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Bachelor Thesis Economics and Business Economics

The effect of the 2007-2008 crisis on income inequality in EU countries.

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1: Introduction

1.1: Inequality

"A nation will not survive morally or economically when so few have so much, while so many have so little." These were the striking words of US Senator Bernie Sanders. This statement represents the world we live in and the one we will end up living in in the future.

Bernie Sanders talked about the United States of America, where income inequality is becoming a large problem. Income inequality in the United States is growing. The difference between the 'haves' and 'have nots' is getting more significant over time. An estimated Gini coefficient of around 0.43 makes the United States one of the most unequal countries in the western world.

The debate on income inequality has been going on for decades, but since Thomas Piketty's book: Capital in the 21st Century (2013), the topic has become more relevant than ever before. It was the first time that ground-breaking economic literature on income inequality was read by so many non-economists.

The main takeaway is that the wealth of the top 1 per cent, is increasing two to three times quicker than the overall economy's growth rate (GDP). At the same time, the median income worker received virtually no gains from increased productivity. Furthermore, workers who fall below median income have dramatically cut their share of national wealth and income.

In one of Piketty's most famous articles, he finds that the top 0.1 per cent income share in the United States has been growing since the late seventies until 2000 (Piketty & Saez, 2003). The paper also shows a decline in income inequality the moment the Second World War shock hit. This was not only experienced in the US, but also in European countries like France (Piketty, 2003).

Although there is plenty of scientific literature on income inequality, there is a lot less on the effect of economic shocks on income inequality. The existing research is often conducted in reverse, in other words: the effect of income inequality on an economic shock.

Obviously, there is more data on 20^{th}-century income inequality than on 21^{st}-century income inequality. Therefore, the research is often conducted on income inequality in the 20^{th} century. This research is often conducted using United States' data. Therefore, it is even more interesting and scientifically relevant to focus on income inequality in Europe.

Furthermore, large shocks such as the Wall Street stock market crash in 1929, the two World Wars and the booming economy in the 1950's offer interesting events for research, among many others.

Overall, there is relatively little research into income inequality in the 21st century, especially into the effect of economic shocks on income inequality in the 21st century. This makes research into the effect of an economic shock on income inequality in the 21st century an interesting and scientifically relevant topic. This is especially the case when the research covers Europe rather than the United States, because, as mentioned, there is more research about income inequality in the US than in Europe.

1.2: The 2007-2008 financial crisis

This paper will focus on the effect of one of the biggest economic shocks of the last decades, the 2007-2008 financial crisis[1].

The crisis started when the Federal Reserve in the United States of America stimulated the struggling economy by cutting interest rates at the beginning of the first decade of 2000. The booming economy led to an increase in demand for homes. Subsequently, the lending standards for some lenders became increasingly relaxed; it sparked the creation of the so-called 'NINJA loan': no income, no job, no asset—no problem. It comes as no surprise that investment firms were eager to buy these loans.

The recession began when the housing market started to crash, borrowers could not pay back their loans, and banks were suddenly saddled with loan losses on their balance sheets.

1.3: Research questions

This paper will focus on the income groups' suffering or gaining the most from the financial crisis in the EU. The main research question is therefore defined as follows:

"What was the impact of the financial crisis on income inequality in Europe?"

In order to better understand the results, this thesis will also answer the following sub-questions:

- *Does more economic prosperity lead to less income inequality?*
- *Does government social spending have a significant negative effect on income inequality?*

[1] Hereinafter referred to as the financial crisis.

1.4: Hypotheses

The main question and sub-questions lead to the following hypotheses:

- Income inequality rose as a result of the financial crisis.
- More economic prosperity leads to less income inequality.
- Government social spending has a negative impact on income inequality.

1.5: Paper structure

The paper is structured as follows: Section 2 discusses the existing literature, Section 3 describes the data, Section 4 describes the methodology, Section 5 contains the results, Section 6 contains the conclusions. The appendices can be found in Section 7.

2: Literature review

2.1: Impact of income inequality on economic shocks

Empirical evidence on economic shocks and income inequality is often conducted the other way around: does income inequality lead to economic crises?

Stockhammer finds that income inequality may contribute to the development of a crisis (Stockhammer, 2013). In particular, Stockhammer suggests that income inequality is a cause of the financial crisis in four ways.

First, income inequality can lead to a drop in demand because lower-income groups have a higher consumption propensity. This means that lower-income groups spend a relatively larger part of their income on goods and service needs instead of savings.

Second, there are two possible strategies to deal with a decline in demand: an export-led growth model on the one hand, and a debt-led growth model on the other hand. Both models apply because of the financial liberalisation of international capital flows that allowed for unprecedented international imbalances.

