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QUANTITATIVE METHODS FOR ECONOMICS

Addressing inequalities in the European Union: An impact evaluation study of the European Social Fund (ESF) programmes

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Abstract

Despite income inequality in the European Union (EU) over the last decade has not increased, concerns on this matter are still high among scholars, policy makers and general public. Notwithstanding the wide range of investments and allocation of funds for economic and social development indeed, the EU is still characterized by large economic disparities and overall poverty has also increased over the last years. The strategy to contrast this inequality must not be confined to the effectiveness of the welfare and redistribution systems, as it requires a larger and more complex policy mix. The existing literature suggests that enhancing competitiveness, upgrading skills and reinforcing equality of opportunities is necessary to successfully address economic imbalances and to achieve higher and more sustainable economic development as well as long-term and inclusive growth, avoiding social instability. This increasing complexity requires the involvement of a wide range of players taking part to the decision-making process to best address cohesion challenges. Especially, entities from the local and regional level are important to counteract this lack of balance among citizens of the European Union. For this reason, Cohesion Policy could play a crucial role. The aim of this thesis is to analyze the link between Cohesion Policy and economic inequality, and specifically to assess the effect of the European Social Fund (ESF) on income distribution within EU Member States. The ESF is the EU main instrument for strengthening social inclusion, combating poverty, promoting education, skills and lifelong learning as well as developing a comprehensive and sustainable active inclusion. The ESF interventions are characterized by a special focus on EU labor market – which underpins income distribution – as they support employment, help people to get better jobs and ensure fairer job opportunities for all EU citizens. Considering that this fund is deemed to intervene in those policy areas affecting the most the development of economic inequalities, the hypothesis to be tested is that the European Social Fund expenditure is reducing inequalities within Member States at national level. For this purpose, 4 panel regression models with fixed effects were estimated. The results confirmed a negative correlation between the income inequality and the ESF modelled annual expenditure, meaning that an increase in the ESF payments by the EU would result in a reduction of the Gini market coefficient, therefore contributing to narrowing the gap between citizens belonging to different income levels. On the basis of these results, increasing ESF budget or investing more financial resources in the typology of interventions sustained by the ESF could be effective in reducing inequalities.

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1. INTRODUCTION

Despite income inequality in the European Union (EU) over the last decade has not increased, concerns on this matter are still high among scholars, policy makers and general public. Notwithstanding the wide range of investments and allocation of funds for economic and social development indeed, the EU is still characterized by large economic disparities. Overall poverty has also increased in the las years – as the latest EUROSTAT data shows, citizens in the poorest income decile have lost share of total disposable income and still significant inequality of opportunity is ascertained. Large differentials in basic services, wellbeing drivers and more generally economic opportunities have been also recorded across Europe and within Member States.

The strategy to contrast this inequality must not be confined to the effectiveness of the welfare and redistribution systems, as it requires a larger and more complex policy mix. The existing literature suggests that enhancing competitiveness, upgrade skills and reinforcing equality of opportunities is necessary to successfully address economic imbalances. Tackling inequality in its multidimensional nature and reconciling it with growth and competitiveness strategies is crucial to achieve higher and more sustainable economic development and long-term and inclusive growth, avoiding social instability.

This increasing complexity calls for ensuring the involvement of the insights of a wide range of players in the decision-making process to best address cohesion challenges. Especially, entities from the local and regional level are important to counteract this lack of balance among citizens of the European Union. For this reason, Cohesion Policy could play a crucial role. The aim of this paper is to analyze the link between Cohesion Policy and economic inequality, and specifically to assess the effect of the European Social Fund (ESF) on income distribution within EU Member States.

The ESF is the EU main instrument for strengthening social inclusion, combating poverty, promoting education, skills and lifelong learning as well as developing a comprehensive and sustainable active inclusion. The ESF interventions are characterized by a special focus on EU labor market, which underpins income distribution, supporting employment, helping people to get better jobs and ensuring fairer job opportunities for all EU citizens.

Considering that this fund is deemed to intervene in those policy areas that are affecting the most the development of economic inequalities, the main working hypothesis is that European Social Fund expenditure is reducing inequalities within Member States at national level.

This dissertation is structured as follows:

- Chapter 1 – "Introduction" offers a brief outline of this work, introducing the main themes and presenting the rationale behind it.
- Chapter 2 – "Overview and Background" aims at providing an overview of the two major subjects under analysis in this study, i.e. the European Social Fund and income inequalities in the European Union. In this chapter will be also reported the main findings of the existing literature on this topic.
- Chapter 3 – "Data and Methodology" is aimed to shed a light on the methodological approach adopted to carry out this research. All the phases passed through to answer to the research question will be thoroughly illustrated, as well as the statistical method used to assess the impact of ESF interventions on the national income inequality situation of the MSs, the multiple linear regression model. Furthermore, all the variables and the relative database considered for this study will be introduced.
- Chapter 4 – "Analysis of the Results": the result obtained by the different regression models will be presented and explained.
- In Chapter 5 – "Conclusion", the main conclusion that can be drawn from the quantitative analysis and literature review findings will be presented.

2. OVERVIEW AND BACKGROUND

This chapter aims at providing an overview of the main issues that will be addressed in this dissertation. The two major topics under analysis in this work, i.e. the European Social Fund and income inequalities in the European Union, will be described in more detail in order to provide the reader with the key tools to understand the rationale behind the research question. In particular, the main findings emerged from the literature review will be reported.

The chapter is divided into three sections:

- "Cohesion Policy and the European Social Fund": this section describes the main objectives, instruments and implementation methods of one of the European Union's major investment policies. It also sheds light on the 2021-2027 framework, by providing some key insights of the new programming period that has recently started. A special focus is placed on the European Social Fund of which objectives, types of intervention funded, and beneficiaries were accurately described.
- "Inequalities": this section offers a general overview of income inequality trends in the European Union and its MSs. Furthermore, a preliminary analysis of the data contained in the EU Statistics on Income and Living Conditions database provided by Eurostat was performed.
- "Previous studies on the topic": it reports a brief analysis of the conclusions drawn by previous studies conducted on the relationship between Cohesion Policy and Income Inequalities in the European Union.

2.1. Cohesion Policy and the European Social Fund

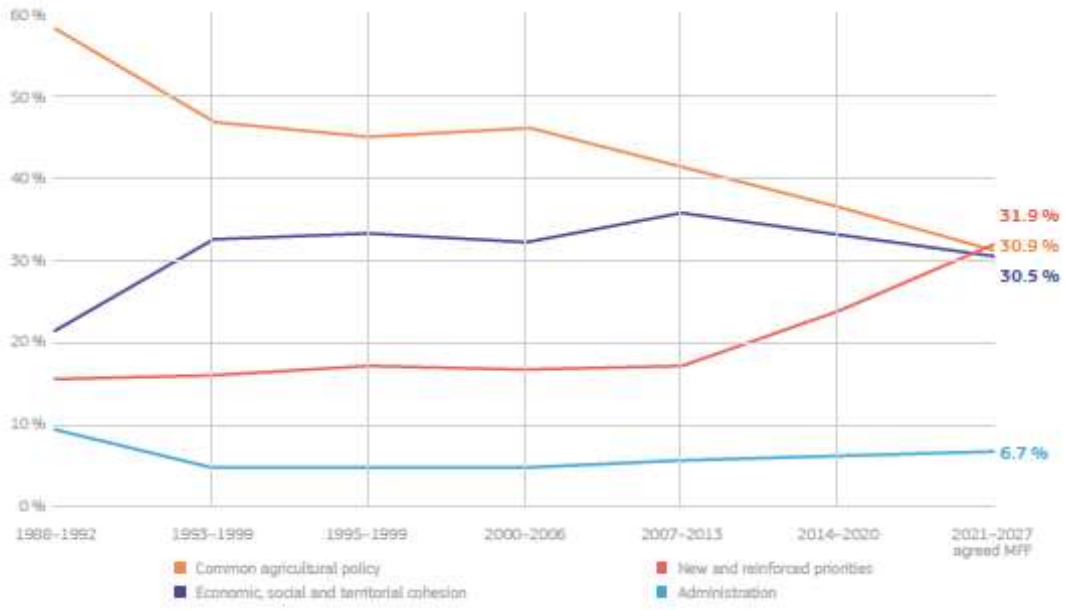
Cohesion policy is the regional strategy of the European Union (EU) aimed at promoting and supporting the "overall harmonious development" of its MSs and regions through the implementation of actions meant to strengthen the economic, social and territorial cohesion of the EU countries.[1]

[1] Consolidated versions of the Treaty on Functioning of the European Union (TFEU) [2012] OJ 326/01, art. 174.

After the accession of Greece in 1981, and Spain and Portugal in 1986, the need to correct imbalances between the level of development of the EU countries and regions started becoming clear. The EU Council agreed that it was necessary to take measures in order to reduce the disparities between European regions and to support the less favoured countries in bearing the cost for the economic integration. It was in this context that on 24 June 1988 the Council decided to approve a regulation which integrated the then existing EU funds under "economic and social cohesion", a concept that was already introduced in 1986 by the Single European Act (Dudek, 2014). Since then, cohesion policy has become one of the most important and debated policies of the EU.

The Maastricht, Amsterdam and Nice Treaties have reaffirmed the pivotal role of the Cohesion Policy inside the EU and high shares of the EU budget has continued to be allocated to the economic, territorial and social cohesion of the MSs. As can be observed from the chart below (Figure 1), since the 1993-1999 programming period more than 30% of the EU budget has been committed to this area making Cohesion Policy the EU's second largest investment policy after the Common Agricultural Policy (CAP).

Figure 1: Shares of the main policy areas in the multiannual financial framework



Source: European Commission (2021, p 10). Retrived at: https://op.europa.eu/en/publication-detail/-/publication/d3e77637-a963-11eb-9585-01aa75ed71a1/language-en

On the other hand, during the last 14 years the amount of financial resources earmarked for these two policy areas has decreased in favour of the new reinforced priorities addressing research, education, border protection, climate and digital transition. For 2021-2027, the 30.5% of the EU budget will be used for the economic, social and territorial cohesion while the 31.9% for the new priorities – moreover this share increases to more than 50% when Next Generation funding is taken into account (European Commission, 2021). This change of priorities for the 2021-2027 is also aimed to make up for the strategic re-orientation of funding which has taken place during the COVID-19 crisis and diverted attention from long-term and structural issues (e.g. climate change) to the emergency needs. Most of the Cohesion Policy resources were indeed shifted from supporting long-term strategic investments in national and regional development, towards extra support to struggling small and medium-sized enterprises (SMEs), citizens and the healthcare sector, leaving behind fundamental processes for the future such as green-transition and digitalization (Böhme et al., 2022).

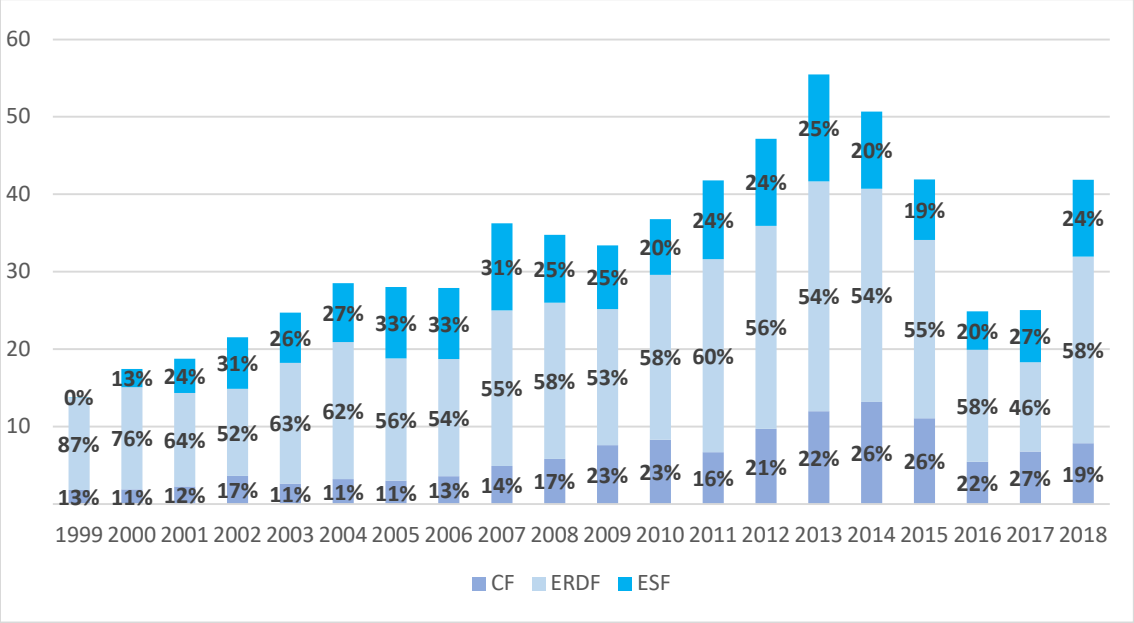
Three main European Structural Investment Funds (ESIF) are used in an integrated manner to implement Cohesion Policy and promoting a balanced and sustainable development of the European regions, in line with the objectives of the Europe 2020 strategy. These are:

- The **European Regional Development Fund (ERDF):** it is the largest of the three funds. As can be observed in Figure 2, in the last 20 years more than the 50% of Cohesion Policy annual payments were issued under this fund. The ERDF is mainly used to finance investments boosting economic growth and employment with the aim of strengthening the regional economies. It is characterized by a thematic concentration in the interventions relative to research and innovation, SMEs, low-carbon economy and Information and Communication Technologies (ICT). Furthermore, the ERDF is the financial instrument through which the EU finances cross-border, transnational and interregional cooperation within the MSs.
- The **European Social Fund (ESF),** which supports employment projects across Europe and invests in Europe's human capital, i.e. workers, young people and job seekers. In the 2021-2027 programming period the ESF has become the ESF+, which consists in a fund gathering together 4 different financial instruments that were separated during the 2014-2020 period. These funds are: the European Social Fund (ESF), the Fund for European Aid to the most Deprived (FEAD), the Youth

Employment Initiative and the European Programme for Employment and Social Innovation (EaSI). Major details related to this fund will be provided in the next section.

- The **Cohesion Fund (CF)**, which supports investments in the field of environment and trans-European networks in the area of transport infrastructure (TEN-T). Unlike the ERDF and the ESF, the CF is the only fund disbursed just in some of the MSs. In particular, it is used to support investments in the countries with a gross national income (GNI) per capita below 90% EU-27 average. For the 2021-2027 period, the Cohesion Fund concerns Bulgaria, Czechia, Estonia, Greece, Croatia, Cyprus, Latvia, Lithuania, Hungary, Malta, Poland, Portugal, Romania, Slovakia and Slovenia.[2]

Figure 2: ERDF, ESF and CF shares of annual EU Payments amount from 1999 to 2018



Source: own elaboration on data provided by https://cohesiondata.ec.europa.eu/

Although the Structural Funds are part of the EU budget, the way they are spent is based on a system of shared responsibility between the European Commission and national authorities – they are delivered indeed through *shared-management*: the co-legislators jointly establish the legal framework, the overall funding, and determine the allocations by MS and category of region. The Commission is in charge of adopting the operational

[2] Eruopean Commission – European Structural and Investments Funds. Retrieved at https://ec.europa.eu/info/funding-tenders/funding-opportunities/funding-programmes/overview-funding-programmes/european-structural-and-investment-funds_en. Accessed on 15/02/2022.

programs and cooperating with MSs for their implementation. On the other hand, the MSs' administrations, at national, regional and local level identify which kinds of projects is better to finance and it is in charge for day-to-day management of the programme implementation. Working together with the MSs, the Commission makes sure that the projects are successfully concluded, and the money is well spent. Funding is disbursed to the final beneficiaries in the form of grants, procurements and financial instruments.

