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THE ROLE OF TAX AND TRANSFERS IN REDUCING PERSONAL INCOME INEQUALITY IN EUROPE'S REGIONS: EVIDENCE FROM EUROMOD

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The role of tax and transfers in reducing personal Income Inequality in Europe's regions: Evidence from EUROMOD

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Abstract

In this paper we use statistical tools and graphic devices in order to give a comprehensive picture of income inequality levels in a set of 100 EU-15 regions at the end of the XX century before and after the operation of the tax-benefit. Our analysis is based on EUROMOD, the first multi-country tax-benefit model built with a common framework that includes detailed information on taxes and benefits paid and received by individuals and/or households from samples that are representative for the 15 EU countries. Our analysis focuses on intraregional inequality and it explores the relationship between regional inequality levels (both in market incomes and disposable incomes) and economic performance. Our main findings indicate that tax-benefits systems in Europe notably reduce market inequality in all EU regions and that the size of this reduction (i.e. redistributive effect) depends crucially on (i) the market inequality level of the region (positively), (ii) the relative economic performance of the region in the country (negatively) and (iii) the country to which the region belongs.

Keywords: Regions, European Union, inequality, redistribution, economic performance.

JEL: C81, D31, I38

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Content

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List of Tables and Figures

1. Introduction

The policy choices made by governments when establishing their tax-benefit systems are important in distinguishing final income inequality levels. As Atkinson (2000) highlights, accounting for the redistributive role of the government budget is crucial when looking for explanations of the extent and timing of changes in the income distribution. This paper is concerned with the impact of the government budget, particularly taxes and transfers, on the extent of personal income inequality in European regions. Our aim is to provide new empirical evidence for income inequality in Europe's regions. We use statistical tools and graphic devices in order to give a comprehensive picture of income inequality levels in a set of 100 EU-15 regions at the end of the XX century before and after the operation of the tax-benefit.

Despite the relevance of the topic in both economic and social policy literature, the lack of comparative personal micro-data on pre-tax-benefit and post-tax-benefit incomes has impeded systematic analyses on the matter. Until recently, comparable estimates of the income distribution before and after the redistributive role of the state among countries have been scarce. Work by Atkinson et al (1995) - relying on the Luxembourg Income Study data -, Wagstaff et al (1999), Heady et al (1999) and Förster and Pellizzari (2000) has contributed in this direction. However, the lack of consistency in definitions for components of income, population coverage, quality of the data on taxes and transfers and policy coverage in different countries have restricted (in one way or another) the degree of comparability of their estimates.

Some of these difficulties, although not all, are overcome in this work. Our analysis uses EUROMOD which is the first multi-country tax-benefit model built with a common framework that includes detailed information on taxes and benefits paid and received by individuals and/or households from samples that are representative for the 15 EU countries.

Our interest focuses on inequality and redistribution at the level of the region. Regions provide particularly interesting case studies. Firstly, nation-state inequality averages may disguise important internal regional differences, given the existing heterogeneity among EU regions in terms of socio-economic and political institutions. Work by

Stewart (2002), Jesuit et al (2002) and more recently Berthoud (2004) stress this point by providing a systematic analysis of the regional dimension of disposable income inequality and/or poverty in EU countries. Secondly, the regional dimension of inequality and poverty is also important in the current context of growing government decentralisation: regional authorities within the EU member states are responsible for an important part of the tasks carried out by the public sector including redistribution in many countries. Moreover, any movement towards making effective the principle of 'subsidarity' in the EU context needs a closer look at the level of regions. Complementing the nation-state approach with a regional one is therefore important.

Focussing on intraregional inequality, our study departs from the standard regional analysis concerned with the convergence of GDP across states and regions. Instead, we explore in detail the relationship between regional inequality levels (both in market incomes and disposable incomes) and economic performance. Are relatively poorer regions more unequal than well-off regions before the tax-benefit system operates? To what extent does the situation change when public redistribution takes place? Of course we expect national tax-benefit systems with a larger redistributive impact at the country level to have a larger redistributive impact in their territorial units or regions. But, are national tax-benefits equally effective in reducing inequality levels in rich and in less well-off regions of a given country? Is there any common pattern observed in the different countries?

Evaluation the distributional impact of tax-benefit policy is a complex task. It is important to point out that our analysis only provides a *partial* assessment of the redistributive effect of tax-benefit systems. Our analysis does not take into account the whole redistributive impact of the public policy but only the arithmetic redistributive effect of cash tax-benefit policy. This is restrictive in at least three important ways. [2] Firstly, countries and regions may show a reduced redistributive effect when looking at monetary redistribution but a substantially larger redistributive impact when benefits in kind are taken into account. [3] Secondly, we compare inequality before the operation of

[2] For a discussion of the difficulties of evaluating the effect of economic policy (not just fiscal policy) on income distribution with a focus on developing countries see Bourguignon et Pereira da Silva (2003). They provide a compendium of existing techniques for evaluation and show the complexity of the topic.

[3] Gardiner et al (1995) show that taking account of the health and housing system differences across countries had a significant impact on international comparisons of income distribution.

the tax-benefit system and inequality post-tax-benefit in a context in which market inequality is taken as given. There is no attempt to take into account the possible effects the tax-benefit may have had in the past or present level of economic performance and market inequality; nor the other way around - the possible effects of market conditions on the current tax-benefit systems. Finally, our analysis focuses only on assessing vertical yearly redistribution. This is obviously restrictive as many tax-benefit instruments are designed to be redistributing over the life-cycle.

The structure of the paper is as follows. In section 2 we describe EUROMOD, the tax-benefit model used in our analysis. We document the regional information used as well as some methodological choices involved in our analysis. Before going into the analysis at regional level, in Section 3 we provide a country's overview of the redistributive role of the tax-benefit system in each country. Section 4 is devoted to the analysis of "Market Gini" (i.e. the Gini coefficient of market income) in EU regions. We study the correlation between market Gini and average regional income levels. The analysis of "Disposable Gini" (i.e. the Gini coefficient once the tax-benefit system has operated) in EU regions occupies Section 5. Section 6 describes the redistributive effect of the tax-benefit system. In section 7 we report the co-movements between inequality, redistribution and economic performance among EU regions and in Section 8 we assess the country fixed effect on regional inequality. A summary of our main results and some policy implications derived from them are summarized in the final section.

2. Data issues and methodology

2.1. EUROMOD: an EU-15 tax-benefit model

EUROMOD is an integrated tax-benefit micro simulation model for all countries of the European Union-15. It was developed by a research team involving researchers from 18 Institutions in 15 EU countries, co-ordinated by the Micro simulation Unit at the University of Cambridge. This model is a powerful instrument for research on tax-benefit reform in a comparative or from a supra-national (European) perspective.[4]

[4] For details about the EUROMOD's team and project, see its website: http://www.econ.cam.ac.uk/dae/mu/emod.

EUROMOD is a source of harmonized micro-data on the different income components "before" and "after" redistribution though the tax-benefit system has taken place. The data represents the population of private households in the different countries of the EU-15. The EUROMOD databases are summarised in Table 1.

Taxes and transfers paid and received by individuals and households are either fully simulated by EUROMOD or taken from the original data. For instance, the personal income tax and the social insurance contributions are simulated in all countries, but in most of them the model neither simulates taxes on capital, inheritance, real estate and property. There are some exceptions: Property tax is simulated in Belgium and included (but not simulated) in Finland and France. On the benefit side, in most countries the model does not simulate pensions in-kind, contributory and disability benefits (these are taken from the data), because the information needed to simulate is not available in the database. Thus, EUROMOD mainly simulates income-tested benefits as data is required that is more frequently available. Currently, EUROMOD simulates the tax-benefit systems of EU-15 countries for year 1998 so income figures from the original surveys have been updated to this reference year.

Finally, EUROMOD does not have an integrated method to model tax evasion and non-take-up of benefits. A comprehensive description of the EUROMOD model including data quality issues, policy scope and model design can be found in Sutherland (ed) (2001). See Mantovani and Sutherland (2003) too for a discussion of the factors affecting the reliability of EUROMOD estimates of household disposable income.[5]

<Insert Table 1>

2.2. Regional information in EUROMOD

[5] Notable differences across countries in the underlying data sources that should be born in mind when interpreting results include (a) for Sweden income is aggregated over the narrow family unit (single person or couple plus children aged under 18. i.e., individuals aged 18 or more are all treated as not living with their parents) whereas for other countries the data allow us to use the wider household – all people living in one dwelling and sharing some of the costs of living; (b) the reference time period for incomes for most countries is one year, but for Ireland and the UK it is shorter (a month or a week for most sources of income).