Third, the debt-to-income-ratio of the poor has increased relatively faster than that of the rich in debt-led countries.

Fourth, growing inequality has increased the tendency to speculate, and therefore has led to a shift towards more risky financial assets. One particular aspect of this shift is that subprime derivatives, the segment where the financial crisis broke out in 2008, were developed to cater for the more risky demands of hedge funds that manage the assets of the top 1 percent income group. Increasing inequality has, in that way, not only played a role in the origin of the imbalances that erupted in the crisis, but also in the demand for the assets in which the crisis broke out.

Other evidence also suggests that the subprime crisis in 2007-2008 can, among other things, be attributed to rising income inequality (Rajan, 2010; Kumhof & Rancière, 2011).

However, the findings do not lead to an unambiguous conclusion. The main reason lies in the fact that it is challenging to measure a causal effect of income inequality on a crisis and vice versa. For example, some authors cannot find evidence of a causal effect of income inequality on crises (Bordo & Meissner, 2012).

2.2: Effect of a crisis on income inequality

This thesis focuses primarily on the effect of a crisis on income inequality. Findings are still inconclusive: some scientific work suggests that income inequality rises as a result of a crisis, other work find no significant effect at all.

Evidence suggests that income inequalities expanded in most European countries from the onset of the crisis mainly due to rising unemployment levels (Vacas-Soriano & Fernández-Macías, 2018). The European welfare states have managed to mitigate the effects however. These states ensure that the low-income groups who lose their jobs are looked after, while being looked after happens relatively less to the high-income groups. Therefore, the actual effects are dampened.

More evidence also suggests that, among other things, banking crises, such as the financial crisis, lead to an increase in income inequality (de Haan & Sturm, 2017).

A reason for this increase is related to the different types of assets of various income groups (Kuhn, Schularick & Steins, 2018). For example, the middle class has a higher share of its wealth in housing, whereas the rich own relatively more stock.

When house prices collapsed due to the financial crisis, the value of middle-class households' portfolios dropped substantially, while the quick rebound in stock markets boosted wealth at the top.

Other evidence still show that the financial crisis made the already increasing income inequality in the United States even worse. The losses suffered by the lower-income groups were relatively larger than those suffered by the higher-income groups (Almeida, 2020). At first, the tax and transfer system strongly reacted in the aftermath of the crisis, but this effect partly lost its power in the following years. After five years, the high-income groups had managed to almost fully recover their losses, while the lower-income groups were still experiencing problems.

Vacas-Soriano and Fernández-Macías (2018) argued that European welfare states have managed to cushion the extent of the growing inequalities due to the crisis. Some even argue that household income distribution was not significantly affected by the financial crisis because the government supported the lower half of the income distribution (Jenkins et al., 2013).

A study conducted from 1996 until 2013 in the same 27 EU countries on which this thesis is based also showed that the financial crisis had no apparent effect at all on income inequality. On the one hand, the crisis did not cause an increase in income inequality due to the redistribution effects by welfare states. On the other hand, the crisis did not decrease income

inequality either. Income equalisation had probably dropped to the status of a secondary objective for most European governments (Amate-Fortes et al., 2017).

However, the distributional effects by the governments in welfare states can have such a large impact that a crisis can even decrease income inequality (Agnello & Sousa, 2012). This heavily depends on the type of government in a country. One can imagine, this could be the case with a left-wing government.
Furthermore, banking crises like the one in 2008 can negatively impact top income shares. When losses of the top income shares are relatively more considerable than those of the lower-income shares, a banking crisis can lead to a decrease in income inequality (Roine et al., 2009).

Overall, the scientific literature shows no strict negative nor positive relationship between a crisis and income inequality. It is therefore challenging to measure an effect of such a crisis on income inequality. Government spending in the form of social services appears to have the biggest effect on the magnitude of change in income inequality. This magnitude seems to eventually determine the pattern of income inequality both during and after a crisis.
As Kuhn, Schularick & Steins (2018) argued, the pattern of income inequality also depends on both the type of crisis, as well as the type of assets owned by a certain income group.

In conclusion, some studies find a negative effect, some find a positive effect, and some find no effect at all. When one looks at which income group suffered the most from the crisis, opinions go both ways. On the one hand, the lower-income groups suffer the most because they are more likely to get fired. On the other hand, this group is more likely to be compensated by government social plans. High-income groups are barely compensated in times of crisis. A crisis can have an effect on income inequality, but the effect is sometimes dampened by the welfare states.