Cohesion policy brings together actors across different levels of governance: regional, national and EU policy-makers are indeed all involved in the decisions related to the allocation of regional funds and their implementation. The interaction and coordination of these supranational, national and subnational administrations, and the sharing of power between them, gives rise to the notion of the EU as a system of *multilevel-governance* (Kenealy et al., 2018).

The economic and social situation is very different in the various EU regions, which is why the intensity of the financial resources granted by the EU is not the same for all the countries/regions. Specific eligibility criteria have been indeed established for the ERDF and ESF allocations among MSs for all the programming periods.

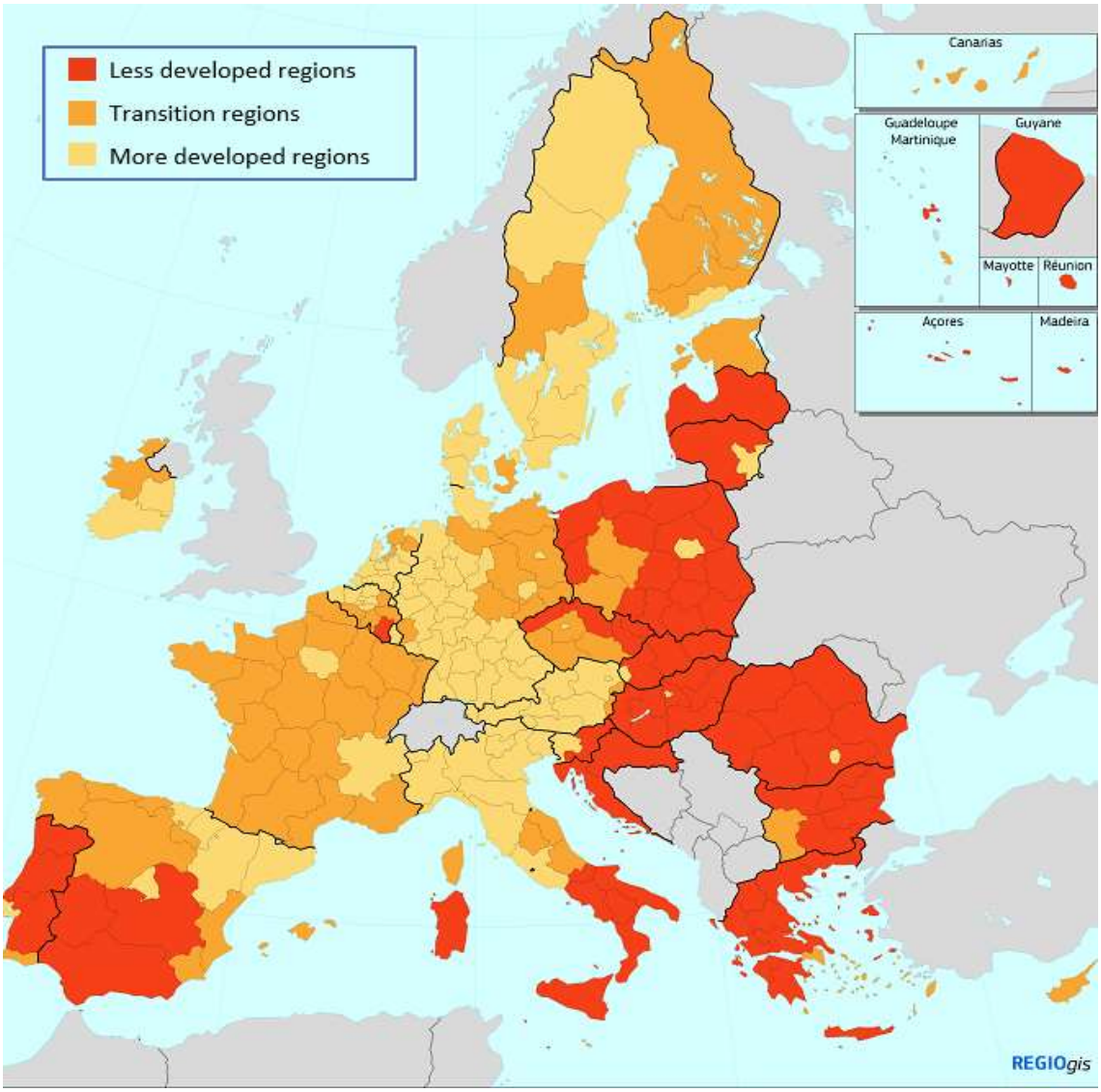
First of all, it is worth noticing that all the MSs receive money from the ESI funds; in particular, regions with specific problems can get financial support even if they are part of a wealthy member state, which makes the policy politically acceptable to all. Moreover, in order to operate at regional level the common classification of territorial units for statistics (NUTS 2) was established by Regulation (EC) No. 1059/2003 as amended by Regulation (EU) 2016/2066. This territorial breakdown has been since then the main rule for the territorial allocation of EU structural funds, providing a single standard scheme which does not take into account the territorial size of administrative units.

The ERDF, the ESF and the Cohesion Fund shall support the "Investment for jobs and growth" goal in all regions corresponding to NUTS 2 level. In particular, for the 2021-2027 programming period, resources from the ERDF and ESF+ for the "Investment for jobs and growth" goal shall be allocated among the following three categories of regions at NUTS level:

- less developed regions, whose GDP per capita is less than 75% of the average GDP per capita of the EU-27;
- transition regions, whose GDP per capita is between 75% and 100% of the average GDP per capita of the EU-27;
- more developed regions, whose GDP per capita is above 100% of the average GDP per capita of the EU-27.[3]

In the figure below it is possible to observe how the EU regions have been divided into the three above-mentioned categories for the allocation of funds in the 2021-2027 programming period (Figure 3).

Figure 3: 2021-2027 eligibility rule for ERDF and ESF+ allocation



Source: EC DG Regio

[3] European Parliament Regulation 2021/1060 art. 108.

The Cohesion Policy framework is established for a period of 7 years after which the European Commission must re-negotiate again with the national authorities of each MS the content of the Partnership Agreement, i.e. the document defining the strategy and the investment priorities to be adopted. The Partnership Agreement also includes a list of national and regional operational programs to be implemented throughout the whole programming period, as well as an indicative annual financial allocation for each programme.

Finally, Cohesion Policy funds are responsible for financing strategic transportation and communication infrastructures. They encourage the shift to the environmentally responsible economy, the development, innovation and competitiveness of SMEs which represents the main character of the European economic scenario.

In particular, for the programming period 2021-2027 there are 5 main objectives driving investments and supporting growth:

1. a **smarter Europe** through the promotion of innovative and smart economic transformation, SMEs support, as well as regional ICT connectivity;
2. a **greener, low-carbon Europe** transitioning towards a carbon-free economy, through the promotion of clean and fair energy transition, green and blue investment, circular-economy models, climate change mitigation and adaptation, risk prevention and management, and sustainable urban mobility;
3. a **more connected Europe**, by enhancing mobility with strategic transport and digital networks;
4. a **more social and inclusive Europe**, implementing the European Pillar of Social Rights and supporting social inclusion and delivering equal access to healthcare;
5. a **Europe closer to citizens**, by fostering the sustainable and integrated development of all types of territories and local initiatives.[4].

2.1.1. The European Social Fund

The European Social Fund is the EU main instrument for investing in human capital, i.e. European workers, young people and all the job seekers. It is committed to improving employment conditions, strengthening social inclusion, combating poverty, promoting

[4] Regulation (EU) 2021/1060 of the European Parliament and of the Council of 24 June 2021, art. 5.

education, skills and lifelong learning as well as developing a comprehensive and sustainable active inclusion.[5] In accordance with the art. 162 of the Treaty on the Functioning of the European Union, the ESF:

«[…] shall aim to render the employment of workers easier and to increase their geographical and occupational mobility within the Union, and to facilitate their adaptation to industrial changes and to changes in production systems, in particular through vocational training and retraining.»

Furthermore, as stated in art. 9, the ESF should contribute to guarantee an adequate social protection to the EU citizens, the fight against social exclusion, and producing a high level of education and protection of human health.

This fund was created in 1957, when the European Economic Community was established (Brine, 2002). While the overall purpose of the Fund has remained unchanged, its objectives and scope of application have been adapted to the socio-economic developments of the MSs. Today, the ESF is playing an important role in meeting Europe's goals and in mitigating the consequences of the economic crisis, especially the rise in unemployment and poverty levels.[6] The economic crisis we have experienced in the last decade, and the "fourth industrial revolution" we are going through – characterized by increased automation and the use of artificial intelligence on the rise, risk not only to displacing some specific types of jobs but could lead to an overall decline in employment (Levarlet et al., 2018). In this scenario, the ESF plays a pivotal role in helping citizens to develop the best suitable skills for today's labour market and boosting their adaptability in order to avoid negative impact on the MSs economic and social development and growth. In some countries, around 90% of the actual expenditure for labour market measures comes from the ESF (European Commission, 2017).

As mentioned in the previous paragraph, the ESF strategy and budget is negotiated and decided between the EU MSs, the European Parliament and the Commission. On this

[5] Regulation (EU) No 1304/2013 of the European Parliament and of the Council of 17 December 2013 on the European Social Fund.
[6] European Commission. The European Social Fund. *What is the ESF?.* Retrieved at: https://ec.europa.eu/esf/main.jsp?catId=35&langId=en. Accessed on 10/02/2022.

basis, seven-year Operational Programmes are planned by MSs together with the European Commission. The implementation of the ESF on the ground is achieved through projects which are applied for a wide range of organizations, both in the public and private sectors. These include national, regional and local authorities, educational and training institutions, non-governmental organisations (NGOs) and the voluntary sector, as well as social partners such as industry and professional associations. Projects funded under the ESF frameworks usually target people in society who are more vulnerable to unemployment and social exclusion, such as the long-term unemployed and women.[7]

In the regression models developed to test the above-mentioned hypothesis, ESF data covering a time span from 2000 to 2018 will be used. This means that data from three different programming periods will be considered: 2000-2006, 2007-2013 and 2014-2020. Table 1 reports the relevant regulatory references and the budget related to each of these periods. It is worth mentioning that the objectives pursued by the ESF and its role within the Cohesion Policy framework remained almost the same across the different programming periods.

Table 1: Regulatory framework and EU budget allocation of the ESF in the 2000-2006, 2007-2013 and 2014-2020 programming periods.

Programming Period	Regulation	Budget
2000-2006	• EU Regulation No 1260/1999 (amended by1447/2001, 1105/2003) • EU Regulation No 1784/1999	Total: 120 bln € EU: 62 bln € National: 58 bln €
2007-2013	• EU Regulation No 1083/2006 • EU Regulation No 1828/2006 • EU Regulation No 1081/2006	Total: 116 bln € EU: 77 bln € National: 39 bln €
2014-2020	• EU Regulation No 1303/2013 • EU Regulation No 1304/2013	Total: 136 bln € EU: 100 bln € National €36 bln €

[7] European Commission. The European Social Fund. *What is the ESF?*. Retrieved at: https://ec.europa.eu/esf/main.jsp?catId=35&langId=en. Accessed on 10/02/2022.

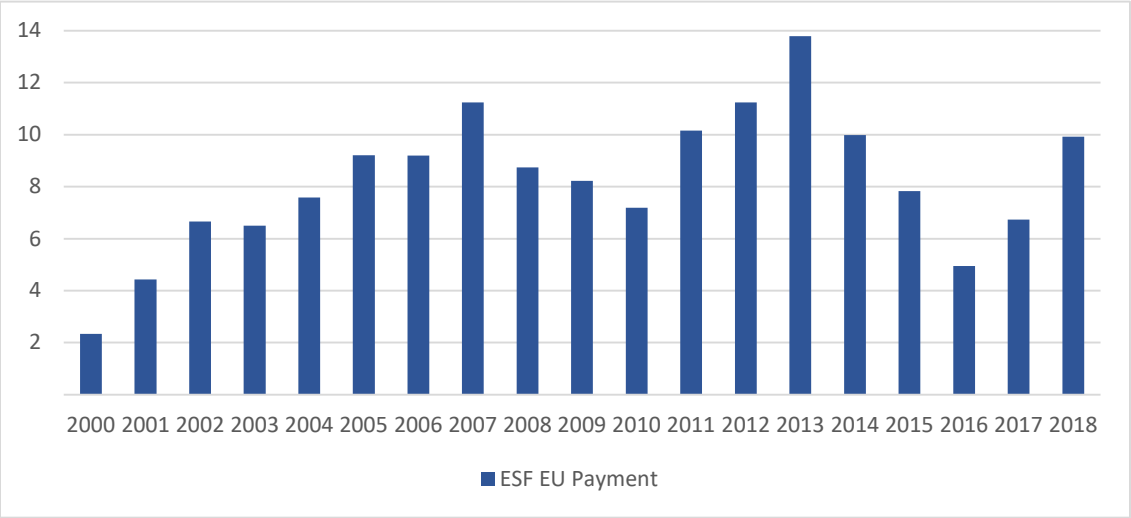
Source: own elaboration on data retrieved from ESF 2000-2006 EX POST EVALUATION International Evaluation & Methodology Conference (2000-2006), swd-2016-452-final_en.pdf (2007-2013), https://cohesiondata.ec.europa.eu/funds/esf (2014-2020)

The graph below (Figure 4) shows the aggregated data related to the amount of ESF payments made by the European Union to the MSs on annual basis. The figures do not correspond to the entire budget allocated to the European Social Fund for those years since the share of co-financing provided by the EU countries is not taken into account. The data indeed corresponds only to the annual share of certified expenditure being reimbursed by the EU after the certification controls have taken place. Therefore, it should be noted that the flow of expenditure does not correspond exactly with the implantation of the ESF measures, as an expenditure incurred in a given year can be reported and paid by the Commission the following one. Considering these premises, it is possible to maintain that starting form 2002 the European Union has spent almost annually at least EUR 6 billion of its resources on co-financed ESF operational programs. It can be observed that there are peaks in expenditure during the transition years from one programming period to another. This probably occurs for two main reasons:

- the overlapping use of resources from two different programming cycles; for example, during the 2007-2013 period the decommitment rule known as 'n+2' was applied.[8] This meant that the budget commitment of each operational programme had to be used by the end of 2015, two years after the end of the programming cycle.
- The greater intensity of programs spending take place in the latter part of the programming cycle where all projects are already started and at an advanced stage. Usually, is during the last years of the 7-year period that the beneficiaries submit most of the payment claims.

[8] Council Regulation (EC) No. 1083/2006 of 11 July 2006 laying down general provisions on the European Regional Development Fund, the European Social Fund and the Cohesion Fund, art. 93.

Figure 4: ESF EU Payments (in billions of euro) 2000-2018



Source: own elaboration on data provided by https://cohesiondata.ec.europa.eu

In 2000-2006, most of the ESF budget was spent for the implementation of employment policies (33%) and for improving human capital (29%) while most of the activities enacted to reach the final recipients consisted in trainings and counselling services. The 2000-2006 ESF programs supported also around 1.7 million organizations and reached more than 75 million individuals (Pasimeni, 2011). From the ex-post evaluation emerged that the main categories addressed by these programs were young and long-term unemployed people (Galazka, 2010).

