series and panel data, and it has a larger impact on the robustness when there is unobserved heterogeneity in the model (Durlauf,

Johnson &Temple (2005) *apud* Nogueira, 2019). The GMM estimation method can be considered more efficient in comparison with other estimation techniques since the alternatives tend to present more correlation between the error terms and the independent variables (Hsiao (2003) *apud* Nogueira, 2019).

$$Yit = \beta_0 + \beta_1 \text{gdp\_pcit-1} + \beta_2 \text{pov\_riskit-1} + \beta_3 \text{educit-1} + \beta_4 \text{rd\_expit-1} + \beta_5 \ln(\text{emp\_git-1}) + \beta_6 \text{gov\_expit-1} + \varepsilon \quad (4.1)$$

As it is typical in the related literature, the model (equation 4.1) was estimated with a temporal lag of one year between the dependent variable and the independent variables, in order to capture the temporal gap between the measures and their effect on income inequality.

This analysis, as already explained, will be done using as unit of analysis NUTS2, which allows us to analyse the geographical regional detail of the redistribution policies that have been implemented by the EU during the period of analysis. Therefore, we have some limitations in the analysis, namely because the data for the dependent variable is not available at that level, as above mentioned.

4.2 Robustness check

As discussed previously, the econometric model was estimated using the GMM methodology and the software EViews.

In order to test the consistency of the model, we have estimated the correlation matrix of the model using the Pearson correlation test,[20] (see table below). By analysing the results, we conclude that some of the independent variables of the model might be highly correlated between each other: (i) "Employment in technology and knowledge-intensive" (emp_g) and "People at risk of poverty or social exclusion" (pov_risk); (ii) "Total R&D personnel (researchers) " (rd_exp) and "People at risk of poverty or social exclusion" (pov_risk); and (iii) "Employment in technology and knowledge-intensive" (emp_g) and "Total R&D personnel (researchers) " (rd_exp). To overcome this problem, three restricted models were estimated, which are based on the exclusion of some independent variables that showed correlation issues.

[20] For negative and positive values: 0 to |0,3| not relevant for correlation analyses; |0,3|to |0,5|low possible correlation; |0,5|to |0,7| moderate possible correlation; |0,7|to |0,9| high possible correlation, for values higher than |0,9| very high possible correlation.

Table 8. Correlation matrix of the original model

	y	gdp_pc	pov_risk	educ	rd_exp	emp_g	gov_exp
y	1						
gdp_pc		1					
pov_risk		**0,044**	1				
educ		**-0,040**	**-0,061**	1			
rd_exp		**0,432**	**0,750**	**-0,034**	1		
emp_g		**0,044**	**1**	**-0,061**	**0,750**	1	
gov_exp		**0,220**	**0,010**	**-0,007**	**0,088**	**0,010**	1

Source: own elaboration.

The first model (equation 4.2) is described as "restricted model 1" and it corresponds to the "original model" (equation 4.1) excluding the following variables: "Total R&D personnel (researches)" (rd_exp) and "Employment in technology and knowledge-intensive" (emp_g):

$$Yit = \beta_0 + \beta_1 \text{gdp\_pcit-1} + \beta_2 \text{pov\_riskit-1} + \beta_3 \text{educit-1} + \beta_4 \text{gov\_expit-1} + \varepsilon \quad (4.2)$$

The second restricted model (equation 4.3) is described as "restricted model 2" and it corresponds to the "original model" (equation 4.1) excluding the following variables: "People at risk of poverty or social exclusion" (pov_risk) and "Total R&D personnel (researches)" (rd_exp):

$$Yit = \beta_0 + \beta_1 \text{gdp\_pcit-1} + \beta_2 \text{educit-1} + \beta_3 \ln(\text{emp\_git-1}) + \beta_4 \text{gov\_expit-1} + \varepsilon \quad (4.3)$$

The last restricted model (equation 4.4) is described as "restricted model 3" and it corresponds to the "original model" (equation 4.1) excluding the following variables: "People at risk of poverty or social exclusion" (pov_risk) and "Employment in technology and knowledge-intensive" (emp_g):

$$Yit = \beta_0 + \beta_1 \text{gdp\_pcit-1} + \beta_2 \text{educit-1} + \beta_3 \text{rd\_expit-1} + \beta_4 \text{gov\_expit-1} + \varepsilon \quad (4.4)$$

4.3 Estimation results

The results we obtain from the estimation of the models are reliable and globally statistically significant below 1% under the F statistic test. However, it is possible to conclude that the four estimated models present a very low Adjusted R- Square,[21] with the "Restricted model 3" having the highest but still very low value, which means the model explanatory capacity is quite low (below 20%, vd. Table 9).