3: Data description

3.1: The dataset

Researchers have been trying to explain why income distribution varies across countries, but database issues often caused problems. Almost all data was suitable to analyse income distribution within a country, but a cross-national analysis was not possible because existing databases lacked reliable data for that particular purpose (Solt, 2009). However, the introduction of the Standardised World Income Inequality Database (SWIID) met the needs of those interested in a cross-national analysis of income distribution. The SWIID is used in this paper because of its high comparability.

The data for this analysis is a panel data set with observations from 2004-2016 for all 27 European Union member states. The primary motivation behind the use of panel data is that it deals with unobserved heterogeneity in a more efficient way than time-series or cross-sectional models (Zhu et al., 2015). The panel data set is unbalanced, meaning that not all countries have observations for every year from 2004 until 2016. In addition, some countries lack observations from the first year(s). One cannot simply add data for the missing years from other sources because of possible differences in measurement techniques.

It is better to look at income inequality in the European Union than in Europe itself. First, the EU has Union-wide policies and objectives to decrease income inequality, like the Europe 2020 strategy, aiming to accomplish inclusive growth (Brandolini, 2007; Fredriksen, 2012). Second, the EU data is often better in terms of quality and reliability than data from non-EU countries, which allows for a more significant and reliable interpretation of a cross-national analysis.

3.2: Description of the variables

The dependent variable in this thesis' regression analysis is 'gini'. It equals the Gini-coefficient of a country in a particular year, with a scale from 0 (perfect equality) to 100 (perfect inequality). The variable is dependent, meaning that the effect of the crisis on income inequality is measured through gini.

The Gini-coefficient is a statistical measure used to measure income inequality in a country or within any group of people. The coefficient varies between the values of 0 and 100 (or 0 and 1). A Gini-coefficient of 0 reflects perfect equality, meaning that incomes are the same for every household. A coefficient of 100 reflects perfect inequality, in which case one single household

earns all income while others earn nothing. So the closer the Gini-coefficient is to 100, the greater the inequality.

There is no 'ideal' Gini-coefficient. The United Nations has set a warning level at 40 (or 0.4), where others argue that a warning level of 50 is more sufficient. On the other side, perfect equality is neither desired since it removes all incentives to undertake and surpass oneself or someone else. Some argue that the desired Gini-coefficient should equal 25, like in Scandinavian countries.

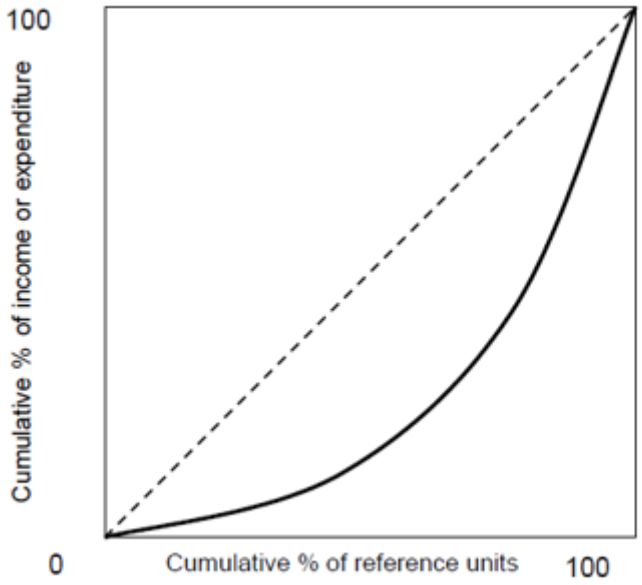

Figure 1: Lorenz curve

The Gini-coefficient is based on the Lorenz curve, the thick curve in Figure 1. The horizontal axis measures the cumulative percentage of the population whose inequality is under consideration, starting from the poorest and ending with the richest. The vertical axis measures the cumulative percentage of income (or expenditure) associated with the units on the horizontal axis. The Lorenz curve varies with income distribution: in a complete egalitarian income distribution, the Lorenz curve equals the dashed 45-degree line. In case of other income distribution the line curves like the thick line in Figure 1. The Gini-coefficient is a ratio of the area between the 45-degree dashed line and the Lorenz curve, and the total area under the 45-degree dashed line.

The gini-variable in this thesis is based on household net income. The motivation for using net income data instead of gross income data is related to the fact that this paper concentrates on

tangible income inequality rather than measuring different taxation systems. Households notice little of gross income inequality, assuming they pay their taxes.
Furthermore, empirical evidence suggests that one cannot simply divide households by the household size to get to the per capita income. This is due to economies of scale (Solt, 2020). A two member household earning €50.000 is better off than a one member earning €25.000. Although there are various ways to deal with the problem of economies of scale, the Modified OECD scale stands out. The convergence from household resources to per capita resources are computed in the following way:

$$Household\ size = 1 + 0.5 * n\ of\ additional\ adults\ +\ 0.3 * n\ of\ children$$

The gini variable is retrieved from the Standardised World Income Inequality Database.