Table 2 shows the regional information available in EUROMOD. The databases in EUROMOD for each country have different levels of regional aggregation. Most countries follow the NUTS system. Ireland, Luxembourg and Sweden use different systems. Most countries have regional data at NUTS1 level. However, for France and Portugal, NUTS2 is available and for Finland NUTS3.

<Insert Table 2>

NUTS2 is particularly useful in Portugal - NUTS1 divides the country into two regions: the continental part and the Islands of Açores and Madeira. NUTS2 is also relevant for France (*régions*). NUTS1 is in turn appropriate in Germany (Länders) and the UK. Regional data for the UK is at NUTS1 level; however, the southeast region is split into NUTS2, since 'greater London' is identified separately. In Italy NUTS1 is available (we do not have the *Provinces)* but the southern region distinguishes Basilicata/Calabria and Puglia. Unfortunately, NUTS2, corresponding to Spanish regional governments, is not available.

Table 2 summarizes the regional information we use for each country. For Sweden and Finland, we grouped regions into NUTS2 to keep some degree of comparability with the other countries while Denmark, Ireland, Luxembourg and the Netherlands are not considered in our analysis because no regional information is available. The total number of regions considered is 100.

Table 2 also shows the average population size per region and total number of regions per country. The average population per region varies from less than 1 million people in Finland to 5.5 million people in Spain. Out of the total number of regions considered, France concentrates 22 of the regions analysed, while Austria and Belgium only 3 regions each and Greece 4. For the other countries, the number of regions is in the range 6 to 12.

In sum, we believe that the regional information offered in EUROMOD is rich enough for our analysis to be of interest. Nevertheless, the reader should keep in mind that the significance of "regions" widely varies among countries. For instance, while have just pointed out that in Spain regions correspond to an arbitrary aggregation of CCAA (regional governments), in others we are able to identify the big metropolitan areas.

Moreover, in some countries the usefulness of the regional analysis may be limited because regions are too heterogeneous. This is the case of Austria in which the East region involves the rich Vienna as well as the very poor region of Burgenland and Lower Austria is somewhere in the middle.

Sample sizes

One of the common problems distributional estimates at regional level present is the small sample size available. Table 3 shows the sample size available for the different regions. In our case, this is a severe problem in only a few regions such us Corse in France for which only 38 observations are available in our sample, Bremen in Germany with only 65 observations and Ahvenanmaa/aland in Finland with 62 observations. These regions are the ones with the lowest population in each country. For statistical reasons, it may be appropriate to merge some of these regions with others in the country. However, to avoid artificial merging, the figures presented below use the whole 100 regions, providing standard errors of the regional inequality estimates.

<Insert Table 3>

2.3. Income definitions and other methodological choices

2.3.1. Income definitions

Our *market income* variable includes all components of market income: wages and salaries and self-employment income (net of employer insurance contributions and other benefits, but gross of employee contributions to such schemes), property income (interest, rents, dividends) as well as occupational pensions from employers, regular interhousehold cash transfers and other sources of income which are not redistributive government transfers. From now on, we refer to ***Original, Gross*** **or** ***Market*** income indistinctly. [6]

[6] For the procedures used to impute gross amounts from net incomes see Immerwoll and O'Donoghue (2001).

The *disposable income* variable is market income plus all social transfers minus employee Social Insurance Contributions, personal income taxes and other taxes. Figure 1 summarizes the elements of the tax-benefit systems that have been taken into account for the conversion from market Income to disposable Income in EUROMOD. Indirect taxes are not considered. In Sutherland ed. (2001) (pages 63 to 76) there is detail about the components included in disposable income for each country [7]. The EUROMOD Country Reports (listed in the reference list) offer detailed explanations about the content of these variables for each country.

<Insert Figure 1>

By looking at the variables included in the disposable income definition for each country it can be seen that most of the tax-benefit components considered by EUROMOD are established at national level. In most countries the central government is responsible for the overall redistribution. Austria and Germany are the only two countries with noticeable regional benefits. These include several benefits, which are specific to states and provinces. In the case of Austria, the Family Bonus, Disability Benefit, Social Assistance and Housing Support are partly established at the level of the province. Likewise, in Germany, there is provincial Child Raising Allowance and Social Assistance Complements (cost of living assistance and assistance in special circumstances) given at the level of the Länders. For Sweden and Finland, local income tax is an important component of income taxation and social assistance varies to some extent across regions too.

It should be taken into account that for most countries, EUROMOD is not able to model detailed policy instruments at the regional and local level. For instance, in Spain the minimum income programmes established by the regional governments are not modelled because NUTS2 information is not available. In most cases, data constraints are the main argument for not considering local and regional taxation (See the Country Reports listed in the reference list).

2.3.2. The frequency of zeros in the market income variable

[7] See also baseline output available at http://www.econ.cam.ac.uk/dae/mu/emodstats/index.htm available now for years 1998 and 2001.

There is one important question to address, which relates to the frequency of zero incomes in the market income variable.

Zero incomes in the market income variable affect over 10 per cent of the whole EU sample. The distribution of zero incomes among countries and regions is not randomly distributed. Zero market incomes are over 20 per cent in Austria, Belgium and Portugal and above 17 per cent of the sample in Spain and Greece whereas the frequency of zero incomes is less important in Finland, France, Germany and Italy (around 5 per cent) and is below 1 per cent in Sweden.

This substantial divergence raises doubts of comparability among countries of market inequality levels, especially concerning the reliability of non-labour market incomes in countries such as Austria, Belgium, Portugal, Spain and Greece. Our main problem is that we are not able to distinguish true zero incomes (for instance, pensioners with no other income) from measurement error. Dropping zero incomes from both income distributions seems not appropriated in our case. Any *ad hoc* imputation to the market income variable would be arbitrary too. For these reasons, we decided to leave zero incomes in the computations shown below. Note that leaving zero incomes is likely to lead to overestimating market inequality in countries in which zero incomes are disproportionately frequent.

The frequency of negative incomes is less than 0.05 per cent and zero incomes are concentrated in Sweden. Zero and negative income is much less of a problem in the disposable income variable, affecting only 0.25 per cent of the whole sample.[8]

Comparisons of inequality levels among countries and regions are likely to be affected by any systematic difference in the quality of the data in the different countries and by any other country specific characteristic.

2.3.3. Other methodological choices

[8] In various studies analysing disposable inequality and poverty the importance of making top and bottom coding is emphasized (See Stewart (2002), Gottchalk and Smeeding (1997)). Atkinson et al (1995) also performed some top and bottom coding in their analysis of market inequality, but they considered only non-zero respondents. Our analysis does not make any bottom or top coding.

In all estimates made in this paper (using market and disposable income), we use the personal income distribution in each country and region constructed under the following assumptions. Each individual gets the equivalent income of the household to which it belongs. This implies that the household as the unit of analysis (i.e. inequalities within the household are not taken into account). Equivalent income is estimated by means of the modified OECD scale. Inequality is measured solely by the Gini coefficient and that of the redistributive role of the state measured by the difference between market Gini and disposable Gini. We are aware that this set of assumptions is restrictive. For instance, Atkinson and Brandolini (2003) have emphasised the need to look at different parts of the income distribution and not solely on a summary measure such as the Gini coefficient. [9]

Given the lack of PPP factors at the level of the regions, when comparisons in average income across regions are made, there are **no** PPP adjustments taken into account. [10] The Danish, Swedish and UK currencies were converted into Euro using the exchange rate of December 31st, 1998. The whole analysis refers to 1998 annual incomes.

Standard errors were computed for all indices using bootstrap. Bootstrap is a technique based on re-sampling with replacement (Efron and Tibshirani, 1993). Given a random sample Z = (z^1, z^2,…, z^n), B bootstrap samples Z^* = Z^{*1}, Z^{*2},…, Z^{*B} are drawn so that each bootstrap sample Z^*= (z^{1*}, z^{2*},…, z^{n*}) is a random sample of size n from the original distribution Z. Replicates of the analysed index (Ð) are then calculated for each bootstrap sample Ð(Z^{*1}), Ð(Z^{*2}),…, Ð(Z^{*B}). The bootstrap estimate of the standard error is then computed as the standard deviation of the bootstrap replicates:

$$\hat{se}_B = \left\{ \frac{1}{B-1} \sum_{b=1}^{B} \left[\Pi(Z^{*b}) - \sum_{b=1}^{B} \Pi(Z^{*b})/B \right]^2 \right\}^{1/2}$$

In the graphical presentations of results which follow the reliability of estimates is shown using confidence intervals that have been constructed to be significant at the 5% level: i.e.+/- 1.96 * estimated (e_B).