Table 99. Main estimation results of the models

	Restricted model 1	Restricted model 2	Restricted model 3
Gross Domestic Product per capita	-1.07E-05 ***	-1.49E-05 ***	-1.80E-05 ***
	(3.54E-06)	(3.54E-06)	(3.91E-06)
People at risk of Poverty or social exclusion	0.000127 **	------	------
	(7.38E-05)		
Education Ratio	8.78E-05	3.41E-05	1.83E-06
	(0,00218)	(0.00022)	(7.97E-06)
Total R&D personnel (researches)	------	------	1.24E-05 ***
			(2.47E-06)
Log of Employment in technology and knowledge-intensive	------	0.051233	------
		(0.03374)	
Government expenditure in %of GDP	-0.035581 ***	-0.037457 ***	-0.051380 ***
	(0.00454)	(0.00445)	(0.00461)
Prob (F- statistic)	0,000	0,000	0,000
Adjusted R- Squared	0,082	0,090	0,154

Source: own elaboration.
Notes: Instruments specification: the independent variables lagged up to one period: ***, (**) and [*] statistically significant at 1%, (5%) and [10%]. The standard errors of the coefficient are indicated in parentheses.

[21] This test represents the proportion of the model that is explained by the independent variables.

To improve our results, we have estimated three additional models. These models are based on the three restricted models presented above (from equation 4.2 to equation 4.4)[22] considering, in addition, geographic dummy variables (identified below in Table 10).

The introduction of these variables aims to capture the potential impact of the location of a region in a certain geographic area in Europe on income inequality. The models are presented below:

$$Yit = \beta_0 + \beta_1 gdp\_pcit\text{-}1 + \beta_2 pov\_riskit\text{-}1 + \beta_3 educit\text{-}1 + \beta_4 gov\_expit\text{-}1 + \beta_5 d\_ee + \beta_6 d\_ne + \beta_7 d\_se + \varepsilon \quad (4.5)$$

$$Yit = \beta_0 + \beta_1 gdp\_pcit\text{-}1 + \beta_2 educit\text{-}1 + \beta_3 \ln(emp\_git\text{-}1) + \beta_4 gov\_expit\text{-}1 + \beta_5 d\_ee + \beta_6 d\_ne + \beta_7 d\_se + \varepsilon \quad (4.6)$$

$$Yit = \beta_0 + \beta_1 gdp\_pcit\text{-}1 + \beta_2 educit\text{-}1 + \beta_3 rd\_expit\text{-}1 + \beta_4 gov\_expit\text{-}1 + \beta_5 d\_ee + \beta_6 d\_ne + \beta_7 d\_se + \varepsilon \quad (4.7)$$

Table 10. Description of the geographic dummy variables

Dummy Variable	Long definition
d_ee	regions in Eastern Europe
d_ne	regions in Northern Europe
d_se	regions in Southern Europe
d_wce	regions in Western- Central Europe

Source: own elaboration.

As it is possible to see in Table 11, the "restricted" models with geographic dummy variables contain only three of the four categories. The exclusion of the "NUTS 2 located regions in Western- Central Europe" variable (d_wce) was done to avoid multicollinearity and this is the variable used as the baseline for the interpretation of the estimation results.

In order to test the impact of the selected independent variables in the inequality ratio considering the geographic dimension, we have then estimated the restricted models with dummies (see Table 11).

[22] "Restricted model with dummies 1" (equation 4.5) is based on "Restricted model 1" (equation 4.2); "Restricted model with dummies 2" (equation 4.6) is based on "Restricted model 2" (equation 4.3); "Restricted model with dummies 3" (equation 4.7) is based on "Restricted model 1" (equation 4.4).