The first independent variable is called 'ln(GDP)'. It equals the natural logarithm of the gross domestic product (GDP) converted to 2017 US$ in per capita terms. This variable gives insight in the relationship between financial wealth (GDP) and income inequality (Gini). The variable data are also retrieved from the Standardised World Income Inequality Database.

The next independent variable is called 'trade openness'. It equals the sum of a country's exports and imports as a share of that country's GDP (in %). Evidence suggests that democracies and trade openness has a negative effect on income inequality within countries (Reuveny & Li, 2003). A democracy index has been omitted from this analysis because almost all EU-member states would achieve the same score. After all, a country that wants to join the EU must amongst others have a stable democracy that guarantees the rule of law, respect for human rights and the protection of minorities.
However, a trade openness variable is added because trade openness it varies with every EU-member state. As one can see in Table 1 on page 23, trade openness varies a lot between EU countries. The variable data are retrieved from Our World in Data.

Two economic models of international trade have included the effect of trade openness on income inequality. The two-country Heckscher-Ohlin model with one developed country and one developing country is an example of such economic model. The developed country is

capital abundant, and the developing country is labour abundant. According to the Heckscher Ohlin model, a country's exports are dominated by the abundant factor.
Wolfgang Stolper and Paul Samuelson (1941) argued that international trade benefits the owners of a country's abundant factor. Taken into consideration that all EU-members are developed countries and that capital is mainly owned by the rich, international trade benefits the rich while disadvantaging the poor. Thus, according to the Stolper-Samuelson theorem, income inequality rises as a result of international trade.

The next independent variable is called 'government spending'. It equals central government expenditure as a share of GDP. Examples of expenditure are the provision of public goods and the redistribution of resources. As argued earlier, government spending, especially in the form of redistribution of resources, has an effect on net income inequality. This is because welfare states ensure that the lower-income groups are compensated through progressive taxation systems. The variable data are retrieved from Our World in Data.

Furthermore, the dataset contains a dummy variable for the years of the financial crisis, which equals one in the years 2007, 2008 and 2009, and 0 otherwise. The so called 'crisis dummy' is a useful variable to determine whether the crisis had a significant effect on income inequality. The use of the crisis dummy is further explained in Section 4.

The dataset also contains a dummy variable for the years of the European debt crisis. This crisis started when several Eurozone members like Greece, Portugal, Cyprus and Ireland were unable to refinance their government debt at the very end of 2009. It was only in 2014 that these economies had reasonably recovered from this crisis.
Although this paper does not primarily focus on this particular crisis, it is still essential to use this variable in the regression because this crisis might have a significant effect on income inequality. This effect can both be negative and positive.
The so called 'european debt crisis dummy' variable equals one in the years 2010 until 2014, and 0 otherwise.

The regression furthermore contains two interaction terms, one relating to the financial crisis dummy and government spending, and the other relating to the financial crisis dummy and trade

openness. An interaction term shows whether the effect of the explanatory variables on the outcome variable is significantly different if the dummy variable equals one.

Lastly, the regression contains a lagged gini variable to prevent autocorrelation.

4: Methodology

4.1: Unit root test

The STATA analysis starts with a unit root test to check whether the panel data variables are non-stationary and possess a unit root. If time series contain a unit root, it shows a systematic pattern that is unpredictable. A unit root can cause problems in the statistical inference involving panel data models.

There are only two panel data unit root tests available for unbalanced datasets. The first one is the Im-Pesaran-Shin (IPS) unit-root test. However, as the data set does not have enough observations for an IPS unit-root test, this thesis will use the Fisher-type unit-root test instead. One downside of the Fisher-type unit root test is that it only tests for at least one panel to be stationary, while it is better to know if all panels are stationary.

The Fisher-type unit-root test checks two hypotheses:

- the null hypothesis: all panels contain unit roots.
- the alternative hypothesis: at least one panel is stationary.

The results are displayed in Table 2-5 in the appendix. The outcome shows four test statistics. The inverse normal Z statistic offers the best trade-off between size and power and should therefore be used (Choi, 2001).

The null hypothesis can be rejected for Gini and government spending ($p<0.05$). It can be concluded that not all panels contain unit roots.

The null hypothesis however cannot be rejected for trade openness and the natural logarithm of GDP ($p>0.05$). All panels contain unit roots for these two variables.