[9] This is an issue that deserves further research in the future.
[10] This is an issue that deserves further research in the future.

3. The redistributive impact of taxes and transfers: A country's overview

EUROMOD has been recently used to study the redistributive effect of taxes Verbist (2004) and the combined effect of taxes and transfers (Immervoll et al (2004)) in EU-15 countries. We refer to these two works for a detailed analysis of the contribution of the different taxes and benefits to the overall redistributive effect analysed here.

Table 4 summarizes market Gini (G_X), which is the Gini computed using the income distribution before taxes and transfers, and the disposable Gini (G_Y) which refers to the distribution once transfers have been added to market income and taxes have been deducted. The difference accounts for the redistributive effect of the national tax-benefit systems in the 15 EU countries.

<Insert Table 4>

There are several observations. Firstly, the market Gini is slightly above 0.5 in Portugal, Spain and Ireland. It is around 0.5 in the UK, Belgium, Italy and Sweden and slightly below 0.5 in Greece, Finland, Germany, and France. Austria, Denmark and, more markedly, the Netherlands show the lowest of market Ginis in the EU. Differences in gross Gini among countries are never larger than 0.1 points. The correlation between average gross income and market Gini is negative and statistically different from zero for α=0,05 significance level when considering all 15 countries together.

The range of variation among countries in disposable Gini is wider. Disposable Gini ranks from 0.35 in Portugal to 0.23 in Austria. Higher inequality levels are in Southern countries, particularly (other than Portugal) Italy, Greece, followed by Spain, Ireland and the UK. At the other extreme with Gini coefficients between 0.23-0.26 we have Germany, Austria, Belgium, Finland, Denmark, Luxembourg and the Netherlands. For France and Sweden the Gini is around 0.28-0.29.[11] The correlation coefficient between disposable income inequality and average income levels is also negative and significantly different from zero for α=0,05 significance level.

[11] These figures of market Gini are substantially higher than others derived using LIS (see for instance market income Gini in Atkinson et al (1995)). This is because zero incomes are considered here whereas market inequality in Atkinson et al considers only non-zero market incomes.

The redistributive effects of the tax and transfer system, measured as the Gini reduction, are greater in Finland and Belgium (around 0.23). In Austria, Sweden and Germany the figure is also above 0.2. At the other extreme, it is particularly low in Greece (0.14) Portugal and Italy. France, Spain and the UK are in an intermediate position (around 0.19).

The correlation coefficient between the redistributive effect and average country income is positive and statistically different from zero for α=0,05 significance level. Figure 2 depicts the position of countries in a two-way scatter plot including the redistributive effect (RE) and mean average income, relative to European average. Low-income countries (Portugal, Spain and Greece) show a lower redistributive effect, although the Spanish RE is similar to that in some richer countries such as the UK and France. The redistributive effect of medium income countries is much contrasted: Italy has one of the lowest RE and Belgium and Finland show the largest.

<Insert Figure 2>

4. Market income inequality in EU regions

To what extent does market income inequality differ in EU regions? Are regional gross inequality levels similar for all regions in a given country? How does inequality change with regional economic performance?

Figure 3 shows the Gini coefficient in EU regions using our market income distribution and a confidence interval for this estimate. Countries and regions within a country are sorted by increasing (equivalent) income levels. Map 1 provides a picture of Europe in which regions are grouped into 5 classes according to the Gini level. Details about the relative position of the different regions in the EU ranking are included in Table A.16 in the appendix.

<Insert Figure 3 and Map 1>

The market Gini ranges from 0.42 (in the French region of Haute-Normandie) to 0.607 (in the Italian southern region of Sicilia). Among the lowest levels of market income inequality we find other regions in France (Alsace, Auvergne and Franche Comte), the West and South regions of Austria and some Italian regions (Emilia, Lazio and Sardegna). At the other extreme, regions with the highest levels of gross income inequality are to be found in some of the poorest regions of Italy (Balisicata/Calabria and Sicilia), Portugal (Algarve and Açores), Spain (both Castillas and Extremadura, Andalucia and the north west region), Germany (Schleswig-Holstein and Sachsen-Anhalt) and the North region and Northern Ireland in the UK. Market inequality is also relatively high in some of the more well off regions of the UK (Greater London) and Sweden (Stockholm). The majority of the regions (80% of the total) show a gross Gini coefficient between 0.44 and 0.53.

Within a country, differences in internal regional inequality are important in Germany and particularly in Italy. France, Spain, Portugal and the UK also show internal differences, although much smaller than Italy. In Greece, Finland, Austria and Belgium the gross Gini is more similar between regions. This can be clearly seen in Figure 4, a Box Plot, where the internal box line represents the median regional Gini and the box upper and lower bands indicate the regional Gini at the 25th and 75th percentiles. The lines extending above and below the box report the minimum and the maximum Ginis in each country and the symbol ° the outliers. It is interesting to notice that regional gross income inequality levels appear to be rather independent from the country in which regions belong. This is further confirmed by means of the estimation of an ANOVA model (See Table 5). A simple decomposition of the variance of the Ginis before the action of the tax-benefit shows that we cannot reject the null hypothesis that average regional market Ginis between countries are equal. In fact the country factor explains only 15% of the variance observed.

<Insert Figure 4 and Table 5>

Is there any correlation between inequality and average incomes at regional level?

Looking first at what happens in regions of a given country, Figure 3 suggests that there is not a clear relationship between inequality levels and the relative economic performance of the region. Internal regional inequality seems to increase with average regional income in Sweden and slightly decrease in Finland and Belgium. It shows an inverted U shape in Portugal (although it slightly increases in Lisboa), Greece and Spain whereas more irregular patterns in Italy, Germany, the UK and France. However, Figure 3 does not take into account actual average income values in the different regions. A two-way scatter plot is shown in Figure 5, that provides market Gini by market average equivalent income (in logs) in the different regions for each country. The axes of these plots are common to all countries. Notice that for most countries, there is a negative correlation between gross inequality levels and the economic performance of the region. The negative correlation is particularly high in Greece, Spain, Finland and Italy but it can also be observed in France, Germany, the UK and, to a lesser extent, in Portugal. Notice that in most of these countries, gross inequality increases slightly for the most well off region in the country. In most cases these regions contain the capital city. Only in Austria, Belgium and Sweden the correlation between market average and inequality levels is positive. In Belgium and Austria, countries with only three regions in our sample, the richest region (which contains the capital) shows inequality levels higher than the other two regions in the country and it dominates the trend. In Sweden, all regions show very similar average income levels except the richest, Stockholm, with higher inequality levels.

<Insert Figure 5>

Figure 6 shows the relationship between average (log) market equivalent income and market Gini for all 100 EU regions taken together. We also provide a Nadaraya-Watson non-parametric kernel regression adjusted to this bivariate distribution. A bandwidth of 0.4 is used and the weight function (kernel) to calculate the required univariate densities is biweight. We can see that the regression curve is rather flat for regions with very low average income levels (most regions in Portugal and the poorest regions of Spain, Greece and Italy) and the curve slightly decreases thereafter. More than 70 per cent of the regions are concentrated with an equivalent average income level above 1000 euros per month and the dispersion of original Gini among these relatively well-off regions is not so high. The small sample size of Bremen calls for care in its estimate. The case for the whole set of EU regions taken together suggests that we could be in the decreasing part of the inverted U curve as predicted by Kutznets.

<Insert Figure 6>

This negative association between market Gini and income is reinforced when the economic performance of the region is expressed as a relative magnitude of country's performance. This can be seen clearly in Figure 7, which provides the two-way relationship between market Gini and the relative economic performance of the region in the country (expressed in logs). Relatively well-off regions in a given country show gross inequality levels significantly lower than the less-well off regions, particularly those regions below country average. Here, we can notice the relatively low market inequality levels in the richest regions of Spain (Madrid), France (Ille de France) and Italy (Emilia).

<Insert Figure 7>

5. Disposable income inequality in EU regions

Map 2 and Figure 3 show the Gini coefficient using equivalent disposable income in the different regions. Table A.16. offers detail on the relative position of regions in the EU ranking in terms of the disposable Gini.