Likewise the previous programming period, during the 2007-2013 cycle most of the ESF resources were spent in improving human capital (34%) and the access to employment and sustainability (30%). The ESF registered 98.7 million participations by individuals, including the inactive, employed and unemployed citizens. During this programming period, the ESF programs helped 9.4 million participants to gain employment, and 8.7 million citizens to gain a qualification/certificate. Furthermore, according to the ex-post evaluation of the 2007-2013 ESF programs, on the basis of macroeconomic simulations, the investments on human capital are estimated to have had a positive impact on GDP (0.25% increase) and productivity. In particular, these effects are turned out to be much stronger in the Central and Eastern European countries (European Commission, 2016). The countries receiving most of the ESF resources were Poland, Germany and Spain.

Finally, during the 2014-2020 programming period the ESF has funded 4 of the 11 Cohesion Policy thematic objectives namely:

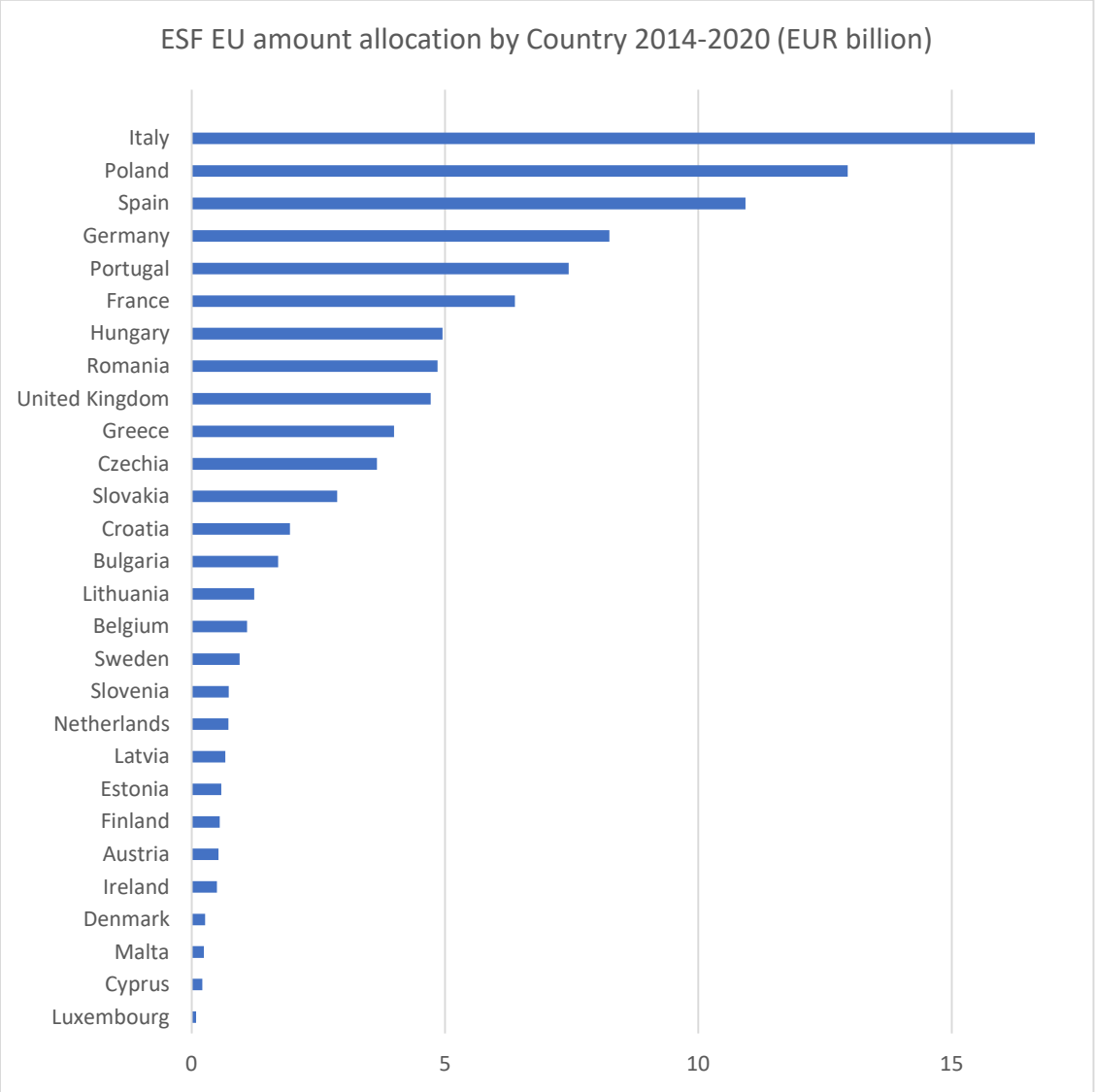
- **sustainable and quality employment**, manly by facilitating the access to employment and labour mobility, supporting workers, enterprises' and entrepreneurs' adaptation to change and the sustainable integration of youth in the labour market;
- **educational and vocational training,** under which the main intervention fields have been:
    - **social inclusion**, promoting active inclusion and enhancing access to service as well as integration of marginalised communities;
    - **efficient public administrations**, including investments in institutional capacity and capacity building activities for ESF stakeholders[9].

According to the 2020 strategic report on the implementation of the ESI funds,[10] 45.3 million participants benefitted from the ESF and Youth Employment Initiative supported projects. At the end of 2020, 21.8 million low-skilled people had been helped, 7.4 million had gained a qualification and 2.2 million were in education and training. In the chart below it is possible to observe how the ESF resources were allocated among the EU MSs in 2014-2020 (Figure 5). The countries receiving most resources in this care were Italy, Poland and Spain.

[9] European Commission. Cohesion Data – The European Social Fund. Retrieved at: https://cohesiondata.ec.europa.eu/funds/esf. Accessed on 20/02/2022.

[10] https://ec.europa.eu/regional_policy/sources/docoffic/official/reports/annual_2020/implementation_2020_report.pdf.

Figure 5: Planed EU amount allocation of the ESF by Country 2014-2020 (EUR billion)



Source: own elaboration on data provided by https://cohesiondata.ec.europa.eu/

2.2. Inequality in EU

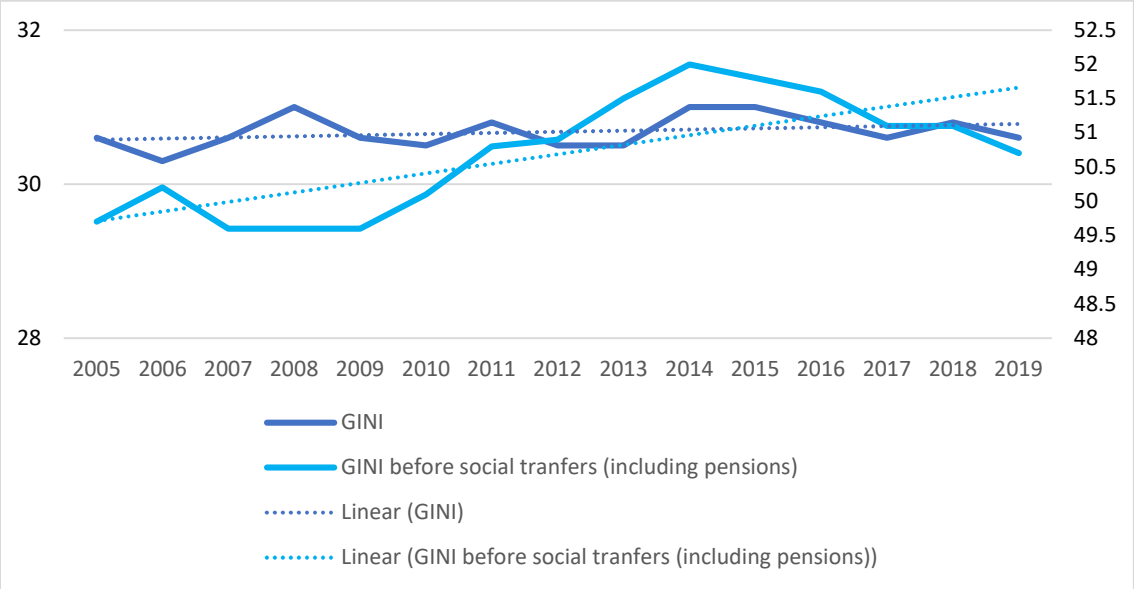
Concerns related to income inequalities within EU MSs have become increasingly present in the current public debate and have been the object of growing attention among policymakers, scholars and general public. Reducing income inequality and preventing social exclusion is crucial to economic integration. Substantial inequalities in the long-term could indeed lead to a weakening of the economy and increase the risk of sharp social divisions. A fair distribution of resources and wealth, on the other hand, increases social cohesion and the efficiency of the system, avoiding internal dysfunctionality which could generate negative spillover effects.

The convergence of regions and households' income conditions across the EU is determined by what happens between and within countries (Inchauste and Jonathan, 2018). For this reason, Cohesion Policy – thanks to its multi-level contribution to the public administrations – could play a role to counteract the negative effects of economic imbalances that could generate at supranational, national and subnational level.

The overall income inequality in Europe (between countries) over the last decade has not increased. As shown in the chart below (Figure 6), the Gini index considering only disposable income – i.e. the part of income remaining after deducting taxes and contributions – over these years has followed a flat trend characterized by some slight fluctuations lower than 1%. The highest income inequality peak (31%) was recorded in 2008, while the lowest level (30.3%) in 2006.

On the one hand, this reflects the progressivity of tax systems and the effectiveness of EU's welfare systems (Bubbico and Freytag, 2018). As a matter of fact, if we look closely at the line representing the Gini values before the redistributive effect of taxes (including pensions) took place, we can see that the trend is upward and the fluctuations greater. The highest level of inequality was recorded in 2014, with a Gini index of 52%, while the lowest of 49.6% in 2008.

Figure 6: Gini vs. Gini before social transfers (including pensions) EU27(excluding Croatia) 2005-2019 (%)



Source: own elaboration on data provided by https://ec.europa.eu/eurostat (database: ilc di12 and ilc_di12b)

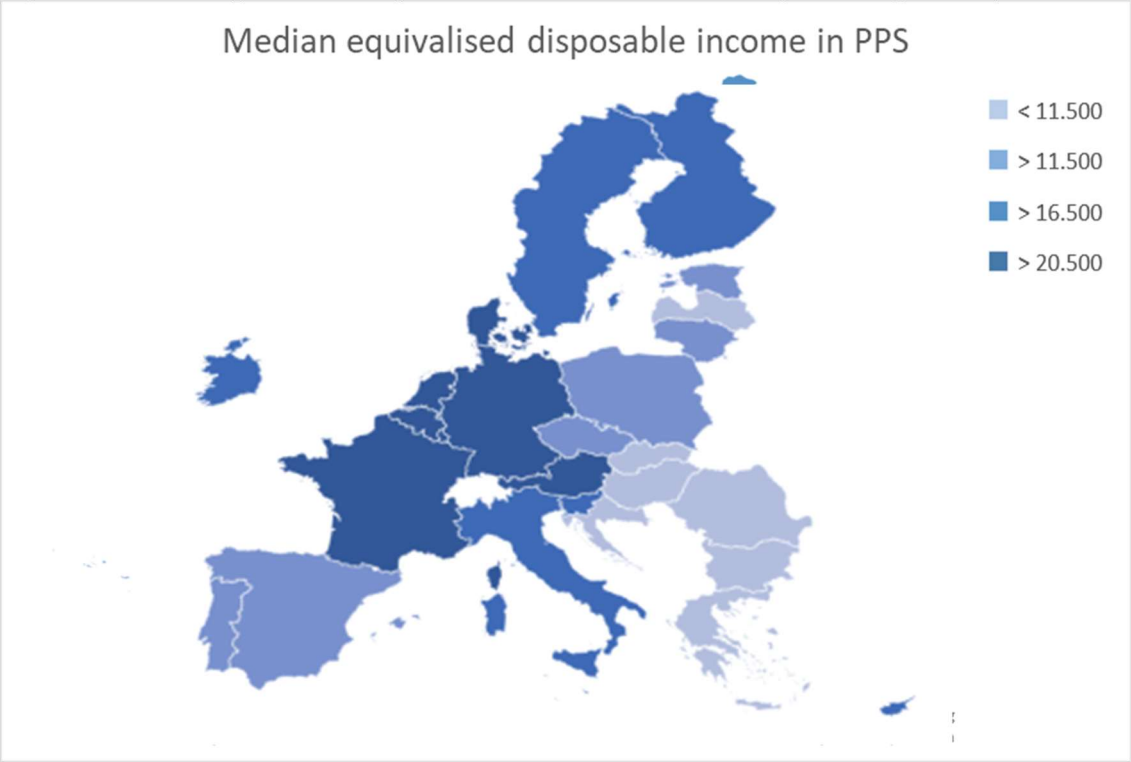
This was also confirmed by a study released by the World Inequality Lab reporting that in 2017, the top 10% earned on average 7.2 times more than the bottom 50% before taxes and transfers, and 5.1 times more after the operation of the taxes and transfers system (Blanchet et al., 2019).

When analyzing the inequality trend in the EU, it is important to take into account that this scenario is the result of conflicting trends, with diversified national growth trajectories and large variations in performance of welfare systems (Bubbico and Freytag, 2018). It is indeed true that, considering EU as a single country, income inequality across its citizens has declined over time but the income differences between the richest and the poorest countries continues to be broad (Figure 7).

From the analysis of data provided by the EU-SILC[11], it emerges that in 2019 the median equivalised disposable income varied considerably across the EU MSs, ranging from PPS 7,338 per inhabitant in Romania, to PPS 28,943 in Luxembourg. The EU average in 2019 was PPS 17,422. In general, it is possible to observe that the median equivalised disposable income is lower in the Eastern countries while the highest values can be found, in addition to Luxembourg, in France, Netherlands, Belgium, Denmark, Germany and Austria.

[11] https://ec.europa.eu/eurostat/web/microdata/european-union-statistics-on-income-and-living-conditions. Last time accessed the 20/02/2022

Figure 7: Median equivalised disposable income in PPS in 2019 (excluding the UK)

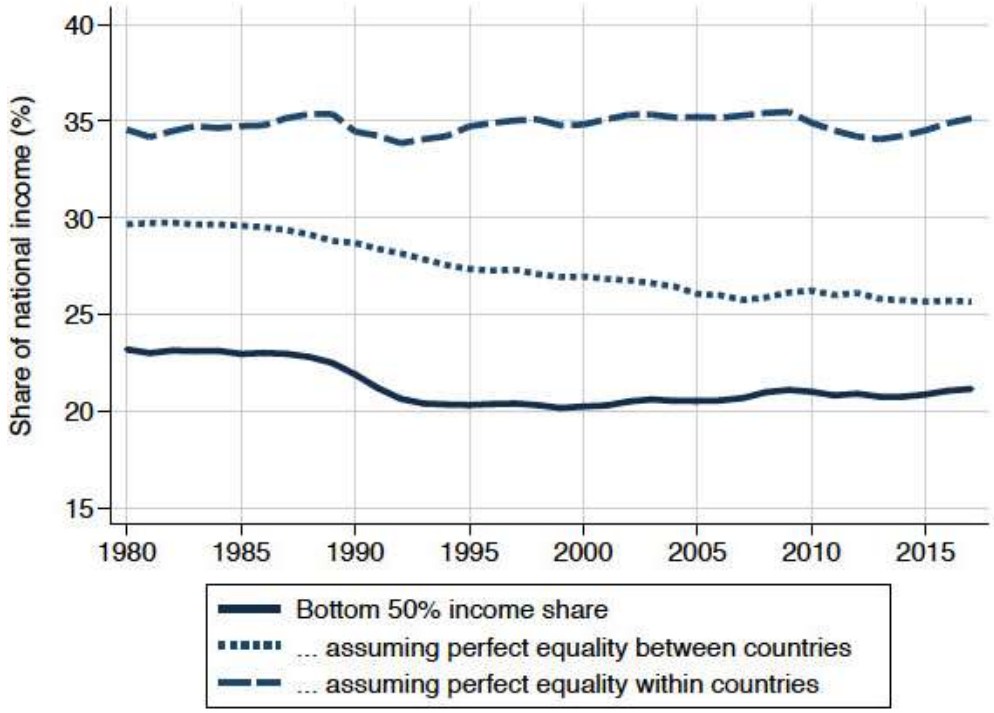


Source: own elaboration on data retrieved at https://ec.europa.eu/eurostat (database: ilc_di03)

As mentioned above, the convergence of regions and households across the EU is not only determined by what happens between its MSs, but also by what happens within these ones. According to Blanchet et al. (2019), over 75% of European inequalities are accounted for by the within-MSs component. This was demonstrated in the above-mentioned study by comparing actual inequality levels to two counterfactual scenarios:

1. **Assuming perfect equality between countries**: in this first scenario, the assumption is that all the European MSs perfectly converge in their average national incomes (*"isolating inequalities* within *countries"*).
2. **Assuming perfect equality within countries**: in this second scenario, it is assumed there are no differences among the incomes of households of a same country. Basically, all the European citizens earn the average income of the country where they live (*"isolating inequalities* between *countries"*).