4.2: Hausman test

A Hausman specification test determines whether a random effects model or a fixed effects model should be used in this regression to prevent misspecification of the model.

The Hausman specification test checks the following hypothesis:

- the null hypothesis: the random-effects model is preferred
- the alternative hypothesis: the random-effects model is preferred

Based on the results in Table 6, the null hypothesis is rejected at a 99% significance level. This analysis therefore uses the fixed effects model.

The main benefit of panel data regression with fixed effects lies in a smaller chance that the regression suffers from a bias. Time invariant factors that otherwise could have caused omitted variable bias are no longer a problem.

An excellent example of a time-invariant factor in a relatively short time period is a democracy index. A democracy index does not often change, especially in EU-members states. It is, therefore, unnecessary to add it to the regression because the fixed effects model deals with it. Fixed effects models also have limitations. A large limitation is the concern about unobserved time-varying heterogeneity (Collischon & Eberl, 2020). However, unobserved (time-varying) heterogeneity is a general problem. No regression model is exempt from this bias.

4.3: Main regression

The main regression relies on a panel data regression with fixed effects, with gini as the variable of interest. It can show whether the financial crisis has had an effect on income inequality. In order to do this, gini is regressed on multiple independent variables. The independent variables can all have a direct effect on income inequality. They are all added to the regression to avoid omitted variable bias.

The model:

$$\begin{aligned} gini_t = \ & \alpha + \beta gini_{t-1} + \gamma \ln(GDP)_{t-1} + \delta trade\ openness_{t-1} \\ & + \theta government\ spending_{t-1} + \mu D_{0,t}^{CRISIS} + \pi D_{0,t}^{EUROPEAN\ BANKING\ CRISIS} \\ & + \rho D_{0,t}^{CRISIS} * government\ spending_t + \tau D_{0,t}^{CRISIS} * trade\ openness_t + \varepsilon_i \end{aligned}$$

Where $gini_{t-1}$ is the Gini coefficient with a one-year lag. $\text{Ln}(GDP)_{t-1}$ is the natural logarithm of GDP, with a one-year lag. $Trade\ openness_{t-1}$ is a country's trade openness, with a one-year lag. $Government\ spending_{t-1}$ is a country's government spending, with a one-year lag. $D_{0,t}^{CRISIS}$ is the financial crisis dummy, which equals 1 in the years of the financial crisis and 0 otherwise. $D_{0,t}^{EUROPEAN\ BANKING\ CRISIS}$ is the European banking crisis dummy, which equals 1 in the years of the crisis and 0 otherwise. $D_{0,t}^{CRISIS} * government\ spending_t$ is the interaction term between the financial crisis and a country's government spending. $D_{0,t}^{CRISIS} * trade\ openness_t$ is the interaction term between the financial crisis and a country's trade openness.

A significant interaction term means that the variable, for example trade openness, deviates significantly in the years of the crisis dummy. In practice, this means that the trade openness during the crisis would differ significantly from the trade openness before or after the crisis.

The goal of the main regression is to show whether there is a significant effect of the crisis on income inequality. This effect is measured through the crisis dummy. The estimated coefficient of the crisis dummy shows whether income inequality was positively or negatively affected by the crisis, and with what magnitude. The other explanatory variables ensure that the estimated effect of the crisis dummy is more accurate, and provide insight into which other factors influence income distribution.

As mentioned earlier, empirical evidence suggests that the relationship between a crisis and income inequality seems to go both ways. A regression without lags is, therefore, likely to suffer from reverse causality. The use of lagged explanatory variables in this regression is to some extent a way to deal with reverse causality. It is essential to mention that lagged explanatory variables do not solve the problem, but it does take some of the concerns away.
The crisis dummy can measure whether the Gini coefficients significantly deviate in the years of the crisis. Consider the regression model without the crisis dummy. The regression measures the effect of all independent variables on the dependent variable for the whole period. The addition of a dummy variable for specific years allows to see if the dependent variable significantly deviates in the specified years within the period.

It is important to note that when this regression refers to a positive effect on income inequality, income inequality increases. The word positive can cause confusion because a positive effect on income inequality can also be understood as a decrease in income inequality. This is not the case. Of course, this reasoning also applies the other way around in case of a negative effect.

A panel data regression focuses on the effect of an explanatory variable on the dependent variable. However, the two sub-questions can better be answered with the help of correlation coefficients. For example, a correlation between GDP and Gini can tell whether more economic prosperity is correlated with higher or lower income inequality. This will reveal whether there is indeed a negative relationship between wealth and income inequality and government spending and income inequality.