<Insert Map 2>

As we expected, for all regions the tax and transfer system substantially reduces personal inequality measured by the Gini. The Gini after tax and transfers ranks from 0.206 in the German region of Brandemburg to 0.377 again in Sicilia. Three Finnish regions (Väli-suomi, Etelä-suomi and Itä-suomi), four German regions (Sachsen-Anhalt, Sachsen, Thüringen and Brandenburg) and two Austrian regions (South and West) are among those regions with lower inequality levels after the operation of the tax and benefit system. The higher positions in the ranking of disposable income inequality are occupied by most regions from Southern countries; in Greece (all regions except Athina), Açores, Lisboa and Centro in Portugal, Sicilia, Basilicata/Calabria and Puglia in Italy but also some capitals in richer countries like Stockholm and Greater London.

Given the diverging sizes and structures of the different tax-benefit systems, the regional ranking in terms of disposable Gini is substantially modified depending on the country in which the different regions belong. For instance, Itä-Suomi in Finland ranked in the 7^{th} position after tax-transfers, is in position 86 in terms of inequality in market income and Sachsen-Anhalt in Germany occupies the 88^{th} position “before” while is ranked the 3^{rd} “after” the tax and transfer system applies (See Table A.16).

The level of disposable income inequality of a given region is to be observed as much more dependent on the country in which this region belongs. Figure 8 (box plot type) shows that most regions in Southern Europe (Portugal, Italy, Greece and Spain) show a Gini coefficient above .3. The UK regions follow with Gini coefficients around 0.3. Most French and Belgian regions are in the interval .25-.3. The lowest Gini are found in the Finnish regions and regions from Austria (values around .2-.25). There are significant differences in disposable inequality levels in regions in Sweden (between .25 and .35) and Germany (from around .2 to .3).

<Insert Figure 8>

These differences are further confirmed by means of an ANOVA analysis. The ANOVA analysis rejects the null hypothesis that the average disposable Ginis between countries are the same. In fact, the country factor explains more than 60% of the variance of the disposable Gini. (See Table 6). Thus, the country is, through the national tax-benefit system, a decisive factor of regions’ disposable income inequality while this is not so in the case of market income inequality, particularly among relatively less well off regions in a country.

<Insert Table 6>

Is there any correlation between disposable inequality and gross average incomes?

At the country level we again find no single tendency between disposable Gini and the economic performance of the region. The two-way scatter plot in Figure 9 provides the disposable Gini and average equivalent income in the different regions for each country. Notice that for most countries, there is now a positive correlation between gross inequality levels and the economic performance of the region. Internal regional disposable inequality now increases with average income of the region in Austria, Finland, France, Germany, Portugal, Sweden and the UK. It decreases in Greece and Italy; it is more inverted U-shaped in Belgium and constant in Spain.

<Insert Figure 9>

Combining this information for all regions in the EU, the relationship between these two variables is rather different (See Figure 10). We can see a group of low-income regions with high net inequality levels (all from Southern Europe) and a second group of more well off regions with lower disposable Gini. The non-parametric regression adjusted to these data allows us to confirm that for the group of better-off regions inequality tends to increase as average income rises. Among the richest regions, Stockholm and Greater London show relatively high inequality levels. Thus, by looking at the inequality once the tax-benefit has operated in the different regions, the Kutznets hypothesis would not seem to work. As a result of the tax-benefit system, net income inequality increases with the income level of the region within a country for most countries. On average, for the whole set of EU regions, disposable income inequality decreases from the low income level regions to the majority of medium income levels, but increases again for medium-high average income level regions.

<Insert Figure 10>

The relationship between disposable income inequality and relative economic performance of the region in the country is also of interest. This relationship is shown in Figure 11. The nonparametric regression shows almost no variation of disposable inequality in this case. Relative inequality is slightly higher in relatively poor and rich regions of a given country once the tax-benefit system has operated, although the dispersion around the non-parametric regression is considerable.

<Insert Figure 11>

6. The role of tax and transfers in reducing personal inequality in EU regions

Differences between market and disposable income inequality account for the redistributive impact of the tax-benefit system. The Gini reduction in EU regions is spread between 0.11 to around 0.32 (See Figure 12 and Map 3). It is larger (greater than 0.25) in one of the poorer Finnish regions (Itä-suomi), one Belgian region (Wallonie) and several German regions (Sachsen, Thüringen, Sachsen-Anhalt, Brandemburg and Hamburg). Conversily, the Gini reduction is smaller (lower than 0.15) in most Greek regions (except Athina), but also in several of the richest regions in southern European countries (Madrid in Spain, Emilia, North, Lombardia, Lazio in Italy and Norte in Portugal) and the South East region in England.

As we expected, average Gini reduction of regions in a given country is very close to the countries' redistributive effect shown in Section 3. On average regional inequality is most reduced in the Belgian regions, followed by the regions in Finland and Germany. In all these countries the average reduction is above 0.23. The average redistributive impact is around 0.2 in Austria and the Swedish and French regions and just below that in the UK and Spain. Finally, the redistributive impact is between 0.14 and 0.17 per cent in Greece, Italy and Portugal. The variation of the redistributive impact between regions of a given country is considerable.

<Insert Figure 12 and Map 3>

The same sort of information is provided by Figures 13 and 14, which show the relationship between the Gini reduction and average market (log) income. As we could predict from our previous analysis, Figure 13 shows that the effectiveness of the tax-benefit system appears to be relatively low among the group of poorer regions of Portugal, Spain, Greece and Italy. For regions with average monthly gross income around 1.100 (per equivalent adult) the degree of effectiveness increases although is greatly spread. For the richest regions, the effectiveness decreases again.

The negative relationship between redistributive effect and economic performance is clearer when average incomes are expressed in relative terms to the country average. This relationship is shown in Figure 14, which is close to linear. As can be clearly seen, the relative performance of national tax-benefit systems in terms of redistributive impact is higher in relatively less well-off regions and lower in the best performing ones.

<Insert Figure 13 and 14>

7. Co-movements: inequality, redistribution and economic performance

In our previous analysis we have shown that the country in which the region is located is, through the tax-benefit system, decisive in the disposable income inequality of the region while it is not in the case of market inequality.

But given the negative and significant correlation between average country incomes and income inequality (See Table 4) we expect market and, even more, disposable inequality at regional level to depend on the economic performance of the country (relative to EU average). Table 7 shows OLS fit of market and disposable Ginis against the relative economic performance of the region (region_rel) and the relative performance of the country (relative to European average) (country_rel) as summarized in the following equations:

$$G_{Xi}^{j} = \beta_0 + \beta_1 \ln(\frac{X^j}{X}) + \beta_2 \ln(\frac{X_i^j}{X^j}) + \varepsilon_i$$

$$G_{Yi}^{j} = \beta_0 + \beta_1 \ln(\frac{X^j}{X}) + \beta_2 \ln(\frac{X_i^j}{X^j}) + \varepsilon_i$$

Where G_{xi}^{j} and G_{Yi}^{j} is the market and disposable Gini in region i in country j, $\ln(X_i^j/X^j)$ is the log of market equivalent income in region i expressed in relation to the country average and $\ln(X^j/X)$ is the log of market income in country j in relation to the EU average. Regional relative income is significant and negative for market inequality and national relative income is significant too although to a lesser extent; national relative income is significant and positive for disposable Gini and regional relative income is not.

<Insert Table 7>

The redistributive effect, in turn, depends not only on the country relative performance but also on the regional relative performance. Table 7 shows also the results of fitting the following equation:

$$G_{Xi}^{j} - G_{Yi}^{j} = b_0 + b_1 G_{Xi}^{j} + b_2 \ln(X^{j} / X) + b_3 \ln(X_i^{j} / X^{j}) + e_i$$

Given a market Gini coefficient, regions in better-off countries will show a larger redistributive effect, but relative well-off regions within a country will see their redistributive impact limited. The size of these two effects is about the same on average.

Taking into account these different elements, our analysis shows that the redistributive impact of national tax-benefit systems on regional inequality positively depends on the relative income level of the country and negatively on the relative economic performance of the region. This implies systematic rank order changes between market and disposable Ginis: from high market Ginis to low disposable Ginis in rich countries' regions, as well as from low market Ginis to high disposable Ginis in relatively rich regions of a given country. The poorest outcomes in terms of redistributive impact are found in relatively rich regions of less well off countries.