Figure 8: Top 10% income share, scenario 1 vs. scenario 2 (1980-2015)

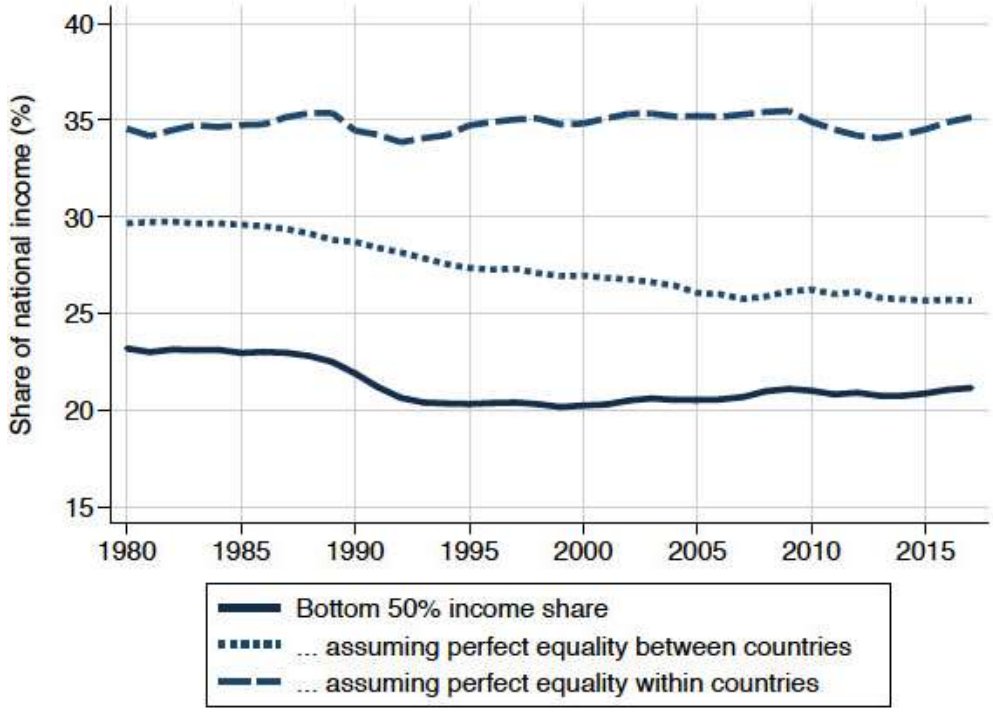


Source: Blanchet et al. (2019, p. 40).

If the share of total income received by the top 10% earners in Europe is considered (Figure 8), it is possible to observe how this share only decrease from 33% to 30% in case of perfect macroeconomic convergence, while it would be more than halved if there had been no inequalities within countries.

Likewise, looking at the share of total income received by the bottom 50% of European citizens (Figure 9), it is possible to notice how erasing differences in countries' average national incomes would just have a moderate impact on the inequality level changing only by a few percentage points. Therefore, it is possible to maintain that if all the European citizens would have earned the average national income of their country of residence, differences in standards of living would be dramatically reduced. The top 10% share would have stagnated at about 15%, while bottom 50% earners would have received more than one third of total income in all years considered.

Figure 9: Bottom 50% income share, scenario 1 vs. scenario 2 (1980-2015)



Source: Blanchet et al. (2019, p. 40).

In order to provide a first overview of the inequality situation within EU counties, an analysis of the trend followed by the S80/S20 ratio[12] in 6 different groups of MSs between 2010 and 2018 was carried out. The methodology adopted for the creation of the country groups, which can be observed in Table 2 below, was already used in several studies, and will be used again throughout this report (Inchauste and Jonathan, 2018; Bodewig and Rdao-Cano, 2019).

Table 2 Groupings of countries

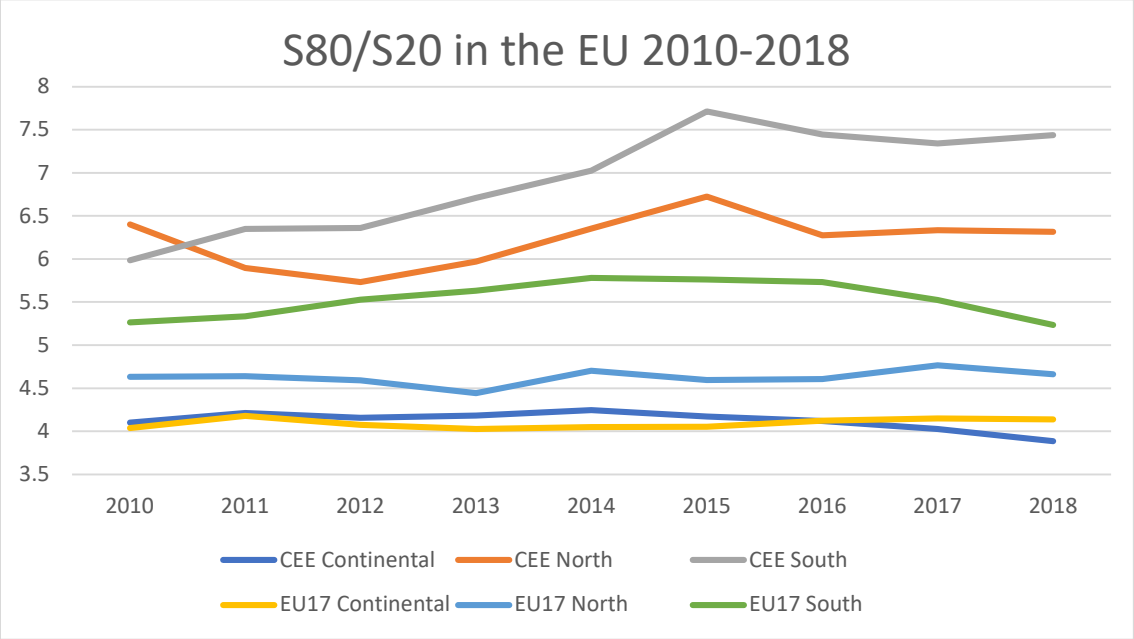
EU17 South	EU17 Continental	EU17 North	CEE South	CEE Continental	CEE North
Italy	Luxemburg	Ireland	Romania	Slovenia	Estonia
Spain	Belgium	Denmark	Bulgaria	Slovakia	Latvia
Portugal	Austria	Finland		Hungary	Lithuania
Cyprus	Netherlands	United Kingdom		Czech Republic	
Malta	Germany	Sweden		Poland	
Greece	France			Croatia	

Source: own elaboration

[12] The S80/S20 ratio compares the mass of income held by 20 % of the richest persons to that held by 20% of the poorest persons.

As can be observed from Figure 10, the highest levels of within-country inequality in the EU are recorded in Central Eastern and Southern European countries. In particular, a marked upward trend can be identified in the case of Southern European countries, from 5.99 in 2010 to 7.32 in 2018. Also in the Continental EU17, representing the group of the richest EU countries, starting from 2015 the gap between the income share of the richest 20% of the population and that of the poorest 20% has begun to widen, increasing from 4 to 4.32. A more specific picture of the situation of inequalities in the different MSs will be offered in the next section.

Figure 8: S80/S20 in the EU 2010-2018



Source: own elaboration on data retrieved from https://ec.europa.eu/eurostat (database: ilc_di11)

In order to better understand the contribution that the European Social Fund can give to the problem of economic inequalities among EU citizens, it is worth highlighting that labor income inequality was identified as one of the main drivers of total income imbalances within MSs. Nevertheless, this problem is gradually increasing as low-income people fall behind, while capital income and wealth are more and more concentrated at the top of the distribution (Inchauste and Jonathan, 2018). Furthermore, according to the World Economic Forum, all the major global economies could face a near future of mass unemployment for some categories of low- or un-skilled workers (Leopold et al., 2016). Automation and artificial intelligence risk not only displacing some specific types of jobs

but could lead to an overall decline in employment, including also cognitive tasks until recently considered non-automatable.

As a matter of fact, a falling labour share of income not only challenges one of the key foundations underlying most macroeconomic models (constancy of labor-share of income[13]) but it may be signalling rising income inequality. This could have a significative effect on long term growth, as well as could produce crucial political issue possibly leading to political instability and the rise of populist and extremist parties (OECD, 2015).

For this reason employment growth over the next decade is assumed to be driven by jobs requiring greater preparation through in-employment, training and formal education. In this sense, the role of the ESF in providing complementary support to EU regions for the acquisition of higher-level skills in smart specialisation sectors will be essential (Levarlet and Hrelja, 2018). In particular, it could be an important tool to mitigate the effect of income inequality. Thanks to the continuity ensured by its 7-year programming cycle, it allows the development of sustainable employment strategies. Furthermore, as far as the creation of necessary skills for the adaptation to these new labor market conditions is concerned, the courses/training and the issuing of certificates funded under the ESF framework could be extremely valuable.

2.3. Previous studies on this topic

Literature that studies the effectiveness of Cohesion Policy and its diverse effects on the MSs' economies is substantial. However, it is still difficult to confirm the connection between the regional policy expenditure – in particular, the European Social Fund payments – and the MSs income convergence. Furthermore, an additional question which is important to be answered is whether the benefits generated in the European regions by the European Structural Funds justify the significant amount of the EU budget spent for this purpose.

[13] Represented by the Cobb-Douglas production function, which simplifies economic modelling by assuming that the functional income distribution between labour and capital always remains constant.

With regards to the contribution of ESF to the achievement of a more equitable economic context in the EU, to the best of our knowledge no study has yet been carried out for specifically analyzing the relation between ESF contribution and income inequality in the MSs. Most of the researches indeed tend to assess the macroeconomic impact of the whole Cohesion Policy. However, the results obtained by these studies are still quite varied and there are many unresolved questions.

Boldrin and Canova (2001) analysed the distribution of regional income per capita of the EU15[14] (national scale) and of the national averages (EU scale) in 1980 and 1996, and the estimated long run-redistribution resulting in case the same conditions continue in the future. Looking at the national and the EU scale distributions for all the 3 periods, three main findings emerged:

1) a convergence tendency cannot be observed in any of the models in 1996 and in the steady state distributions compared to 1980;
2) the features of the distributions are very persistent. For example, the spread between the upper and the lower decile of the distribution in 1980, 1996 and at the steady states is largely unchanged; no form of systematic catching-up of poor regions can be observed and relative income inequalities are not reduced over time.
3) However, there is a tendency in European scaling data for units which started above the mean to regress toward or below the mean. The leftward shift of the overall distribution is quite evident both in 1996 and at the steady state.

According to their analysis, within each country rich regions' income grows faster than poor regions' ones; and the rich (relative to national average) regions of poor countries grow faster than those of countries that are already above the EU mean. This could produce the polarization of regions, in terms of income, in "convergence clubs", obscuring the nature of the convergence process promoted by the EU Cohesion Policy, which assumes the existence of only one attraction point. They finally conclude that there was a lack of effectiveness of cohesion policy:

[14] The composition of the European Union from 1 January 1995: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden, and the UK.

"Our conclusion is that regional and structural policies serve mostly a redistribution purpose, motivated by the nature of the political equilibria upon which the European Union is built. They have little relationship with fostering economic growth."

Bouvet (2010) investigates income inequalities between 197 European regions during the period 1977-2003. She based her study on a panel analysis using the Gini coefficient as a measure of inequality within individual countries. In the construction of the regression model she also took into account four groups of independent variables: demographic, macroeconomic stability, institutions and policies, and the impact of the EMU accession. She concludes that the regional inequality has decreased in the observed period due to decreased cross-country inequalities.

Jovančević et al. (2015) confirmed the hypothesis that the Cohesion Policy payments decrease the cross-country inequalities but fails to mitigate regional inequalities within individual countries. In order to test whether Cohesion Fund payments decrease the cross-country inequalities, the authors estimated an unbalanced panel model and employed Granger causality tests to check if there is causality between the variables of interest, and if so, in what direction. The variables taken into consideration were Cohesion Fund payments (normalized by the country's GDP) and weighted coefficient of variation of real GDP per capita. The main findings were the following:

- **Between-country inequality**: inequalities between countries in the EU are negatively correlated with the cohesion payments in the 2000-2011 period, i.e. cohesion payments decreased the disparities between countries – even if this correlation is relatively weak. The causality exists in one direction, namely the disparities between countries Granger cause the quantity of payments which the country receives.
- **Within-country inequality:** inequalities between NUTS-2 regions within MSs are positively correlated with the cohesion payments, i.e. payments increase the regional inequalities measured by the weighted coefficient of variation; differently from the previous one, this correlation turned out to be relatively strong. There is bidirectional causality, namely inequalities Granger cause the quantity of cohesion payments and vice versa.

With regards to the ESF effect on the EU MSs**,** Sakkas and Stylianos (2018) attempted to evaluate the ESF macroeconomic impact. The results they obtained suggest that the resources of this fund contribute positively in terms of GDP growth and employment. ESF interventions resulted to boost competitiveness and increase labour productivity producing long-lasting effects on the labour market. Furthermore, given the wage benefits and productivity-enhancing effects associated with ESF interventions, it is possible to assume that the programs funded under its framework could have distributional effects. From the study emerged that contribution of ESF funds is important for speeding up the economic recovery taking place in most European economies, and that it generates benefits which are higher than its costs by 2030.

3. DATA AND METHODOLOGY

This dissertation examines the impact of the European Social Fund on the development of income inequalities in the EU MSs at national level. The main working hypothesis is that the European Social Fund expenditures are reducing inequalities within MSs. In addition to justifying the resources invested by the EU for supporting the economic cohesion among its citizens, it is important to understand if ESF interventions have been contributing enough to the achievement of the overall Cohesion Policy objectives.