5: Results

The regression results are shown in Table 7 of the appendix. The findings show that Gini coefficients depend on their past value(s). This is in line with practical findings. Income distribution changes little from year to year.

The GDP coefficient shows a negative effect of GDP on Gini. Although this regression suggests that an increase in GDP lowers the Gini coefficient, it cannot be concluded because the results lack significance.

The correlation coefficient in Table 8 shows that countries with a higher GDP per capita tend to have lower income inequality. Two variables with a correlation coefficient of -0.47 can be considered moderately correlated. This finding suggests that the second hypothesis listed on page 5 holds: countries with more economic prosperity tend to have lower income inequality.

There also seems to be a positive effect of trade openness on income inequality. This would mean that an increase in trade openness increases income inequality. However, this effect is minimal and again not significant.

As argued earlier, scientific literature suggests a negative correlation between government spending and Gini-coefficients. This also seems to be the case in this dataset. However, the coefficient is once again not significant. Therefore, it cannot be concluded that government spending has a negative effect on income inequality.

One possible explanation for the effect to be this small and not significant is that government spending covers more than just social spending in the form of income distribution. Further research is needed to establish the effect of government social spending on income inequality, once the data allows for it.

A second possible explanation is related specifically to the EU countries. When comparing all countries globally, social spending is often the highest in the western world, especially in EU-member states. Considering that social spending is relatively high and that income inequality is relatively low in most EU-member states compared to the rest of the world, it is hard to find a significant effect. The differences in government spending are small. If EU-member states were to be compared with central African countries, it would be much more likely to find a significant effect of social spending on income inequality.

The correlation coefficient of -0.26 between gini and government spending in Table 9 shows a slight negative correlation. Countries with higher government spending tend to have lower income inequality. The correlation coefficient of -0.26 is not sufficient to neither confirm nor

deny the third hypothesis (government social spending has a negative impact on income inequality).
The European debt crisis had no significant effect on income distribution. The coefficient is not significant. Therefore, no conclusion can be drawn that the European debt crisis has had a positive or negative effect on income inequality

The financial crisis dummy in Table 7 also lacks significance ($p>0.05$). Income inequality neither increased nor decreased. The crisis had no significant effect on income inequality in this dataset. The most plausible explanation is that the lower-income groups did suffer from the crisis. The crisis had a positive effect on income inequality through the different types of assets held by different income groups (Kuhn, Schularick & Steins, 2018). However, the welfare states ensured that this effect was largely absorbed.
The effect of the crisis on income inequality may also be limited by the relatively short period covered by the panel dataset. Perhaps the long-term effect can be easier identified.
From the visual interpretation of Figure 2, government expenditures of all countries appear to increase slightly from 2008 onwards. However, according to the results from the regression in Table 10, there is no significant difference in government spending between the period up until 2008 and after 2008.

As one can see in Table 10, the interaction term between government spending and the financial crisis dummy also lacks significance ($p>0.05$). This suggests that there is no significant difference between the effect of government spending on income inequality before, during, and after the crisis. Government expenditure therefore does not appear to have increased as a result of the crisis. This would mean that expenditure by the welfare states is already so high that they have absorbed the blow without much extra effort. In addition, government spending is, of course, not the only way to compensate for lower incomes. This can also be done, for example, through leniency in the field of repayments. A phenomenon that also occurred in the corona crisis of 2020.

6: Conclusion

The question whether the financial crisis affected income inequality remains challenging to answer. The effect of a crisis on income inequality is difficult to measure. From the literature review, it becomes clear that the relationship between a crisis and income inequality can go both ways, which makes data research more complicated because of reverse causality concerns. Scientific literature also suggests that a crisis can either have a positive or negative effect on income inequality or no effect at all. The effect does not go one way. It depends on many factors, including government spending and the source of income for different income groups in a country.

This paper's empirical analysis shows that income inequality was not significantly affected by the financial crisis. Thus, although it is likely that the crisis had a relatively large effect on lower-income groups compared to higher-income groups, the welfare states have ensured that this effect was limited. This is much in line with findings from other papers.
On the one hand, the findings from the analysis of this paper are limited. The data covers a relatively short period, and there still are concerns about reverse causality. This weakens the regression. On the other hand, the regression clearly shows no significant change in income inequality during the crisis years. This is an important conclusion though, especially given that it is in line with previous scientific findings.