Table 11. Main estimation results of the models with location dummies

	Restricted model 1 with 3 Dummies	Restricted model 2 with 3 Dummies	Restricted model 3 with 3 Dummies
Gross Domestic Product per capita	6,86E-06 ***	6,22E-06 ***	4,40E-06 ***
	(1.33E-06)	(1.33E-06)	(1.33E-06)
People at risk of Poverty or social exclusion	2,43E-04 ***	------	------
	(4.88E-05)		
Education Ratio	1,97E-03	2,17E-04	-9,30E-08
	(0.000137)	(0.000170)	(4.80E-07)
Total R&D personnel (researches)	------	------	5,26E-06
			(0.006631)
Log of Employment in technology and knowledge-intensive	------	0,103 ***	------
		(0.022812)	
Government expenditure in %of GDP	1,91E-03	-0,0161 ***	-0,041 ***
	(0.006440)	(0.005986)	(0.006631)
NUTS 2 located regions in Eastern Europe	0,652 ***	0,640 ***	0,884 ***
	(0.127044)	(0.104869)	(0.108506)
NUTS 2 located regions in Northern Europe	-0,459 ***	-0,459 *	-0,0023
	(0.119103)	(0.111525)	(0.133970)
NUTS 2 located regions in Southern Europe	1,759 ***	1,639 ***	1,621 ***
	(0.056033)	(0.048129)	(0.053217)
Prob (F- statistic)	0,000	0,000	0,000
Adjusted R- Squared	0,351	0,359	0,393

Source: own elaboration.
*Notes: Instruments specification: the independent variables lagged up to one period: ***, (**) and [*] statistically significant at 1%, (5%) and [10%]. The standard errors of the coefficient are indicated in parentheses.*

From the previous table, it is possible to conclude that the inclusion of the geographical dummy variables has a positive impact on the global quality of the estimation model. The restricted models with geographic dummy variables (equation 4.5, 4.6 and 4.7) present an Adjusted R- squared among 0,351 to 0,393. The percentage of income inequality that is explained by the independent variables increased more than 50% in comparison with the original restricted models (equation 4.2, 4.3 and 4.4) (see Table 11).

Taking as reference the estimated data in Table 12, the "Gross Domestic Product per capita", although statistically significant at 1%, has a small estimated impact on income inequality and the estimated signal is positive. This means, everything else constant, regional initial GDPpc has a small positive impact on income inequality, that is the higher the initial GDPpc the higher income inequality. During the literature review this effect was also documented since some authors like Iammarino *et al.* (2019) present empirical evidence of the increase of inequality with the areas with highest GDP.

When we analyse the estimations associated with the variable "Government expenditure in % of GDP", we confirm there is evidence of a negative correlation between this variable and income inequality. Everything else constant, the higher these relative expenditures the lower income inequality (although the "restricted model 1 with dummy variables present a positive estimated coefficient it is not statistically significant). This evidence is quite relevant for our second research questions: What is the impact of redistribution policies on income inequality in the EU?

The model seems to present significant evidence that redistribution policies are indeed contributing for the reduction of income inequality in the EU.

Regarding the variable "Education ratio", the estimated coefficients show a very low impact on income inequality, which is not statistically significant. The same for the variable "total R&D personnel and researchers". This result is in contradiction with the literature that, as discussed in Chapter 2, highlights the relevance of human capital accumulation on income inequality (Iammarino et al., 2019; Galor and Wiel, 1996).

Considering the variable "People at risk of poverty or social exclusion" (pov_risk), the estimated models show statistical evidence that supports a positive relationship between poverty and inequality. As referred in the previous chapters, the increase of poverty leads also to the increase of instability, constraining, this way, economic growth (Alesina and Perotti, 1994) (Barro and Sala-i-Martin, 2004), which impacts negatively on income inequality.

The estimation for "Employment in technology and knowledge-intensive" is statistically significant at 1%, with a small and positive estimated impact on inequality. This result seems to be at odds with the literature since over the years, as analysed in Chapter 2, several authors have been publishing a strong body of evidence in favour of a negative relationship between investments in high-technologies and high-specific knowledge and regional convergence (Iammarino *et al.*, 2019).

The results we gathered concerning the variables related to investment on human capital and R&C may be the outcome of the fact that we are measuring income inequality at NUTS1 level (assuming the same value for the NUTS2 regions in a certain NUTS1 area) whereas the independent variables are measured at NUTS2 level. Another explanation may be the existence of some flaws in the distribution channels associated to the considered variables. In other words, the investment in high-tech activities and knowledge in certain areas may be disturbed by a bad distribution channel or may be implemented following a geographical allocation that promotes inequality at the NUTS2 level instead of decreasing it.