8. The "country effect" on regional inequality

Our analysis also suggests that behind the country's economic performance there are quite different country redistributive experiences. It makes sense, therefore, to replace in equation above the country's economic performance by a set of country dummies (fixed effect). Table 8 shows the results of fitting the following equation by OLS:

$$G_{Xi}^{j} - G_{Yi}^{j} = b_0 + b_1 G_{Xi}^{j} + b_3 \ln(X_i^{j} / X^{j}) + \sum_{j=1}^{11} b_{2j} P_{ji} + e_i$$

Where $G_{Xi} - G_{Yi}$ measures the redistributive impact of the tax and transfer system in region *i*, and as in previous equation G_{Xi} is the market Gini, $\ln(X_i^j/X^j)$ is the log of region market income expressed in relation to the country average (region_rel) and P_{ji} is a country dummy for each region. The country dummy (or country fixed effect) measures differences in regional inequality that cannot be attributed to "market" inequality or to regional relative economic performance. The fixed effect would be picking up differences in the structure and size of tax-benefit system as well as other country specificities attributed, among other things, to data quality in countries.

<Insert Table 8>

The adjustment of this regression is high as the R-squared value is 0.85. The results indicate several interesting facts. As expected, there is a positive correlation between the redistributive impact of the tax-benefit system and market inequality. Once we control by the "country" dummy, the redistributive effect of the tax-benefit is lower in more prosperous regions ($ß_2$ is negative). In other words, in a given country, the tax benefit system is more effective in poor than in rich regions. The "country" fixed effect enables countries to be grouped in 4 categories. The largest "country" effect takes place in regions of Austria, Belgium, Germany and Finland (Group 1). The poorest effect is in regions of Southern countries (Portugal, Greece and Italy- Group 4). On average, these Southern regions show a Gini reduction of 0.08 points lower than those in "similar" regions of Austria, Belgium and Finland. The country impact is also important in France and Sweden (Group 2). In these cases, the tax-benefit system would explain Gini reductions around 0.02 lower than the one in an equivalent region in Group 1. Finally, regions in the UK and Spain would show a post tax-benefit Gini 0.04 points more than equivalent regions in Group 1.

Table 9 summarizes the test regarding the differences in parameters $ß_3$ by pairs of countries. We have performed the test $ß_{3j}- ß_{3k}= 0$ for country j different from country k. An '=' means that the redistributive effect in regions in the two countries compared is not statistically different. '+' implies that a region in country in row shows a larger redistributive effect than a region in country in column. The four groups of countries above mentioned can be clearly identified.

<Insert Table 9>

8. Final comments

The main findings from our description of inequality levels before and after redistribution through the tax-benefit systems in 100 EU regions can be summarised as follows.

Both market and disposable regional inequality levels differ significantly in the different EU regions but in very different ways. We have found that tax-benefits systems in Europe notably reduce market inequality in all EU regions and that the size of this reduction (i.e. redistributive effect) depends crucially on:

(i) the market inequality level of the region
(ii) the country to which the region belongs, and its economic performance
(iii) the relative economic performance of the region in the country.

Firstly, the size of the redistributive impact is larger in more unequal regions in terms of market income. Secondly, more redistributive systems at the level of the whole country show a larger redistributive impact in its territorial units. The best performing systems in terms of internal regional inequality reduction appear to be Finland, Germany, Austria and Belgium. The tax-benefit systems of Sweden and France would make up the 2nd best performing group. The 3rd would be Spain and the UK. Finally, the lower redistributive impact groups the systems in Greece, Portugal and Italy. Moreover, EU regional evidence suggests a positive co-movement between the country's economic performance and the inequality reduction: the richer a country is, the larger is its redistributive impact on regional inequality. We have emphasised that differences in the redistributive effect among countries cannot be attributable only to the size and structure of the tax-benefit system but also to systematic differences in other country specific characteristics such as income data quality.

Thirdly, the richer the region is in the country, the more limited the redistributive impact is. The redistributive impact turns out to be particularly high for the poorest regions in a country, but particularly weak in the wealthiest ones, often urban regions including the capital city of the country. Paradoxically, some of the new forms of extreme poverty and wealth are particularly associated to "richer" and more urban regions. This finding suggests the need for further intervention at the level of the regional and "metropolitan" governments.

Our analysis also provides new evidence on the relationship between inequality and economic performance in the EU regions. This relationship turns out to depend on the income distribution chosen (market or disposable income). While for the 100 EU regions taken together, we find a negative relationship between market income inequality and economic performance (this is also the case for the majority of individual countries) it is not the case when disposable Gini is considered. Moreover, interestingly, while regional market inequality levels appear to be rather independent from the country in which the regions belong, the country factor explains more than two thirds of the variance of the disposable regional income inequality.

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Tables and figures

Table 1: Databases used in each country

Country	Base Dataset for EUROMOD	Date of collection	Reference time period for incomes
Austria	Austrian version of European Community Household Panel (W5)	1999	annual 1998
Belgium	Panel Survey on Belgian Households (W6)	1999	annual 1998
Denmark	European Community Household Panel (W2)	1995	annual 1994
Finland	Income distribution survey	1998	annual 1998
France	Budget de Famille	1994/5	annual 1993/4
Germany	German Socio-Economic Panel (W15)	1998	annual 1997
Greece	European Community Household Panel (W2)	1995	annual 1995
Ireland	Living in Ireland Survey (W1)	1994	month in 1994
Italy	Survey of Households Income and Wealth	1996	annual 1995
Luxembourg	PSELL-2 (W5)	1999	annual 1998
Netherlands	Sociaal-economisch panelonderzoek (W3)	1996	annual 1995
Portugal	European Community Household Panel (W3)	1996	annual 1995
Spain	European Community Household Panel (W3)	1996	annual 1995
Sweden	Income distribution survey	1997	annual 1997
UK	Family Expenditure Survey	1995/6	monthly in 1995/6

Table 2. Regional information in EUROMOD national databases

Country	Information available in EUROMOD	Information used in our analysis	Average population per region	Number of regions
Austria	NUTS1	NUTS1	2,645,969	3
Belgium	NUTS1	NUTS1	3,299,186	3
Denmark	NUTS1	Not considered		
Finland	NUTS3	NUTS2	814,532	6
France	NUTS2	NUTS2	2,588,033	22
Germany	NUTS1	NUTS1	4,966,341	16
Greece	NUTS1	NUTS1	2,635,525	4
Ireland	Different system	Not considered		
Italy	NUTS1+ South Split	NUTS1+ South Split	4,767,237	12
Luxembourg	Dif. System	Not considered		
Netherlands	NUTS1	Not considered		
Portugal	NUTS2	NUTS2	1,417,429	7
Spain	NUTS1	NUTS1	5,557,837	7
Sweden	Dif. System	NUTS2	1,123,557	8
UK	NUTS1+Greater London	NUTS1+Greater London	4,786,980	12

Figure 1: From market to disposable income

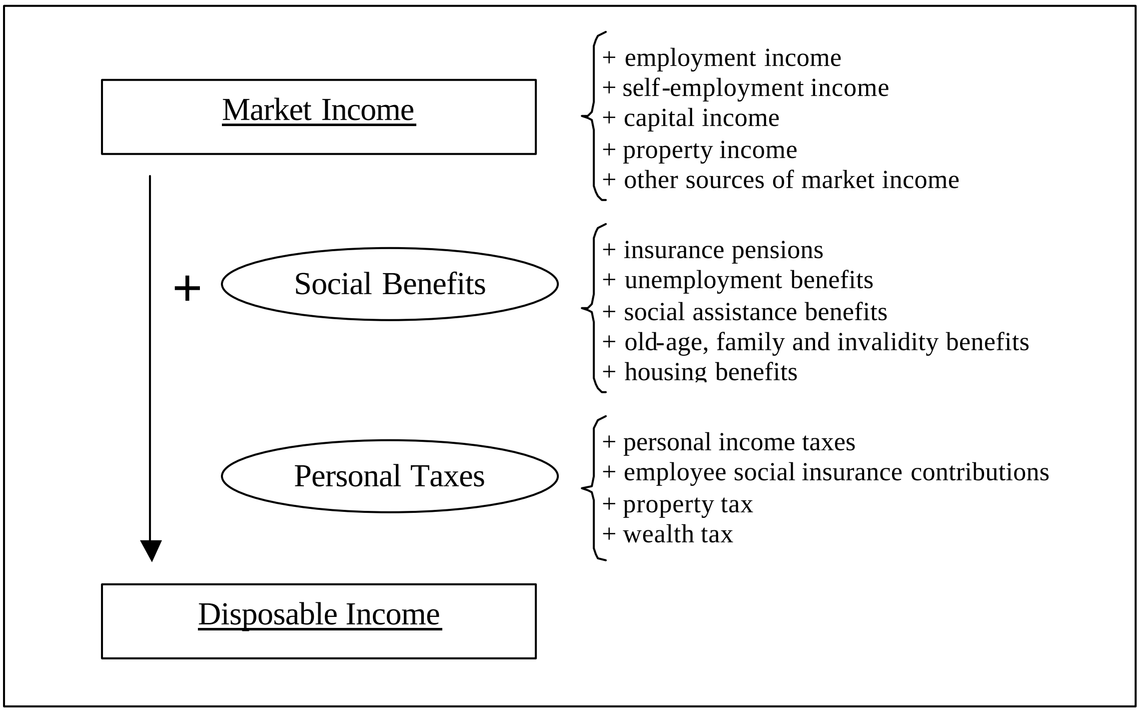


Table 3: Regions in EUROMOD and sample sizes.