The panel dataset of this paper covers a relatively short period. The effect of the financial crisis on income inequality in EU countries may become more precise over time due to the slow-moving nature of income inequality. In addition, the quality of the available data becomes better over time. It is therefore important that research continues to be conducted in this specific area. Although this paper did not primarily focus on the role of a government in the income inequality debate, it has become clear that government spending plays a large role in income distribution. Therefore further research could focus on a government's precise role concerning income inequality to determine the effect more exactly. This requires more specified data on government spending, taxation systems and social benefits, among many others.
Further research could also focus on other countries or areas. As mentioned before, the differences between EU-member states are often small. Comparing EU countries, or western countries in general, with African or Asian countries can, for example, shed light on the effects

of variables that do not play a significant role when comparing only EU member states. One example is the effect of a stable democracy.

7: Appendix

7.1: References

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7.2: Tables and figures

Table 1: Variable descriptive statistics

Table 1 shows the mean statistics of the outcome and explanatory variables for every EU country. Column (1) shows the country, and Column (2), (3), (4) and (5) show the means for every variable.

Country	**Gini coefficient**	**GDP**	**Trade openness**	**Government spending**
Austria	27.01	52,245	99.47	46.16
Belgium	26.60	48,151	154.00	42.91
Bulgaria	34.83	17,959	119.20	32.56
Croatia	30.71	24,188	85.93	37.79
Cyprus	30.75	36,969	114.20	47.08
Czechia	25.10	34,001	137.30	34.18
Denmark	26.02	52,140	97.85	39.24
Estonia	33.23	28,653	147.00	2.18
Finland	25.73	45,846	77.38	37.37
France	29.11	42,792	57.14	47.26
Germany	29.10	48,527	80.61	28.90
Greece	33.80	32,181	57.33	49.58
Hungary	27.32	25,871	158.30	44.23
Ireland	30.56	57,834	179.20	36.42
Italy	32.31	42,798	53.39	40.72
Latvia	36.07	23,911	110.00	44.22
Lithuania	35.17	26,557	137.90	9.98
Luxembourg	28.11	108,502	340.40	38.81
Malta	27.60	34,034	283.00	53.17
Netherlands	26.44	52,418	138.20	39.85
Poland	31.63	24,207	85.32	35.52
Portugal	35.43	31,273	71.42	42.73
Romania	35.14	21,998	75.57	33.17
Slovakia	25.21	26,155	168.10	38.71
Slovenia	23.87	33,613	135.00	41.77
Spain	33.19	37,539	57.31	19.79
Sweden	25.38	48,741	86.18	32.30
Total	29.77	39,985	123.00	36.92

Table 2: Unit root test for gini

Table 2 shows the results of the unit root test for the Gini variable.

Test		**Statistic**	**p-value**
Inverse chi-squared	P	95.6995	0.0004
Inverse normal	Z	-1.7801	0.0375
Inverse logit	L*	-2.7240	0.0036
Modified inv. chi-squared	Pm	4.0125	0.0000

Notes: in this paper, the inverse normal Z statistic is used. A p-value smaller than 0.05 means that the null hypothesis can be rejected.

Table 3: Unit root test for government spending

Table 3 shows the results of the unit root test for the government spending variable.

Test		**Statistic**	**p-value**
Inverse chi-squared	P	67.6104	0.1009
Inverse normal	Z	-1.9583	0.0251
Inverse logit	L*	-1.9455	0.0269
Modified inv. chi-squared	Pm	1.3097	0.0952

Notes: in this paper, the inverse normal Z statistic is used. A p-value smaller than 0.05 means that the null hypothesis can be rejected.

Table 4: Unit root test for trade openness

Table 4 shows the results of the unit root test for the trade openness variable.

Test		**Statistic**	**p-value**
Inverse chi-squared	P	42.2609	0.8766
Inverse normal	Z	1.2301	0.8907
Inverse logit	L*	1.2062	0.8851
Modified inv. chi-squared	Pm	-1.1296	0.8707

Notes: in this paper, the inverse normal Z statistic is used. A p-value smaller than 0.05 means that the null hypothesis can be rejected.

Table 5: Unit root test for the natural logarithm of GDP

Table 5 shows the results of the unit root test for the natural logarithm of GDP variable.

Test		**Statistic**	**p-value**
Inverse chi-squared	P	71.5179	0.0554
Inverse normal	Z	-0.7558	0.2249
Inverse logit	L*	-0.6733	0.2509
Modified inv. chi-squared	Pm	1.6857	0.0459

Notes: in this paper, the inverse normal Z statistic is used. A p-value smaller than 0.05 means that the null hypothesis can be rejected.

Table 6: Hausman test results

Table 6 shows the results of the Hausman test.

Test	**Statistic**	**p-value**
Chi	106.19	0.0000

Notes: a p-value smaller than 0.05 means that the null hypothesis is rejected and that the regression should stick to the use of a fixed effects model.

Table 7: Regression results

Table 7 shows the regression results all variables on Gini for the years 2004-2016.