This chapter provides a detailed outline of the methodological approach adopted to answer the research question. In the following sections the tools, the data and the techniques used during the research phase will be explained in detail. In particular:

- The section "Overall Methodology" provides a general description of all the steps followed to collect and analyze the empirical data for the hypothesis testing.
- The section "The choice of the statistical model" offers an overview of the literature findings supporting the decision to adopt the Multiple Linear Regression technique to carry out the data analysis.
- The section "Multiple Linear Regression Model" aims to explain the statistical method adopted to assess the impact of ESF interventions on the national income inequality situation of the MSs. All the tools needed for understating the results of the statistical analysis, provided in the next chapter, will be presented in this section.
- Finally, the regression equation built specifically to answer the research question will be introduced in the section titled "The Inequality Equation". Under this heading there are 3 main sub-sections describing all the variables which have been taken into consideration for the design of the model:
    - "The Gini Index" describes the characteristics of the index which was adopted as proxy of national income inequality. It is the dependent variable, namely the main factor that we are trying to understand/predict.
    - "ESF Modelled Annual Expenditure" is the main-effect independent variable, included in the model to test the hypothesis that ESF expenditure is contributing to decrease income inequality among EU citizens in the

different MSs. It quantifies the EU annual payments occurred under the ESF framework.

- "Main Drivers of Inequality" describes the variables with a control function, namely all the variables which according to economic literature were proven to have an impact on the evolution of the level of economic inequality.

3.1. Overall methodology

This section presents the adopted working method and all the phases passed through for assessing the impact of the European Social Fund on income inequalities (Figure 9).

Figure 9: Methodological approach

Source: own elaboration.

The methodology adopted consisted of 4 main steps:

- **1st step - Desk research** activities**.** This stage served to collect detailed information on the two main objects of this study: ESF and Income inequality situation in the MSs. Most of these findings were reported in the previous chapter. As a matter of fact, the review of already existing studies and data analysis provided valuable information for the selection of the most appropriate statistical model to address the research question. Moreover, desk research allowed to identify the appropriate theoretical frameworks that articulate the relationship between income inequality and other key economic variables. This was important to better understand which variables, on the basis of economic theory's assumptions, are deemed to be the main drivers of income inequality.

- **2nd step – Data collection** and **database construction**. The second step consisted in the determination of the best indicators available to represent the variables affecting income inequality identified during desk research activities. The activities performed at this stage involved mainly the consultation of different databases in an effort to understand where the most accurate data could be

obtained and which ones would have allowed to cover the longest time span possible and all the EU MSs. An unbalanced cross-pooled sectional dataset was then built including 9 variables. The database covers all the 28 EU countries, including the United Kingdom over a 19-year period (2000-2018).

- **3rd step – Development** and **implementation** of the **regression model**. At this point, on the basis of the acquired knowledge of economic theory on income inequality and the availability of data, the equation underlying the multiple linear regression model was developed. Different regression models were then run – taking into account country and year fixed effects – using R, a free software environment for statistical computing and graphics[15].

- **4th step -** Regression model **assessment** and **analysis** of the results. Once several regression models had been carried out, they were analyzed and the main conclusions drawn. The results obtained will be presented and discussed in the next chapter.

3.2. The choice of the statical model

Since the 1970s, public policy literature has been characterized by a widespread use of quantitative methods for data collection and analysis including survey, inferential statistics, hypothesis testing, cost-benefit analysis, and economic modeling. Still today, quantitative research represents a key component in the field of policy analysis. This is evidenced by the several journal publications and studies based on this typology of approaches as well as by the high number of courses aimed to hone analytical skills and promote the learning of quantitative methods in political science faculties (Petchko, 2018). In particular, from a review of the educational curricula of 44 progammes offered in the leading public policy schools of the United States, it emerged that the most frequently taught methods of data collection and analysis were respectively survey and multiple regression analysis (Morçöl and Ivanova, 2010).

There are many different strategies and techniques for carrying out data analysis in public policy and economics, some being more common in particular research areas than others.

[15] https://www.r-project.org/. Accessed the last time: 18/03/2022.

The choice of the most appropriate strategy for data analysis is largely dictated by the research question to be addressed, and the type of data at disposal. As in this case, quantitative research questions usually aim to analyze relationships among multiple variables, and the data adopted are observational rather than experimental. In this scenario, the most common tool used is by far the multiple OLS regression analysis (Petchko, 2018).

In 2015, Förster and Tóth carried out an exhaustive review of what recent international cross-country studies revealed about the multiple causes of income inequality in the OECD area (Förster and Tóth, 2015). From this thorough survey emerged that the majority of macroeconomic cross-country panel studies attempting to identify the main drivers of income inequalities resort to ordinary least square (OLS) multiple regressions, which probably is also the most widely used tool in econometric analysis. These regression models were mainly built on cross-sections grouped in a macroeconomic setting to measure the causal factors preventing or increasing inequality in countries.

Likewise, also in the review paper "The Drivers of Income Inequality in Rich countries" (Nolan et al., 2019), which provides a critical survey and synthesis of recent research about this topic, many of the mentioned studies that were analyzed adopted multiple regression analysis as analytical tool. For instance, Coibion et al. (2017) used regression analysis with quarterly US micro-data between 1980 and 2008 to prove the connection between expansionary monetary policy and higher inequality. What emerged from their research is that monetary policy shock have only negative but small effect on income inequality. Nolan et al. (2019), however, reached the conclusion that even if a comparative perspective can serve as an important corrective, it is really difficult to arrive at a consensus on the relative importance of different drivers of inequality via aggregate cross-country regression analysis.

With regards to the typology of data used, generally most applications of multiple regressions are carried out on datasets with merely cross-sectional or merely time-series data. Although these two cases are very frequent, a joint use of cross-sectional and time-series dimensions is increasingly used in empirical research. Such datasets can be built up in two ways:

- On the one hand, pooled data occur when we have a time series of cross sections, but the observations in each cross section do not necessarily refer to the same unit and are selected randomly.
- On the other hand, panel data occur when observations are obtained by sampling the same statistical units in different time periods. Therefore, they refer to samples of the same cross-sectional units observed at multiple points in time

The choice of carrying out the analysis using panel data allows us to work with more information compared to simpler datasets, thus including more variability and consequently reducing the collinearity between the variables. As a result, parameters are estimated more efficiently and precisely. Furthermore, panel data allows to study the dynamics of variation over time, whereas, for example, purely cross-sectional data only allow us to study a snapshot of the situation at a given point in time (Hsiao, 2006). Furthermore, since the aim of this study was to understand the impact of ESF-funded interventions over time in each of the EU MSs up to 2018 (including the United Kingdom), the adoption of an unbalanced panel data has deemed to be the optimal solution. The term "unbalanced" was used because it was not possible to observe all 28 countries for all years taken into consideration (2000-2018). For example, Croatia joined the European Union only in 2013 and therefore has not received any financial resources from the European Social Fund until then.

To sum up, in light of the findings emerged from the literature review of previous analyses and given the scope of this study as well as the available data, in this dissertation the statistical tool of the OLS multiple linear regression model estimation was used to assess the impact of ESF on income inequality. On the other hand, as far as the construction of the database is concerned, an unbalanced panel data was chosen.

3.2.1. OLS Multiple Linear Regression

Multiple regression analysis allows researchers to assess the strength of the relationship between a dependent variable (Y) and several predictor variables (X_k) as well as the importance of each of the predictors to the relationship. In particular, it uses several explanatory variables to foresee the outcome of a response variable on the basis of the OLS methodology, estimating namely the best fitting line throughout the data points taken into consideration.

The goal of OLS multiple linear regression is indeed to model the linear relationship between several X variables and one response variable Y, minimizing the sum of squared residuals[16] associated with the regression model (Lewis, 2012). Differently form the information that could be obtained through a correlation analysis, a regression model returns a result characterized by one-way relation, i.e. there is always one variable which is casually dependent from the other and this relation cannot be reversed.

The theoretical multiple linear regression equation is:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_k X_k + \epsilon,$$

where:

- Y is the dependent variable;
- X_k, $k = 1,2, \dots, K$, are the different explanatory variables taken into consideration;
- β_0 is the constant term, representing the intercept of the regression line with y axis;
- β_k, $k = 1,2, \dots, K$, indicate the slope coefficients; for each explanatory variable, it represents how much Y changes for each unit change of X;
- ϵ is the model's error term, namely the distance between the observed values and the regression line (the predicted values).

It is worth highlighting that in many cases simple panel OLS approaches have been judged unsatisfactory, especially if the analysis involves a large sample of countries characterized by systemic differences in their institutional or macroeconomic specificities. As a matter of fact, in these cases there may be unobserved time-invariant, country-specific heterogeneity that forces an error term relating to a same country over time being correlated, leading to biased estimates of traditional OLS method (Foster, 2021).

[16] «The residual sum of squares (RSS) measures the level of variance in the error term, or residuals, of a regression model. It is a statistical technique used to measure the amount of variance in a data set that is not explained by a regression model itself». Formula: $\sum(\boldsymbol{Y_i} - \hat{\boldsymbol{Y}})^2 = \sum \boldsymbol{e_i^2}$, where $\hat{Y}$ represents the predicted value. Retrieved at: https://www.investopedia.com/terms/r/residual-sum-of-squares.asp. Last accessed: 13/03/2022

For this reason, it is necessary to assign country-specific intercepts rather than constraint all countries to the same intercept to minimize bias due to reverse causality and omitted variables. For this purpose, a panel regression with fixed effects model was adopted.

Before analyzing the model developed specifically for carrying out this analysis, it is worth reviewing some of the key concepts for reading the results obtained from the regression.

The coefficient of determination (R^2) is a statistical metric that is used to measure how much of the variation in outcome can be explained by the variation in the independent variables. Mathematically, it can be defined as 1 minus the ratio between the unexplained variability of the regression (SSR[17]) and its total variability (TSS[18]). It is a relative measure and can assume values from 0 to 1, where 0 indicates that the outcome cannot be predicted by any of the independent variables and 1 indicates that the outcome can be predicted without error from the independent variables. It is worth highlighting that the R^2 always increases as more predictors are added to the multiple linear regression model, even though the predictors may not be related to the outcome variable. For this reason, the R^2 by itself cannot be used to identify which predictors should be included in a model and which should be excluded. Furthermore, having adopted a fixed effects model on panel data, the value we are going to take into consideration is the within R^2, indicating how much of the variance within the panel units does the model account for.

The adjusted R^2, on the other hand, is a corrected goodness-of-fit measure for linear models. It identifies the percentage of variance in the target field that is explained by the different inputs[19]. While, the R^2 tends to optimistically estimate the fit of the linear regression, always increasing as the number of effects are included in the model, the adjusted R^2 attempts to correct for this overestimation: the adjusted R^2 might indeed decrease if a specific effect does not improve the model, penalizing the excessive use of

[17] Sum of squares regression (SSR) describes how well a regression model represents the modeled data. A higher regression sum of squares indicates that the model does not fit the data well. Formula: $\sum(\hat{Y}_i - \bar{Y})^2$. Retrieved at: https://corporatefinanceinstitute.com/resources/knowledge/other/sum-of-squares/. Last accessed: 13/03/2022.

[18] Total sum of squares (TSS) is a variation of the values of a dependent variable from the sample mean of the dependent variable. Essentially, the total sum of squares quantifies the total variation in a sample. Formula: $\sum(Y_i - \bar{Y})^2$, where $\bar{Y}$ represents the mean value of a sample. Retrieved at: . Last accessed: 13/03/2022.

variables and allowing the comparison of different regression models. The adjusted R^2 statistic formula includes not only the error and total sum of squares, but also the degrees of freedom associated with each deviation:

$$Adjusted\ R^2 = 1 - \left[\frac{error\ MSE}{total\ MSE}\right],$$

where MSE stands for the mean squares of error, associated with, respectively, the SSR in the numerator and the TSS in the denominator. They are obtained by dividing each sum o squares by its respective degree of freedom (Lewis, 2012).

The Root-Square-Mean Deviation (RMSD), o Root-Mean-Square Error (RMSE), is a measure of accuracy to compare prediction errors of different models for a particular dataset. RMSD is always non-negative, and a value of 0 (almost impossible to achieve) would indicate a perfect fit to the data, namely 100% of the variability of the dependent variable is explained by the model. In general, a lower RMSD is better than a higher one. It consists in the square root of the average of squared errors. The effect of each error on RMSD is proportional to the size of the squared error, thus larger errors have a disproportionately large effect on RMSD. Consequently, RMSD is sensitive to outliers.

Finally, in order to understand if the null hypothesis can be rejected, the p-value related to variable representing the ESF effects will be analyzed. The p-value is a number describing how likely it is that the result obtained would have occurred by random chance, namely that the null hypothesis is true. The level of statistical significance is often expressed as a p-value between 0 and 1 (McLeod, 2019). The smaller the p-value, the stronger the evidence that you should reject the null hypothesis. For example, a p-value which is lower than 0.05 means that there is less than a 5% probability the null hypothesis is correct. In the results, the level of significance at which the null hypothesis can be rejected will be reported as described in the table below.

Table 3: Levels of significance

Symbol	Meaning
***	p-value = 0
**	p-value ≤ 0.01
*	p-value ≤ 0.05
.	p-value ≤ 0.1
	p-value ≤ 1

Source: own elaboration.

Finally, before introducing the model designed to test the working hypothesis discussed in this dissertation, it is appropriate to briefly describe the statistical tool adopted to perform these calculations, R. R is a programming language and free software for statistical computing and graphics used to clean, analyze, and graph data. R possesses an extensive catalog of statistical and graphical methods and it can perform, among others, machine learning algorithms, linear regression, time series, statistical inference. It is widely used by researchers from diverse disciplines to estimate and display results. In this specific case, the R "fixest" package was used for assessing the ESF impact on income inequality in the EU. This package was designed for the estimation of econometric models with multiple fixed-effects. The package includes ordinary least squares (OLS), generalized linear models (GLM), and the negative binomial. The core of the package is based on optimized parallel C++ code, scaling especially well for large data sets. The method to obtain the fixed-effects coefficients is based on Berge (2018). As already mentioned in this paragraph, the model in question is a linear one, therefore the "feols" (Fixed Effects Ordinary Least Squares) function was used[20].

3.3. The Inequality Equation

The regression model developed for this dissertation is based on the findings emerged from the study "Cross-Country Evidence of Multiple Causes of Inequality Changes in the OECD Area" (Förster and Tóth, 2015). The two scholars carried out an in-depth analysis of 48 articles published over the last 20 years aimed at identifying the main factors affecting income inequalities. From the review of the results obtained by these studies they were able to identify 6 main groups of potential key drivers of earnings and income distribution:

1. Structural macroeconomic sectoral changes
2. Globalization
3. Labour market institutions
4. Political processes
5. Redistribution
6. Demographic and structural societal changes

[20] Retrieved from: https://cran.r-project.org/web/packages/fixest/vignettes/fixest_walkthrough.html#18_Extracting_the_fixed-effects_coefficients. Las time accessed: 21/03/2022.