Country	Country Code	Region Name	NUTS abbreviation	Sample size
Portugal	**12**	Madeira	PT3	598
	12	Açores	PT2	599
	12	Algarve	PT15	637
	12	Centro	PT12	1,027
	12	Alentejo	PT14	514
	12	Norte	PT11	840
	12	Lisboa E Vale Do Tejo	PT13	591
Greece	**7**	Thraki, Makedonia, Thessalia	GR1	1,660
	7	Dellada, Sterea, Pelloponisos, Ionia Nisia Ipiros	GR2	1,251
	7	Notio Aigaio, Voreio Aigaio, Kriti	GR4	656
	7	Athina	GR3	1,601
Spain	**13**	Canarias	ES7	380
	13	Andalucia, Murcia	ES6	1,013
	13	Cast Leon, Cast Mancha, Extremadura	ES4	959
	13	Galicia, Asturias, Cantabria	ES1	895
	13	Catalunya, Valen, Baleares	ES5	1,375
	13	Euskadi, Navarra, Rioja, Aragón	ES2	960
	13	Madrid	ES3	537
Italy	**9**	Sicilia	ITA	559
	9	Basilicata/Calabria	IT92	389
	9	Campania	IT8	709
	9	Puglia	IT91	520
	9	Sardegna	ITB	295
	9	Abruzzo-Molise	IT7	396
	9	Lazio	IT6	411
	9	Center	IT5	1,250
	9	North-east	IT3	1,009
	9	North-west	IT1	1,048
	9	Lombardia	IT2	824
	9	Emilia	IT4	725
Belgium	**2**	Flandre	BE2	1,961
	2	Wallonie	BE3	1,300
	2	Bruxelles	BE1	393
Sweden	**14**	Smaland med oarna	SE03	1,607
	14	Norra Melansverige	SE06	1,235
	14	Mellersta Norrland	SE07	888
	14	Ovre Norrland	SE08	1,049
	14	Vastsverige	SE05	4,448
	14	Sydsverige	SE04	2,889
	14	Östra mellansverige	SE02	3,404
	14	Stockholm	SE01	4,114
Finland	**4**	Itä-suomi	FI13	1,394
	4	Väli-suomi	FI14	1,364
	4	Pohjois-suomi	FI15	762
	4	Etelä-suomi	FI12	3,276
	4	Ahvenanmaa/aland	FI2	44
	4	Uusimaa	FI11	2,152
UK	**15**	Northern Ireland	UKB	134
	15	North	UK1	405

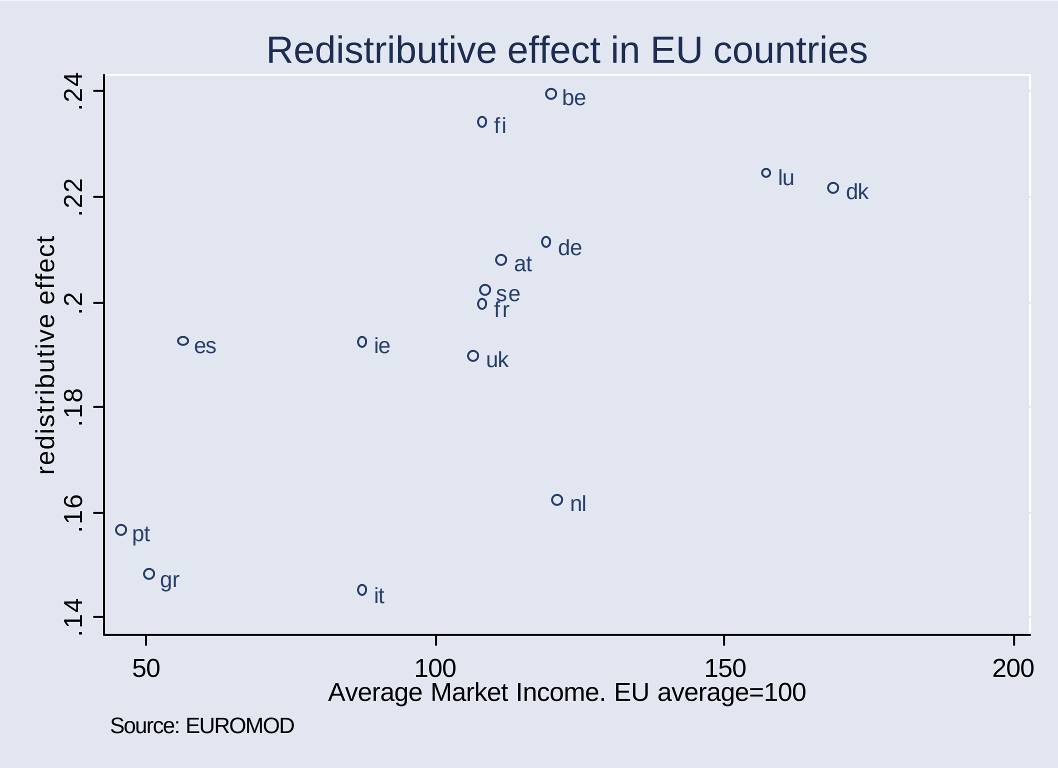
	15	West Midlands	UK7	621
	15	Scotland	UKA	604
	15	Yorks & Humberside	UK2	594
	15	East Anglia	UK4	282
	15	North West	UK8	722
	15	Wales	UK9	339
	15	East Midlands	UK3	491
	15	South West	UK6	637
	15	South East	UK5	1,274
	15	Greater London	UK55	694
Germany	**6**	Thüringen	DEG	358
	6	Sachsen-Anhalt	DEE	356
	6	Sachsen	DED	594
	6	Mecklenburg-Vorpommern	DE8	216
	6	Brandenburg	DE4	318
	6	Rheinland Pfalz / Saarland	DEB	417
	6	Bremen	DE5	61
	6	Berlin-Ost	DE3	189
	6	Niedersachsen	DE9	626
	6	Baden-Würtemberg	DE1	934
	6	Hamburg	DE6	97
	6	Bayern	DE2	984
	6	Saarland	DEC	134
	6	Nordrhein Westfalen	DEA	1,508
	6	Schleswig-Holstein	DEF	190
	6	Hessen	DE7	498
France	**5**	Corse	FR83	38
	5	Nord-Pas De Calais	FR3	715
	5	Basse-Normandie	FR25	281
	5	Auvergne	FR72	234
	5	Champagne-Ardennes	FR21	305
	5	Poitou-Charentes	FR53	309
	5	Languedoc-Roussillon	FR81	437
	5	Bretagne	FR52	582
	5	Pays De La Loire	FR51	653
	5	Centre	FR24	434
	5	Limousin	FR63	153
	5	Franche Comte	FR43	256
	5	Bourgogne	FR26	320
	5	Aquitaine	FR61	585
	5	Midi-Pyrenees	FR62	523
	5	Haute-Normandie	FR23	355
	5	Picardie	FR22	305
	5	Rhone-Alpes	FR71	949
	5	Provence-Alpes-Cote Dazur	FR82	879
	5	Lorraine	FR41	472
	5	Alsace	FR42	367
	5	Ile De France	FR1	2,139
Austria	**1**	West: Oberösterreich, Salzburg, Tirol, Vorarlberg	AT3	879
	1	South: Kärnten, Steiermark	AT2	648
	1	East: Wien, Burgenland, Niederösterreich	AT1	1,145

Table 4: Inequality, redistribution and economic performance in EU countries.