In what regards the geographical dummies, the estimated coefficients are statistically significant showing there is an impact on income inequality that emerges simply due to location of the NUTS2 regions. According to the estimation results, everything else constant, if a NUTS2 region is located in Estearn Europe or Southern Europe, inequality is higher compared with regions located in Western-Central Europe. The opposite occurs for NUTS2 regions located in Northern Europe since, everything else constant, the location in the area reduces inequality compared with the location in Western-Central Europe.

This effect was already foreseen and explained in the literature review (Chapter 2). There is also an indirect effect, well discussed in European Commission (2017), which puts into evidence the effect of spatial spill overs since the location effect has also a positive impact on neighbouring regions.

Another perspective on this topic is provided by Giordano (2017) and it is related with the generic location of the redistribution policies. According to the author, the policy measures should be focused on a specific territorial level (even in a NUTS3 region level) to improve the efficacy of the measures in the region. Otherwise, the author argues, when these policies are not territorially dedicated, they will tend to benefit more developed areas, increasing the gap among the regions.

Chapter 5. Conclusion

Along this dissertation it has been demonstrated, both with the literature review and with our empirical analysis that, although the NUTS 2 European regions have grown in the last ten years, there is a persistent income inequality among these areas.

Despite all the effort and investments made at the EU level, namely with the Cohesion policy, there is no sustainable evidence that EU regions have been converging. On the contrary, it seems there is enough evidence in favour of the increase of income inequality between European regions, being possible to conclude there is inequality of opportunities just due to the geographical location, for instance when a region is far away from the areas where investments are being concentrated, like investments in R&D, and the transmission channels are still weak.

Therefore, our analysis seems to sustain the need to create redistribution policies more efficient in order to improve the capacity of the different regions and promote more cohesion in the European Union. Our empirical study made evident the more favourable trend of development and economic growth of the Western-Central Europe and Northern Europe regions, which are already the areas with higher GDP pc and the most developed regions, in comparison with the regions located in the South and East, most notably in the South for the last decade.

This evidence supports the need to improve not only the distribution channels but also the planning exercises at the level of the Cohesion policy. Policies should be focused on a NUTS 3 level in order to define objective goals and milestones for each underdeveloped area, increasing the probability of a *catch-up effect* (Giordano, 2017).

A crucial limitation of this dissertation is the lack of information at NUTS 2 level in order to cross check the impact of redistribution policies and its influence within specific regions. Therefore, is it difficult to evaluate if these policies are indeed inefficient.

Another limitation of the present study is the omission of the reasons that might explain why the transmission channels are not working properly and why, after so much effort and money spend on the Cohesion policy, there seems to be no efficient way of spreading the development from one developed area to the neighbouring regions.

In future research we intend to improve the database to overcome the limitation above mentioned and analyse what are the main flaws in the inequality transmission channels relevant for European regions that may be blocking a positive and efficient impact of

redistribution policies in Europe as fundamental tools to reduce regional inequality.

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Annex

Annex 1 – Number of NUTS2 regions by country

No.	Country	NUTS 2	abb
1	Austria	9	AUT
2	Belgium	11	BEL
3	Cyprus	1	CYP
4	Czechia	8	CZE
5	Germany (until 1990 former territory of the FRG)	38	DEU
6	Denmark	5	DNK
7	Spain	19	ESP
8	Estonia	1	EST
9	Finland	5	FIN
10	France	27	FRA
11	United Kingdom	40	GBR
12	Greece	13	GRC
13	Hungary	8	HUN
14	Ireland	3	IRL
15	Italy	21	ITA
16	Lithuania	2	LTU
17	Luxembourg	1	LUX
18	Latvia	1	LVA
19	Malta	1	MLT
20	Netherlands	12	NLD
21	Poland	17	POL
22	Portugal	7	PRT
23	Slovakia	4	SVK
24	Slovenia	2	SVN
25	Sweden	8	SWE
26	Romania	8	ROM
27	Croatia	2	CRO
28	Bulgaria	6	BUL

Annex 2 – Countries by European region

Region in Europe	Country
Eastern Europe	Bulgaria
	Estonia
	Hungary
	Latvia
	Lithuania
	Poland
	Romania
Northern Europe	Denmark
	Finland
	Sweden
Southern Europe	Croatia
	Cyprus
	Greece
	Italy
	Malta
	Portugal
	Slovenia
	Spain
Western- Central Europe	Austria
	Belgium
	Czechia
	France
	Germany
	Ireland
	Luxembourg
	Netherlands
	Slovakia
	United Kingdom