However, they found out that many of these studies were focused only on one or some of these groups and involved regression models considering just part of these factors. On the other hand, only few of them attempted to cover the full range of potential variables explaining changes in income distribution. For this reason, they developed a Grand Inequality Regression Equation (GIRE) encompassing all the above-mentioned areas. The regression equation used for this analysis draws on the GIRE formulated by Forster and Tóth (2015):

$$INEQ_{i,t} = \alpha + \beta \times X_{i,t} + \gamma \times Z_{i,t} + \lambda \times Q_{i,t} + \eta_i + \mu_t + \epsilon_{i,t},$$

where:

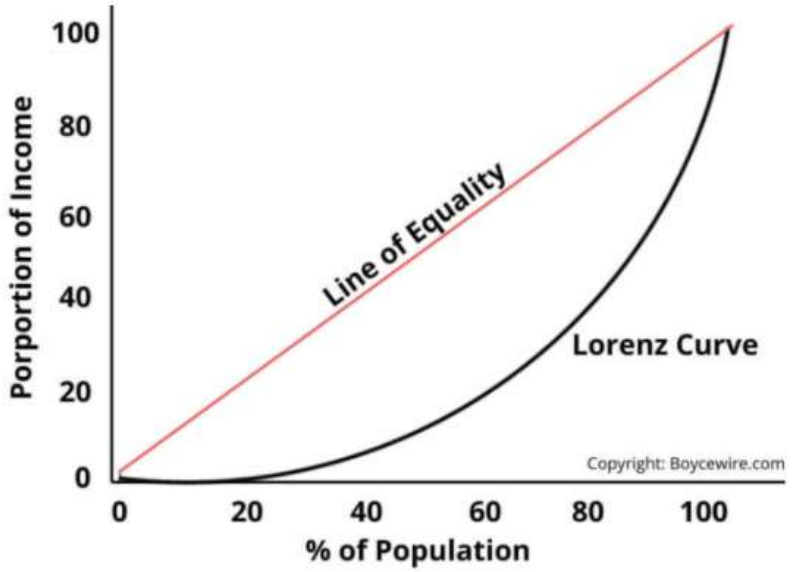
- $INEQ_{i,t}$ corresponds to a properly chosen measure of inequality of household incomes within country i at a certain point in time t. In this case the selected measure is the Gini Index.
- $X_{i,t}$ is the vector of population characteristics aggregated from individual attributes (education, sex, etc.). At the country level, these attributes define the structural conditions to inequality development in a certain country.
- $Z_{i,t}$ is the vector of macroeconomic (GDP, trade, financial globalization, technology, etc.) and institutional variables (policies, redistribution, wage-setting mechanisms, etc.). In a cross-country comparison, where the unit of analysis is country, these variables enter as attributes of the macro units (countries).
- $Q_{i,t}$ stands for the variable representing the ESF effect. In this case the ESF Modelled Annual Expenditure was taken into consideration.
- η_i and μ_t stand for the inclusion of, respectively, country and time dummies (these occasionally entail, as fixed effects, a large variety of country-specific attributes and year-specific effects).
- $\varepsilon_{i,t}$ represents the error term.

3.3.1. The Gini Index

The inequality indicator adopted as dependent variable in the regression equation was the Gini Index. The Gini coefficient compares the income distribution of a population to a perfectly equal distribution, in which every citizen of a city or country has equal income. In order to calculate the Gini Index, economists first have to find the Lorenz curve for the

population, namely the graphical representation of the distribution of income or wealth in a society. The Lorenz curve illustrates how is the actual distribution of a variable compared to a variable equally distributed across a group of elements. On the x-axis the proportion of the population, from lowest to highest income, can be found, while on the y-axis there is the cumulative percentage of income or wealth owned (Lamb, 2012). A perfectly equal society would therefore have a Lorenz distribution represented by a line with the equation $y = x$. The Gini coefficient of inequality is a statistical measure that is derived from the areas of the graph associated with the Lorenz curve.

Figure 10: Lorenz Curve



Source: https://boycewire.com/what-is-the-gini-coefficient/.

In particular, this inequality measure corresponds to the ratio between the area encompassed by the Lorenz curve and the total area under the equidistribution line (Figure 10), and allows to «*incorporate detailed variable shares data into a single statistic, summarizing the relative dispersion of a variable across the entire distribution*» (Lewis, 2012). The formula to calculate the Gini coefficient [21] is:

[21] The formula provided in the text is only one of several formulations of the Gini coefficient. There are other different equation that can be applied to calculate the Gini coefficient. For instance, sometimes the entire Lorenz curve is not known, and only values at certain intervals are given. In this case, the Gini coefficient can be approximated by using various techniques for interpolating the missing values of the Lorenz curve. «If (X_k, Y_k) are the known points on the Lorenz curve, with the X_k indexed in increasing order $(X_{k-1} < X_k)$ so that:

- X_k is the cumulated proportion of the population variable, for $k = 0, \ldots, n$, with $X_0 = 0$ and $X_n = 1$;

$$Gini = 1 - \left(\sum_{i=1}^{N} [f_i(Y_i + Y_{i-1})] \right)$$

where:

- N is the number of groups into which the elements have been sorted, in ascending order based on unique values of the variable;
- f_i stands for the frequency of the elements associated with group i;
- Y_i is the cumulative share of the variable received by elements through group i.

The Gini index is the most commonly used summary measure of economic inequality (Trapeznikova,2019), calculated by many universities, research institutes and economic organizations, and is usually available for many countries with an extended time coverage. Probably, this can be mainly attributed to the fact that it is a sufficiently simple statistic that can be effectively compared across countries and be easily interpreted. Furthermore, the Gini coefficient allows direct comparison of two populations' income distribution, regardless of their sizes (United Nation, 2015) and it is also scale independent; this means that it is not affected by the size of a country's economy, the way this is measured, or whether the country in question can be considered rich or poor on average.

Nevertheless, in order to get a clear picture of the results obtained from the statistical analysis carried out in this work, it is important to mention that this measure has some limitations. The Gini coefficient indeed does not respond in the same way to income transfers between people in opposite tails of the income distribution as it does to transfers in the middle of the distribution (Dixon, 1987). In other words, the coefficient does not capture very explicitly changes in the top 10% or the bottom 40%, where most poverty lies (Lamb, 2012). Finally, it is also important to bear in mind that very different income distributions can present the same Gini coefficient.

- X_k is the cumulated proportion of the income variable, for $k = 0, \dots, n$, with $Y_0 = 0$ and $Y_n = 1$;
- Y_k should be indexed in non-decreasing order ($Y_k > Y_{k-1}$);

the Lorenz curve is approximated on each interval as a line between consecutive points, then the area B can be approximated with trapezoids and $G_1 = 1 - \sum_{k=1}^{n} (X_k - X_{k-1})(Y_k + Y_{k-1)}$ is the resulting approximation of Gini». Retrieved at https://en.wikipedia.org/wiki/Gini_coefficient#Calculation; last accessed: 21/03/2022.

The data related to the Gini index were retrieved from the Standardized World Income Inequality Database (SWIID)[22]. The database was selected because of its wide coverage in terms of both countries and years. As a matter of fact, the SWIID was meant to overcome the limitations of existing inequality database maximizing the comparability of income inequality data while maintaining the widest possible coverage across countries and over time. In order to do so, the SWIID uses a custom missing-data algorithm to standardize thousands of reported Gini indices from hundreds of published sources – e.g. the OECD Income Distribution Database, the World Bank's PovcalNet, the Eurostat's Statistics on Income and Living Conditions, and many others.

Thanks to the exhaustivity of this database, it was not necessary to base this analysis on problematic assumptions that could have led to biased results. The SWIID currently incorporates comparable Gini indices of disposable and market income inequality for 198 countries for as many years as possible from 1960 to the present. The version adopted in this study is the 9.2 and was published in December 2021.

In the construction of the regression model, it was decided to use as dependent variable to be predicted the Gini market index, i.e. the level of inequality recorded before the redistributive action of the State takes place, and which can be significantly reduced if public action is efficient. This choice is mainly motivated by the fact that the Gini market allows us to better capture the existing income inequalities among citizens. In particular, as we have seen in the first chapter, the main ESF-funded interventions aim to:

- reduce unemployment;
- help people acquiring the skills needed to find better and better paid job;
- increase the EU citizens adaptability to the continuous changes in the labor market.

The effect that these types of interventions might have has nothing to do with the redistributive effect of the state, which is why the Gini market is the most suitable proxy for estimating this kind of effect.

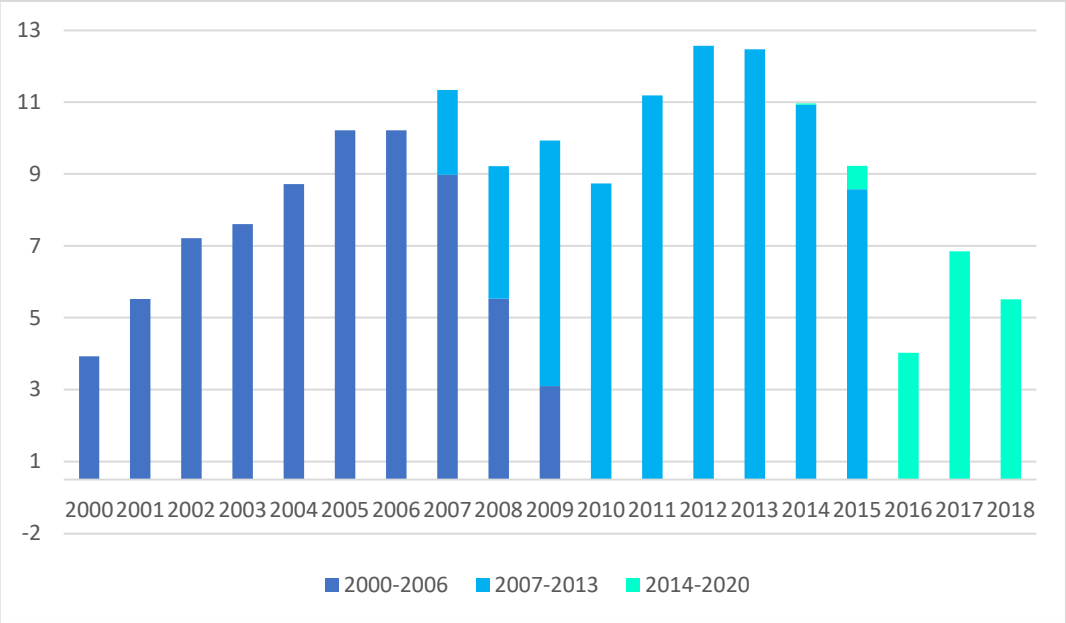
3.3.2. ESF Modelled Annual Expenditure

[22] Retrieved from: https://fsolt.org/swiid/. Last accessed the: 22/01/2022

With regards to the selection of the indicator representing the impact of the ESF, it was decided to rely on the data of the European Structural and Investment Funds (ESIF) payments 1989-2018 database published by the European Commission[23]. There are two main reasons behind the decision to use the variable available in this dataset related to the EU payments rather than other databases containing sometimes more detailed information on the physical and financial implementation of the various programmes financed under the ESF:

- This dataset is the only one aggregating the financial resources of the different budget periods and it makes possible to observe how funding from the 2000-2006, 2007-2013 and 2014-2020 periods arrived on the ground through a fairly continuous flow even during the transitional years (Figure 11).
- The extensive time coverage of the data, which has no equal with the other databases describing the financial performance of the Cohesion Policy Operational Programmes.

Figure 11: 2000-2006/2007-2013/2014-2020 real expenditure of resources 2000-2018 (EUR billions of EUR)



Source: own elaboration on data provided by https://cohesiondata.ec.europa.eu.

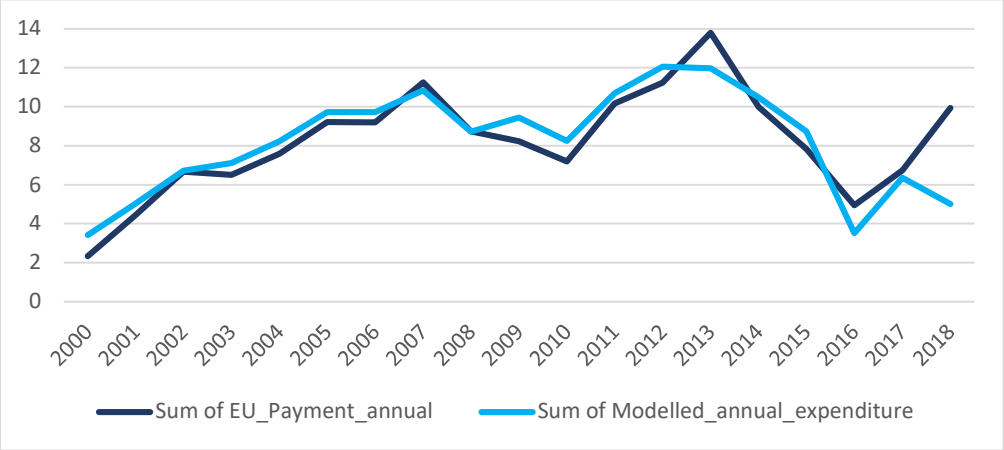
In particular, for the purposes of this study, a specific variable, the Modelled Annual Expenditure relating to payments made by the European Social Fund, was taken into

[23] Retrieved from:https://cohesiondata.ec.europa.eu/Other/Historic-EU-payments-regionalised-and-modelled/tc55-7ysv. Last accessed the: 23/12/2021

account. Over the programming periods, EU payments refer predominantly to reimbursement of expenditure actually incurred, namely they were made by the European Commission (EC) after the actual spending by the final beneficiaries has taken place on the ground. As a result, using the data of EU payments for carrying out an economic analysis may distort the effect to the investments and reveal biased results. This characteristic may negatively affect the analytic works carried out by the experts to assess the policy effectiveness or to run counterfactual impact evaluations estimating the effects of the varying intensities of the EU funds on regional growth variables.

Since this misalignment between the Commission reimbursement cycle and the date of the interventions on the ground may represent a criticality for many studies, the EC decided to commission a treatment of the EU payments figures to develop a more realistic estimate of the annual profile of real expenditure. The Commission tasked the University of Bergen to undertake this work for modelling the real annual expenditure on the ground, and to test the robustness and sensitivity of assumptions used[24]. The study "Regionalisation of ESIF payments 1989-2015" was eventually published in 2017 and several tasks have been performed in order to elaborate a sound and robust algorithm – e.g. modelling and literature review, robustness and sensitivity analysis, and data estimation. As can be observed in the graph below, real payments obtained from the algorithm typically take place earlier than the EU payments.

Figure 12: EU Annual Payments vs. Modelled Annual Expenditure 1986-2018 in billions of EUR



Source: own elaboration on data provided by https://cohesiondata.ec.europa.eu.

[24]Retrieved from: https://cohesiondata.ec.europa.eu/Other/Historic-EU-payments-regionalised-and-modelled/tc55-7ysv. Last accessed the:23/12/2021

The Open Data platform[25] currently provides access to unique data on the monitoring of investment plans, implementation and achievements of a significant share of the 2014-2020 EU Budget delivered through Cohesion policy funds (ERDF, ESF, CF), the EU Agricultural and Rural Development Fund (EAFRD), the EU Maritime and Fisheries Fund (EMFF). The "Historic EU payments – Regionalised and modelled" dataset used in this study, containing the comprehensive historical record of EU budget payments from the Cohesion funds to the Member States and NUTS-2 regions, was published in in April 2018 and then updated in May 2020.

3.3.3. Main inequality drivers

Finally, indicators representing the main drivers of inequality were included in the model as control variables. Control variables are properties that researchers hold constants for all observations in a statistical model. While these variables are not the primary focus of the research, keeping their values consistent helps the study to establish the true relationships between the independent and dependent variables that are to be observed[26].

For each of the areas listed above, specific measures have been identified to represent their impact on economic inequality. The literature review of the economic theory was useful to understand which, according to the economists, are the main causes of economic inequality and which were the most used regressors in the models built in previous studies.

In this section, all the adopted control variables – grouped by area of focus – will be listed. Then, the relationship we expect to observe between these variables and income inequality on the basis of economic theory will be briefly described, and finally the main sources where the data were collected will be illustrated.