	Average market income relative to EU average **X**	**Market Gini** **G_X**	**Disposable Gini** **G_Y**	**$G_X - G_Y$**
Portugal	0.46	0.51425	0.35764	0.15661
		(0.00850)	(0.00667)	(0.00502)
Greece	0.50	0.48416	0.33627	0.14788
		(0.00582)	(0.00416)	(0.00394)
Spain	0.56	0.51995	0.32757	0.19239
		(0.00609)	(0.00398)	(0.00369)
Ireland	0.87	0.51596	0.32364	0.19232
		(0.01033)	(0.00855)	(0.00519)
Italy	0.87	0.49693	0.35201	0.14491
		(0.00613)	(0.00536)	(0.00366)
UK	1.07	0.50216	0.31257	0.1896
		(0.00527)	(0.00354)	(0.00300)
France	1.08	0.48624	0.28689	0.19935
		(0.00383)	(0.00295)	(0.00275)
Finland	1.08	0.48182	0.2477	0.23412
		(0.00589)	(0.00513)	(0.00387)
Sweden	1.09	0.49925	0.29714	0.20211
		(0.00593)	(0.00748)	(0.00308)
Austria	1.12	0.44078	0.23297	0.20781
		(0.00845)	(0.00501)	(0.00561)
Germany	1.19	0.47013	0.25899	0.21114
		(0.00686)	(0.00412)	(0.00459)
Belgium	1.20	0.50328	0.26393	0.23935
		(0.01118)	(0.00846)	(0.00568)
Netherlands	1.21	0.41097	0.24889	0.16208
		(0.00625)	(0.00364)	(0.00427)
Luxembourg	1.57	0.48072	0.25631	0.22441
		(0.00667)	(0.00472)	(0.00574)
Denmark	1.69	0.45667	0.23517	0.2215
		(0.01083)	(0.00803)	(0.00600)
(standard errors in brackets)				
Correlation coefficient with X		-0.5172	-0.8187	0.6577
(p-values)		(0.04840)	(0.00020)	(0.00770)

Source: EUROMOD.
Note: Unit of analysis: Household. Distributions are equivalised using the modified OECD scale. Households are weighted according to the number of members.

Figure 2.


Redistributive effect in EU countries
redistributive effect
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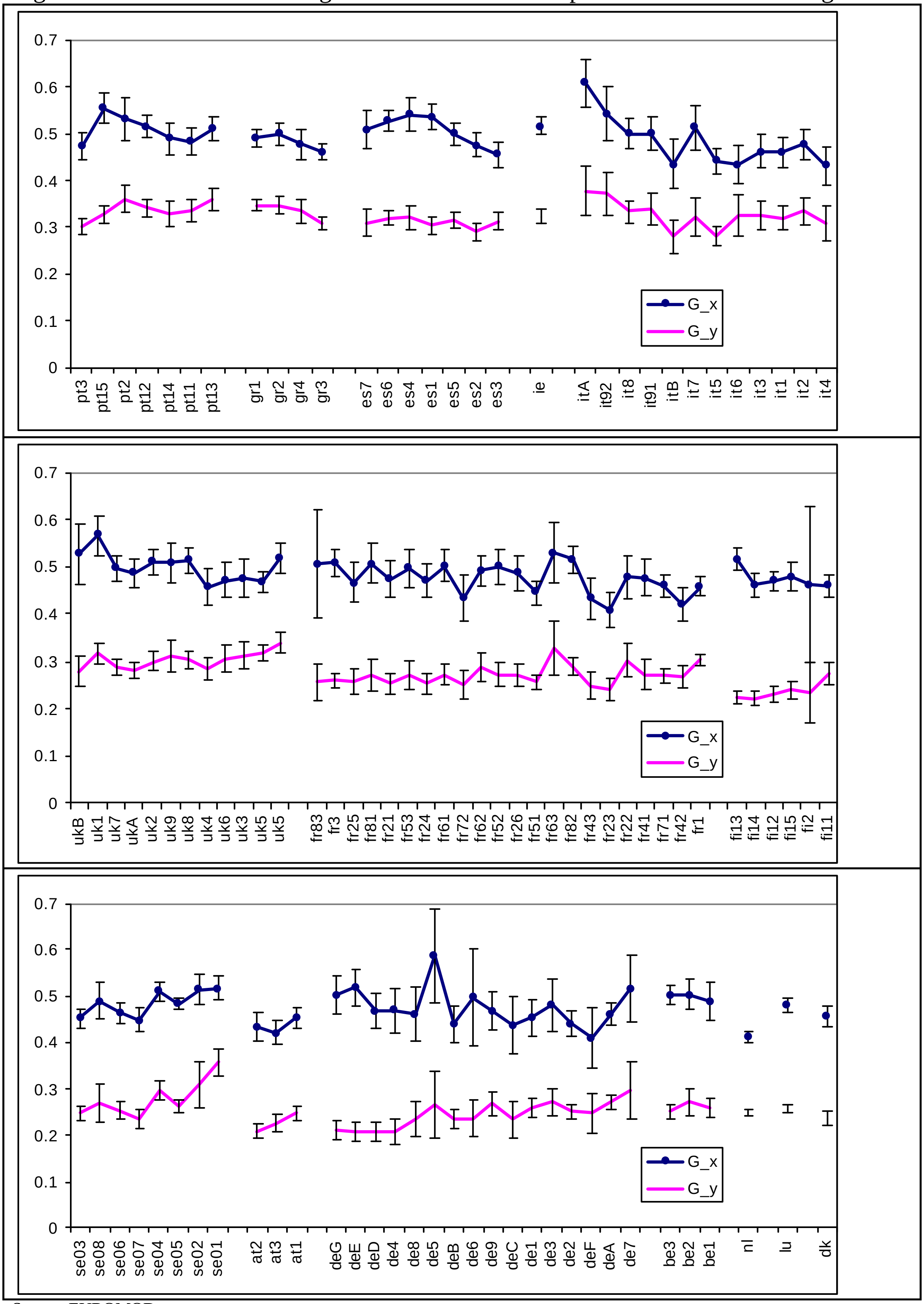
150
200
Average Market Income. EU average=100
Source: EUROMOD

Figure 3: Gini coefficient using market income and disposable income in EU regions.



Source: EUROMOD.

Note. Unit of analysis: Household. Distributions are equivalised using the modified OECD scale. Households are weighted according to the number f persons.

Figure 4.

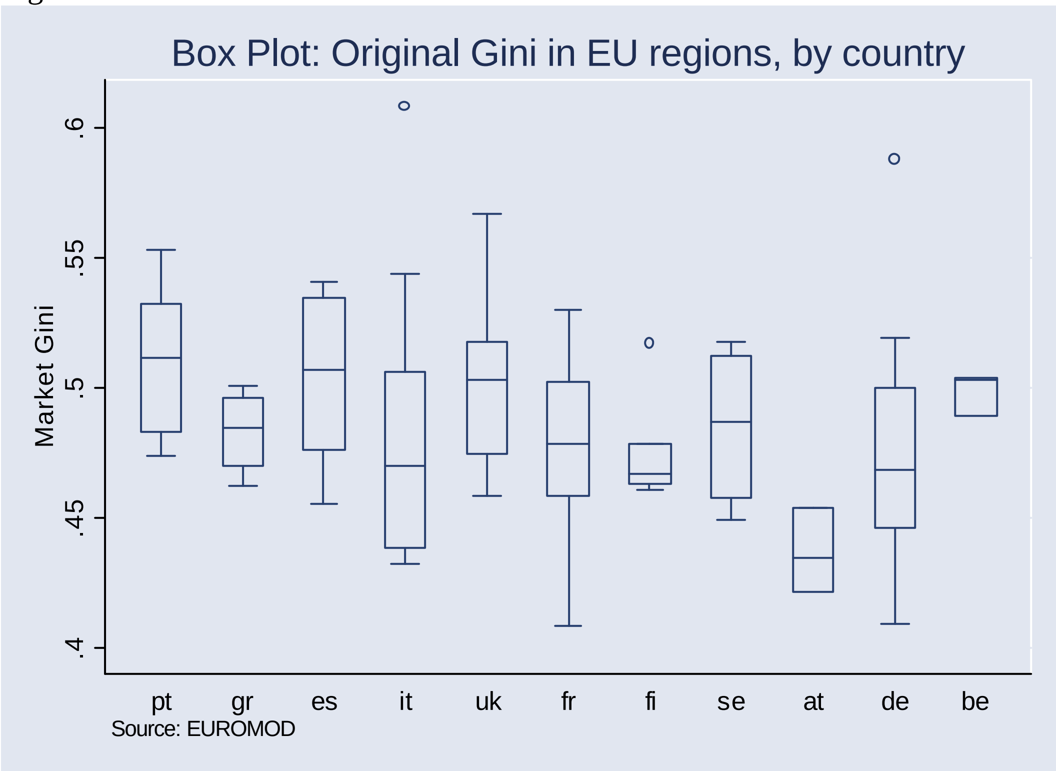


Table 5: Decomposition of the Variance of market and disposable Gini (ANOVA). Factor: country.

```
anova orig_gini country

                           Number of obs =      100     R-squared     =  0.1617
                           Root MSE      = .035199     Adj R-squared =  0.0675

                  Source |  Partial SS    df       MS           F     Prob > F
              -----------+----------------------------------------------------
                   Model |  .021272487    10  .002127249       1.72     0.0891
                         |
                 country |  .021272487    10  .002127249       1.72     0.0891
                         |
                Residual |  .110267137    89  .001238957
              -----------+----------------------------------------------------
                   Total |  .131539624    99  .001328683
```

Figure 5.