The p-value denotes: * p < 0.1, ** p < 0.05 and *** p < 0.01.

Gini	**Coefficient**	**Standard error**	**t-statistic**	**p-value**	**[95% confidence interval]**	
Gini coefficient (L1)	0.463***	0.049	9.400	0.000	0.366	0.560
Ln(GDP) (L1)	-1.387	1.094	-1.270	0.206	-3.542	0.768
Trade openness (L1)	0.008	0.008	1.050	0.292	-0.007	0.024
Government spending (L1)	-0.015	0.017	-0.920	0.359	-0.048	0.018
Crisis dummy						
European Banking Crisis dummy	-0.164	0.493	-0.330	0.739	-1.135	0.806
Interaction term crisis dummy and government spending	-0.069	0.147	-0.470	0.638	-0.359	0.221
Interaction term crisis dummy and trade openness	-0.001	0.011	-0.060	0.956	-0.023	0.021
Constant	-0.002	0.002	-0.710	0.476	-0.006	0.003
	30.910**	11.845	0.610	0.010	7.588	54.231

Notes: the coefficients should be interpreted in the following way: an increase in x by 1 increases Gini by the coefficient. The natural log of GDP should be interpreted in the following way: an increase in GDP by 1% increases Gini by -0.0139. (L1) denotes a one-period lag.

Table 8: Correlation coefficient of Gini and GDP

Table 8 shows the correlation coefficient of Gini and GDP for 26 EU countries.

	Gini	**GDP**
Gini	1.0000	
GDP	-0.4742	1.0000

Notes: Luxembourg's GDP per capita value is an outlier and is therefore excluded from the calculations.[2]

Table 9: Correlation coefficient of Gini and government spending

Table 9 shows the correlation coefficient of Gini and government spending for 26 EU countries.

	Gini	**Government spending**
Gini	1.0000	
Government spending	-0.2630	1.0000

Notes: Malta's government spending value is an outlier and is therefore excluded from the calculations.[3]

[2] See Table 1
[3] See Table 1

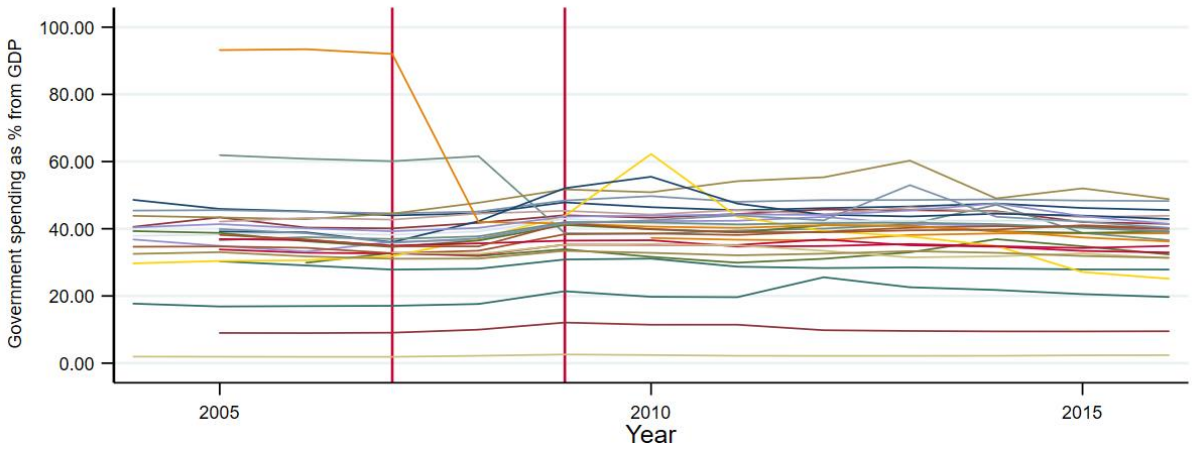

Figure 2: 27 EU countries' government spending from 2004 to 2016. The two vertical red lines are equal to 2007 and 2009 on the horizontal axis.

Table 10: Regression results

Table 10 shows the regression results for government spending and the break dummy, which equals 0 in the years 2004 until 2008, and 1 in the years after 2008. A significant break coefficient implies that there is a significant difference in government spending before and after the break point (2008). The p-value denotes: * p < 0.1, ** p < 0.05 and *** p < 0.01.

Government spending	**Coefficient**	**Standard error**	**z-statistic**	**p-value**	**[95% confidence interval]**	
Break	0.819	0.686	1.19	0.232	-0.524	2.163
Constant	36.369***	2.257	16.11	0.000	31.945	40.793