3.3.3.1. Structural macro-economic changes

The two phenomena that were taken into account among those that can be classified as structural macro-economic changes were economic development and unemployment. The choice was dictated by the fact that the nature of the relationship between these two structural conditions and income inequality has long been the subject of considerable

[25] https://cohesiondata.ec.europa.eu/
[26] https://statisticsbyjim.com/basics/control-variables/. Last accessed: 12/02/2022.

debate, and from the literature review emerged that these two elements play a role in shaping income inequality. Most observers consider unemployment and inequality to be closely related. In particular, the economic crisis has shown that high unemployment increases inequality, with declining employment opportunities for the least skilled and a wider dispersion of earnings (ILO, 2015). While, on the other hand economic growth no longer seems to be associated with improved equality since strong economic development may coexist with persistent labour underutilization and rising inequality (Monfort et al., 2018).

For a long time, the quest to identify driving factors of inequality looked primarily at the association with the economic development and was focused on testing the hypothesis that Kuznets (1955) put forward. In the 1950s and 1960s, he hypothesized that as an economy develops, market forces first increase then decrease the overall economic inequality of a society, and this could be illustrated by the inverted U-shape of the Kuznets curve (McKeever, 2017). This is linked to a sectoral move from a more traditional sector, such as agriculture, to a modern sector requiring higher-skilled workers, such as industry. Insofar as the traditional sector is less productive and generally require lower-skilled workforce, it will provide lower wages than the modern sector. Furthermore, it is also expected that the traditional sector has lower inequality within it. Consequently, on the basis of this theory is assumed that development first increases and subsequently decreases inequality (Forster and Tóth, 2015). Usually, economic development is proxied by real income or GDP per capita.

With regards to unemployment, several empirical studies have documented the existence of a positive correlation between income inequality and unemployment. However, the literature on income distribution still lacks theoretical formalizations able to deliver such a result (Cysne, 2004). Among the various scholars who have come to the conclusion that higher levels of unemployment have a major impact on income distribution by increasing inequality there are Blinder and Esaki (1978), Mirer (1973) and Budd and Whiteman (1978). For example, Nolan (1986) measured the impact of changes in the level of unemployment on the UK size distribution of annual income using cross-sectional data from the Family Expenditure Survey. He documented that unemployment led to a shift in the shape of the income distribution, with a rise in the top decile – in this case the effect of unemployment on income distribution resulted to be quite relevant. In South America,

Cardoso (1993) and González (2000) achieved similar results: they found the same positive correlation when studying, respectively, data of Brazil in the '80s and Argentina in the '90s.

The data related to Real GDP per capita and the Unemployment rate (%) were provided by EUROSTAT[27,28].

3.3.3.2. Globalization

Globalization is a multifaceted concept, and for this reason it was decided to use the overall KOF index of globalization to quantify its impact[29]. The KOF index aggregates 23 variables to an overall index on a scale of one to hundred, where higher values denote greater globalization. The index encompasses economic, social, and political dimensions of globalization covering 122 countries and it has been used in hundreds of studies (Dreher, 2006). It was conceived by Axel Dreher at the Konjunkturforschungsstelle of ETH Zurich, in Switzerland, and was first published in 2002. The index actually covers a period of time going from 1970 to 2018; new versions of the data were published in 2017, 2018 and 2019[30].

The Heckscher-Ohlin model is the classical theoretical framework used to explain the relationship between globalization and distributional market outcomes. In particular, the Stolper-Samuelson theory included in this model emphasizes that trade in goods which are heterogenous in capital intensity creates winners and losers from globalization, altering the relative return to factors of production. Specifically, the Stolper-Samuelson mechanism predicts that global integration increases income inequality within developed countries where capital and skilled labor are relative abundant. In these countries, opening up to trade would lead to greater concentration towards the top incomes, increasing the remuneration of the abundant production factors and creating a greater internal gap. By contrast, globalization is expected to decrease inequality within developing countries, where unskilled labor that is intensively used in local production would instead benefit from economic openness by increasing wages.

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[27] https://ec.europa.eu/eurostat/web/products-datasets/-/sdg_08_10. Last accessed: 22/12/2021.
[28] https://ec.europa.eu/eurostat/en/web/products-datasets/-/TIPSUN20. Last accessed: 22/12/2021.
[29] https://kof.ethz.ch/it/previsioni-indicatori/indicatori/kof-globalisation-index.html. Last accessed: 17/03/2022.
[30] https://kof.ethz.ch/it/previsioni-indicatori/indicatori/kof-globalisation-index.html. Last accessed: 17/03/2022.

Several theoretical contributions, however, have shown shortcomings of the Stolper-Samuelson assumptions and have provided various potential channels and implications on how globalization shapes income inequality. The link between globalization and inequality has been analyzed in many empirical studies during the last decades and what emerged from their experience was mainly that, the results obtained differ depending on the measures of globalization and income inequality adopted and the sample of countries examined. However, the majority of studies using the Gini coefficient as the inequality measure report a positive relationship between globalization and income inequality (Dorn et al., 2017).

It is important to bear in mind that the KOF index was chosen to carry out this analysis in an attempt to include in the model the complex phenomenon of globalization in its wholeness; the main aim was taking into account the various repercussions that this process could have on income distribution, and not just those purely related to the economic sphere and in particular to the trade openness. There are other more social, political and cultural aspects which would also merit consideration (Forster and Tóth, 2015).

In a study commissioned by the European Commission "Globalization and Income Inequality Revisited", where the KOF index was adopted as measure of globalization, the results confirmed the previous findings that income inequality and globalization are positively correlated within countries. From the analysis of this sample covering 140 countries, both developed and developing, over the period 1970-2014 they observed that this positive relationship is mainly driven by export openness, FDIs and social globalization. The significance of the positive relationship holds within the full sample of countries and the sample of emerging markets and developing economies. For the most advanced economies the results do not suggest that globalization and income inequality are positively correlated.

3.3.3.3. Politics, political processes and labour-market institutions

In order to develop an accurate model involving most of the factors considered in the literature as main drivers of inequality, it is crucial to take into account the effect of political dynamics on income distribution. As institutional variable, representing the type

of political regimes in place in different countries and the resulting policies, the Economic Freedom Index by the Heritage Foundation[31] was selected.

The index value is calculated, for 184 countries, on the basis of 12 quantitative and qualitative factors, grouped into four broad categories, or pillars, of economic freedom:

1. Rule of Law (property rights, government integrity, judicial effectiveness)
2. Government Size (government spending, tax burden, fiscal health)
3. Regulatory Efficiency (business freedom, labor freedom, monetary freedom)
4. Open Markets (trade freedom, investment freedom, financial freedom)

Each of the twelve economic freedoms within these categories is graded on a scale of 0 to 100. In general, a positive correlation between the Economic Freedom Index and the Gini coefficient is expected to be found. More market-oriented policies are, for example, expected to be correlated with globalization and inequality. While, higher regulated labor markets might promote equality at the expense of globalization and growth.

In a recent study published by the University of Cambridge in collaboration with Universiti Teknologi MARA Malaysia (Ahmad, 2017), it was found out that the estimated size of inequality-increasing effects of economic freedom is substantial, ranging between 0.3% and 0.5% annually. The analysis was carried out using the latest inequality data from version 5.0 of the SWIID database for a sample of countries up to 115 over the 1970-2014 period. It is worth mentioning also that the results obtained indicate that freedom-induced inequality is attenuated in case a sate present a highly democratic regime.

Another aspect described by the Economic Freedom index that is important to explore in this context is that of Labour Freedom. In several studies, it has been reported that greater labour market deregulation has led to an increase in income inequality. The labor freedom component of the Economic Freedom Index is a quantitative measure that considers various aspects of the legal and regulatory framework of a country's labor market, including regulations concerning minimum wages, difficulties of firing redundant employees, severance requirements, and measurable regulatory restraints on hiring and rigidity of hours worked.

[31] https://www.heritage.org/index/about. Last accessed: 18/03/2022.

According to an OECD report (2011), decline in employment protection and the weakening of the system of labour relations contribute to a shift bargaining power away from workers and towards firms. This phenomenon is widely seen to have played an important role in increasing earnings dispersion, a shift from labour to capital, and rising income inequality. Furthermore, these dynamics are also influenced by labour market regulations, the system of labour relations, and prevailing social norms which are at the basis of the labor market as social institution (Solow, 1990). In light of this, it is useful considering that the labour markets have been subject to important changes over recent decades with structural reforms aimed at increasing their flexibility. This situation placed this issue at the centre of national and international debates, especially in the European Union (Nolan et al., 2019).

3.3.3.4. Redistribution

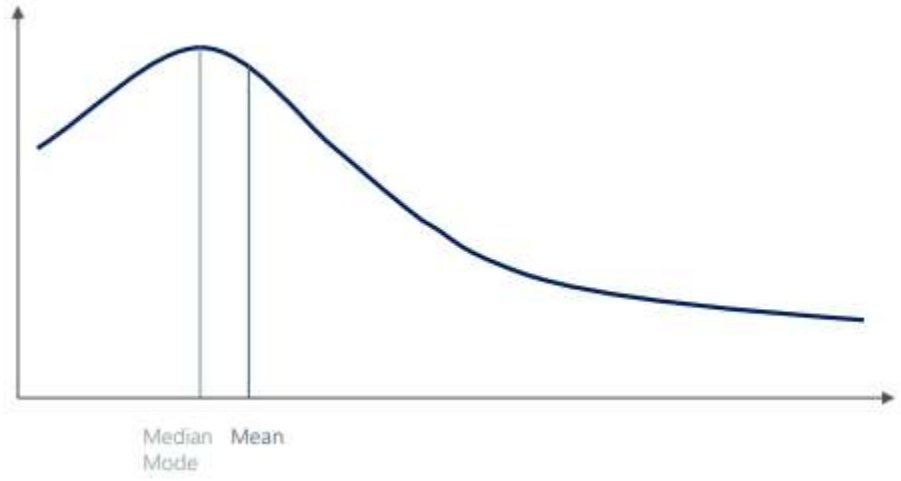
Another key factor which, according to previous studies, seems to significantly affect the distribution of income within a population is the redistribution of market income by the state via taxation and social expenditure. However, even if it is still offsetting some of the increase in inequality in market incomes among households, the effectiveness of direct taxes and transfers has been shown to have often weakened in the last decades (Nolan et al, 2019).

In order to obtain information related to redistribution, the mean and the median, representing the central tendency of the equivalized net income distribution of the different MSs, were taken into account. The data were retrieved from the EU-SILC database[32]. Specifically, the ratio between mean and median was included in the regression. This statistic provides additional information on income distribution in the EU MSs, allowing to better understand the structure of the inequality characterizing the different countries. From a policy-making perspective, it is indeed extremely important to understand to what extent the wealth of a country, even after the redistributive effect of taxes, is concentrated in the hands of a few people, so as to be able to formulate more effective policies.

[32] Retrieved from: https://ec.europa.eu/eurostat/web/microdata/european-union-statistics-on-income-and-living-conditions. Last accessed the: 15/02/2022

In general, if the ratio of the mean to the median of an income distribution increases, it means that the rich are getting richer. This is graphically manifested by an elongation of the right tail of the distribution, while the hump is shifted to the left, namely a positively skewed distribution (Figure 13). This occurs when the outliers lays in the upper end of the distribution pulling the arithmetic mean above the median (and mode). For this reason, when this ratio increases, it is clear that a more immediate and active redistributive action by the State is necessary. On the other hand, in contexts where the ratio decreases, this situation is very likely to be representative not only of a more effective state intervention, but also of a reduction of market inequality,

Figure 13: Positively Skewed Distribution



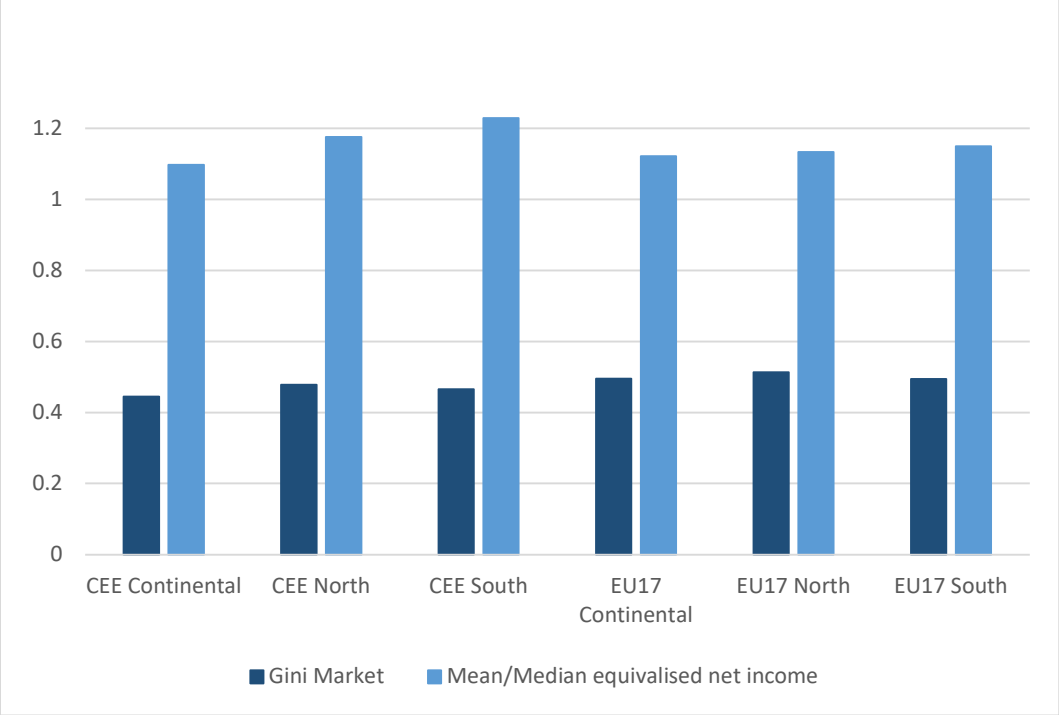
Source:365DataScience.

A positive correlation is expected to be observed between the Gini market and the ratio of the mean to the median equivalized net income because: (i) an increase in the ratio is symptom of increased inequality; (ii) the fast pace of increase of income inequality observed in the last years exceeded the increase of redistribution over the same period.

In the graph below the Gini market and the ratio of the mean to the equivalised net income distribution in 2018 were placed in contrast. The highest level of inequality can be observed in the EU North countries (Gini market coefficient 0.5) even this is partially compensated by a good redistribution system, since the ratio observed is quite lower if compared to the other groups of MSs (1.13). On the other hand, the less effective redistribution systems appear to be in the countries of the CEE South group. As a matter of fact, even inf the market inequality is less pronounced than in other geographic

groupings (0.47), the ratio between the mean and median of the net equivalized income is the highest (1.23).

Figure 14: Gini Market vs. Mean/Median equivalised net income (2018)



Source: own elaboration

Another implication of tax redistribution which is worth highlighting is linked to the effect the electoral turnover might have on income inequality. The mobilization of voters turned out to be a crucial issue in how inequality translates into politics of redistribution (Pontusson and Rueda, 2010). Political inequality (at least in terms of participation in elections) may play a major role in policy formation, since the low-income voters who might be motivated in larger redistribution may not be sufficiently activated during elections, redistribution might be lower than predicted by the inequality level. In 2013, Mahler and Jesuit (2013) carried out a study exploring the relationship between political participation and income redistribution in high-income countries, with particular focus on middle-income groups. The study showed that political participation (most notably union density) is positively related to redistribution, especially when the share gains of the lower middle classes are considered. It extended the previous researches on the topic by measuring the income skew of the electoral turnout as a proxy for its income bias and emerged that, controlling for a number of other variables, the income skew of turnout is negatively related to transfer redistribution and that electoral participation by those in poverty is positively associated with redistribution in their favor.

3.3.3.5. Demographic and other microstructural changes

When it comes to demographic and other microstructural changes, education and female employment were included in the regression as control variables – indeed, research often emphasizes human capital as one of the major factors affecting the degree of income inequality.

Human capital, measured by the educational attainment embodied in a worker, is considered to be a major determinant of the worker's lifetime earnings. The education expansion is often seen as an important policy instrument for combating rising income inequality over the medium term. As a matter of fact, a more widespread education is not only important for promoting economic growth, but it can also help to break the intergenerational transmission of poverty and reduce inequality of opportunity which in turn reduces future income inequality (Coday and Dizioli, 2017).

The standard theoretical framework for analyzing the relationship between education expansion and income inequality is the traditional human capital model. The human capital model suggests that the level and distribution of schooling across the population determines the distribution of earnings (Becker and Chiswick, 1966). Hence, the model predicts that the supply and demand of educated people influence income inequality in a society. However, while the model predicts an unambiguously positive association between educational inequality, the effect of the average years of schooling on income inequality may be either positive or negative, depending on the evolution of the rates of return on education (Lee and Lee, 2018).

In the study "Human Capital and Income Inequality" (Lee and Lee, 2018), different regression models using a panel dataset covering a broad range of countries between 1980 and 2015 were analyzed. The results show that a more equal distribution of education contributes significantly to reducing income inequality. Reduced educational inequality turned out to be an important factor that counterbalanced income-unequalizing forces – e.g. trade expansions and rapid technological progress – over the period taken into consideration.

The indicator adopted to gauge the educational level of citizens in the different EU Member States was "population by educational attainment level, sex and age (%)". The indicator counts the percentage of the MSs population in upper secondary, post-secondary non-tertiary, and tertiary education out of the total population. The data were retrieved from EUROSTAT[33].

Similarly, data on female employment have also been collected by EUROSTAT. The increasing female labor force participation has been one of the most remarkable economic developments of the last century. In his LIS-based analysis of 18 rich countries, Brady (2006) tested the effect of various structural factors on the lower tail of the income distribution. He found out that an increase in employment in general, and female employment in particular, reduces income poverty. After having controlled the effects produced by other institutional (welfare state variables) and economic factors, the increased female employment was found to be the largest single item with the largest poverty-reducing impact.

With regards to the effect of an increased female employment level on income distribution, Susan Harkness in her "The Contribution of Women's Employment and Earnings to Household Income Inequality: A Cross-Country Analysis" (2010) investigates the relationship between these 2 elements using micro-data for seventeen OECD countries. From the results she obtained it is possible to observe how in all countries female earnings exert an equalising force on the distribution of income in spite of large employment gaps between high and low educated women. The study also revealed marked similarities across countries. For instance, even in Nordic countries where employment rates are high, female earnings comprise a small proportion of the family budget and single women, employed or not, are overrepresented in the bottom of the income distribution.

[33] Retrieved from: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Educational_attainment_statistics. Last accessed: 17/12/2021.

4. ANALYSIS OF THE RESULTS

In this chapter, the results obtained from the various regressions carried out will be presented and commented on. In particular, the results of four different regressions will be analysed. The models are presented in incremental order of complexity, starting with the simplest model including 5 explanatory variables and ending with a more complex model characterized by 8 regressors. All the regression model have inequality as the dependent variable, proxied by the Gini Market coefficient, and as main-effect independent variable the ESF Modelled Annual Expenditure. Additional control variables are increasingly added to the main estimation model; the 4th multiple regression model is the most detailed and exhaustive.

The chapter is divided in 2 sections:

1. "ESF and Income inequality correlation", where a simple analysis of the correlation coefficient is carried out.
2. "Regression Results", where all the results obtained by the OLS multiple regressions are illustrated.

4.1. ESF and Income Inequality correlation

Before analyzing in detail the results obtained from the various regression models, a first general analysis of the correlation coefficient between the two variables, ESF Modelled Annual Expenditure and Gini Market, has been carried out. The correlation coefficient between the 2 variables turned out to be 0.28, denoting that an in increase in the amount of resources issued under the ESF would make inequality level rise. This result would not allow to reject our null hypothesis, since what is expected is that the ESF intervention will contribute to the achievement of a major equality among citizens supporting major employment, gender equality and social inclusion.

Furthermore, in order to obtain a greater level of detail of the potential relationship existing between ESF financial resources invested and economic inequalities, the correlation coefficient was calculated per each country.

As can be seen from the table below, the relationship between the two variables is particularly heterogeneous among EU MSs. In fact, the correlation coefficient ranges from 0.66 in Slovenia to a negative coefficient of - 0.56 in Ireland. An observation which is worth highlighting is that a strong positive correlation is denoted for the countries which have entered the EU after 2004. This can be assumed as indicative of the fact that the effect of the EU investments has not started having an effective impact on this structural internal problem yet. However, looking at Table 4, where the countries are arranged in ascending order on the basis of coefficient of correlation, it is possible to notice how the EU15 countries, with few exceptions, are all in the center of this distribution. EU15 countries are mainly characterized by weak negative, absent or weak positive correlation. On the other hand, the EU13 countries exhibit contrasting correlation coefficient.

Table 4 Correlation coefficient btween Modelled Annual Expenditure and Gini market in all the EU 28 MSs

Country	Category	Correlation Coefficient
Ireland	EU15	-0.555
Poland	EU13	-0.542
Slovakia	EU13	-0.541
Spain	EU15	-0.363
Czech Republic	EU13	-0.360
Sweden	EU15	-0.322
Austria	EU15	-0.298
Estonia	EU13	-0.217
Belgium	EU15	-0.211
Portugal	EU15	-0.205
Denmark	EU15	-0.150
Finland	EU15	-0.079
Italy	EU15	-0.026
Germany	EU15	0.009
France	EU15	0.041
Luxembourg	EU15	0.068
Netherlands	EU15	0.078
Croatia	EU13	0.388
Greece	EU15	0.446
Cyprus	EU13	0.479
Bulgaria	EU13	0.488
Romania	EU13	0.541
Hungary	EU13	0.564
United Kingdom	EU15	0.564
Latvia	EU13	0.568
Malta	EU13	0.639
Slovenia	EU13	0.662

Lithuania	EU13	0.702

Source: own elaboration.

4.2. Regression Results

In this section, the results obtained by the different specifications of multiple regression models will be illustrated. The tables below report the results of each regression from where it is possible to infer the contribution the key independent variable, the ESF Modeled Annual expenditure, gave to the model. In particular, for each of the specifications the results with and without taking into account the ESF effects are showed.

Table 5: Regression Model 1

Generalities	w/o ESF	With ESF
Dependent Variable	Gini market	Gini market
N. Observations	425	425
Adjusted R^2	0.947689	0.949289
Within R^2	0.406991	0.426651
RMSE	0.71221	0.700305
Fixed Effects		
Country	28	28
Year	18	18
Coefficients		
Modelled Annual Expenditure (ESF)		-0.000709*
Real GDP per capita	0.000045**	0.000045**
Unemployment	0.196542***	0.190124***
Education	-0.070445*	-0.069780*
Inequality ratio	14.774979**	14.296051**

Source: own elaboration.

In the first regression model, including the independent variables Unemployment, Education and the Inequality ratio, the R^2 determination coefficient stands around 95% and the within R^2 is 41%. The coefficient of the variable Real GDP per capita is positive and consequently denotes a positive correlation with the dependent variable Gini Market. The p-value of the coefficient is less than the conventional confidence level of 5%, therefore the estimate is statically significant. Similarly, the estimated coefficient for the unemployment variable suggests a positive correlation with Gini Market. Also, for the

latter the coefficient is different from 0, so it is possible to reject the null hypothesis. The estimates of the Inequality ratio coefficient are the same as the previous one. The education variable, on the other hand, presents a negative correlation with Gini Market and the coefficient is statistically significant (p-value less than 5%).

In the subsequent estimation, by adding the MAE ESF regressor representing the effect of the ESF spent resources, the considerations on the other regressors do not change and the model improves its predictive capacity obtaining an adjusted R^2 slightly higher than the previous one and a within of 43%. The estimated coefficient of the MAE ESF variable turns out to be negative and statistically significant at 5%. Furthermore, in the with-ESF model a decreased $RMSE$ value is observed.

Table 6: Regression Model 2

Generalities	w/o ESF	With ESF
Dependent Variable	Gini market	Gini market
N. Observations	425	425
Adjusted R^2	0.951572	0.952642
Within R^2	0.452468	0.46599
RMSE	0.684356	675853
Fixed Effects		
Country	28	28
Year	18	18
Coefficients		
Modelled Annual Expenditure (ESF)		-0.000592 .
Real GDP per capita	0.000037**	0.000037**
Unemployment	0.158703***	0.155751***
Education	-0.129871**	-0.125535**
Inequality	13.742145**	13.407963**
Female Employment	0.333108*	0.311917*

Source: own elaboration.

By adding the variable Female Employment to the model, the sign of the coefficients in the regression with and without ESF do not change compared to regression 1. The estimation of the Female Employment parameter shows a positive relationship with Gini

Market. Furthermore, we also observe that the parameter is statistically different from zero. In the above regressions, in which the Female Employment variable is added, an improvement in R^2 and within R^2 is obtained despite the fact that the estimated coefficient is different from the expected one according to economic theory. Moreover, in the model including ESF the other regressors do not change their statistical significance. Therefore, the coefficients for the variables Real GDP per capita, Inequality ratio, Unemployment and Female Employment are to be considered significant and positively correlated with the dependent variable, while the coefficient for the variable Education is significant and negatively correlated as in regression 1. The same considerations apply to the regression including the ESF regressor.

The explanatory power of the entire model by including the variable female employment improves the within R^2, which passes from 45% to 47%. Finally, in regression 2 it can be noticed that the adjusted R^2 of the with-the-ESF model increases compared to the regression excluding the ESF Modelled Annual Expenditure, thus suggesting the contribution of this variable to the model results.

Table 7: Regression Model 3

Generalities	w/o ESF	With ESF
Dependent Variable	Gini market	Gini market
N. Observations	411	411
Adjusted R^2	0.949343	0.950268
Within R^2	0.459554	0.470901
RMSE	0.647007	0.640179
Fixed Effects		
Country	27	27
Year	18	18
Coefficients		
Modelled Annual Expenditure (ESF)		-0.000515.
Real GDP per capita	0.000035*	0.000035*
Unemployment	0.143364***	0.143596***
Education	-0.148696***	-0.142831***
Inequality ratio	12.036785**	11.848593**

Female Employment	0.365489*	0.348527*
Economic Freedom	-0.000081	0.008439

Source: own elaboration.

In the third regression model, the Economic Freedom Index is included and it is possible to observe a decrease in both the R^2 and within R^2 values compared to the specifications previously considered. As a matter of fact, the estimated coefficient of the regressor is not statistically different from zero in both versions of the model (with and without ESF).

Moreover, in the model including ESF the other regressors change their statistical significance. Thus, the coefficients for the variables Real GDP per capita, Inequality ratio and Female Employment remain significant and positively correlated with the dependent variable, while the coefficient for the variable ESF remains significant at 10% and negatively correlated. Finally, in regression 3 we can see that the gap between the within R^2 of with ESF and w/o ESF decreases, suggesting that the model is reaching a good degree of predictivity.

Table 8: Regression Model 4

Generalities	w/o ESF	With ESF
Dependent Variable	Gini market	Gini market
N. Observations	411	411
Adjusted R^2	0.950832	0.951692
Within R^2	0.476893	0.487472
RMSE	0.636544	0.630074
Country	27	27
Year	18	18
Modelled Annual Expenditure (ESF)		-0.000498.
Real GDP per capita	0.000035*	0.000036*
Unemployment	0.147524***	0.147657***
Education	-0.138023**	-0.132593**
Inequality ratio	11.437289**	11.268694**

Female Employment	0.351858*	0.335773*
Economic Freedom	0.008091	0.016141
Globalization	-0.124346*	-0.121610*

Source: own elaboration.

In the regression above, in which we add the variable KOF index, we obtain a little improvement of R^2 and within R^2 compared to regression 3, and the estimated coefficient of the regressor is statistically different from zero in both versions of the model (w and w/o ESF). Globalization turns out to be negatively correlated with inequality at a significance level of 5%. The other regressor coefficients keep the same signs and remain significant except for the Economic Freedom index as observed in the previous model.

To sum up, the null hypothesis can be rejected since in all the models the MAE ESF regressor was found to be statistically significant. Precisely, in models 1 and 2 we can support at the 95% the hypothesis that the European Social Fund contributes to the decrease in the level of inequality within the EU member states. However, as the complexity of the model increases (regression 3 and 4), this level of significance decreases and it is possible to reject the null hypothesis only at the 90%. Finally, the regression coefficient of the ESF variable assumes a negative value in all the 4 model even if it reveals only a small-scale effect on the determination of the inequality level.

5. CONCLUSION

This dissertation contributes to its field of research by providing new insights into the relationship between the Cohesion Fund and income distribution within EU Member States, focusing on the contribution of the ESF to counteract inequality within countries. The working hypothesis that the European Social Fund expenditure is reducing inequalities within Member States at national level cannot be rejected. All the 4 regression model specifications (the 1st and the 2nd at a 5% significance level, whereas the 3rd and the 4th at the 10%) confirmed a negative correlation between income inequality and the ESF modelled annual expenditure. This means that an increase in the ESF payments by the EU would result in a reduction of the Gini market coefficient, therefore contributing to narrowing the gap between citizens belonging to different income levels. On the basis of these results, increasing ESF budget or investing more financial resources in the typology of interventions sustained by the ESF could be effective in reducing inequalities. Furthermore, the wage benefits, the productivity enhancing and the skills development effects associated with ESF interventions not only contribute to income redistribution, but are also pivotal to boost inclusive and sustainable economic growth and social development of EU Member States. Indeed, most of the EU labour markets are still characterized by pronounced earnings inequality which, as the regressions results revealed, can be mainly attributed to the different educational background and wealth of households as well as to the unemployment level. In recent years, the European Union has undergone a period of repeated financial crises and recessions, income and employment asymmetries within Member States and European regions have increased, exacerbating social tensions and political risks. Moreover, in 2020, the health emergency generated by the Covid-19 pandemic led to a severe economic crisis forcing the adoption of emergency measures with profound social repercussions. In this context, policy-makers should attempt to maximize the potential redistributive effects of the ESF, through combined use of the Cohesion Funds in the attempt to address social inclusion and cohesion issues through integrated strategies instead of sectoral policies. Likewise, the development of synergies with other EU policy instruments in the area of social affairs are important to implement an integrated approach producing major benefits, mitigating the economic and social impact of the Covid-19 pandemic and

making European economies and societies more sustainable and resilient. This point is especially important now with the allocation of resources made available by the temporary instrument NextGenerationEU, where almost EUR 800 billion have been earmarked to strengthen cohesion and resilience between EU Member States, mainly through the Recovery and Resilience Facility (RRF) and React-EU (European Commission, 2021).Finally, a major coordination in the relevant policy areas will be ensured during the 2021-2027 programming period through the creation of the ESF+, gathering together 4 different financial instruments that were separated during the 2014-2020 period, namely the European Social Fund (ESF), the Fund for European Aid to the most Deprived (FEAD), the Youth Employment Initiative, and the European Programme for Employment and Social Innovation (EaSI). The merge of these funds is intended to strengthen synergies and avoid duplication and overlaps while enabling a more integrated and targeted support to respond to the social and labour market challenges that people in Europe face today.

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