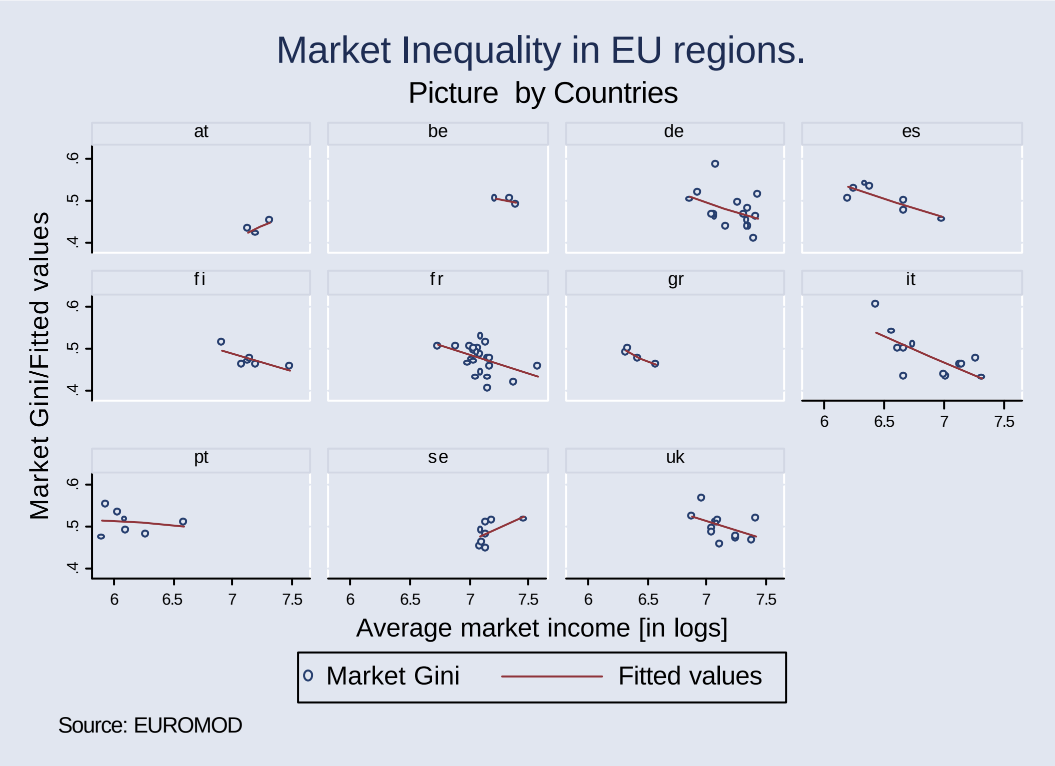
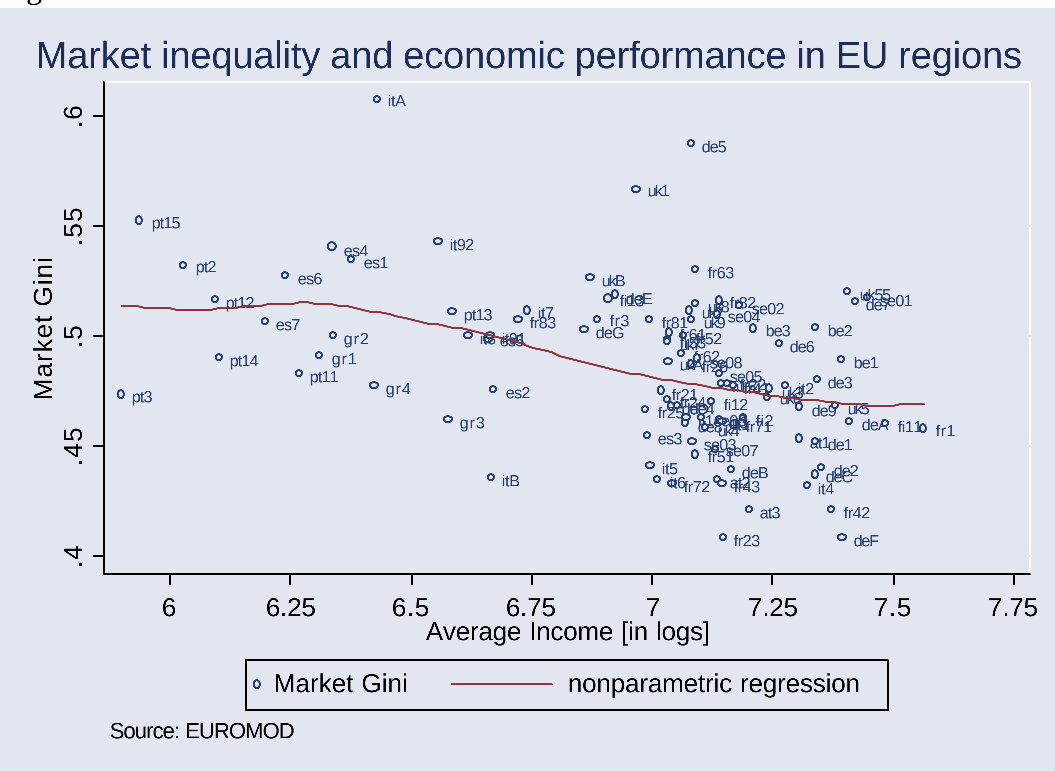
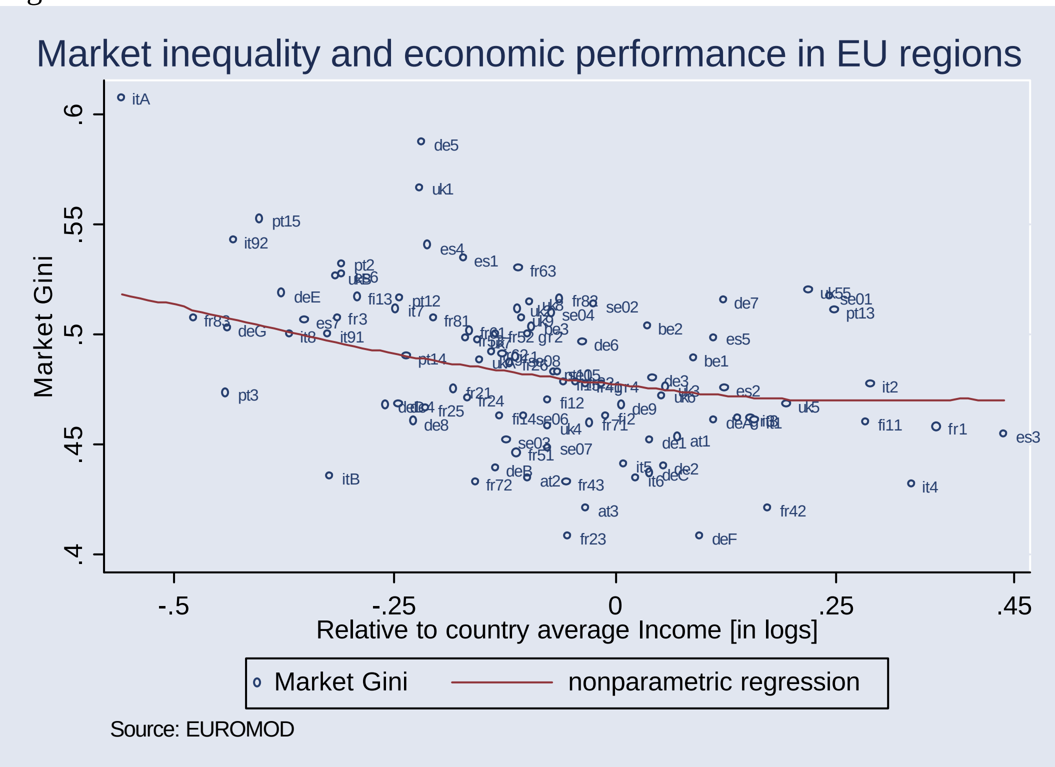


Figure 6.



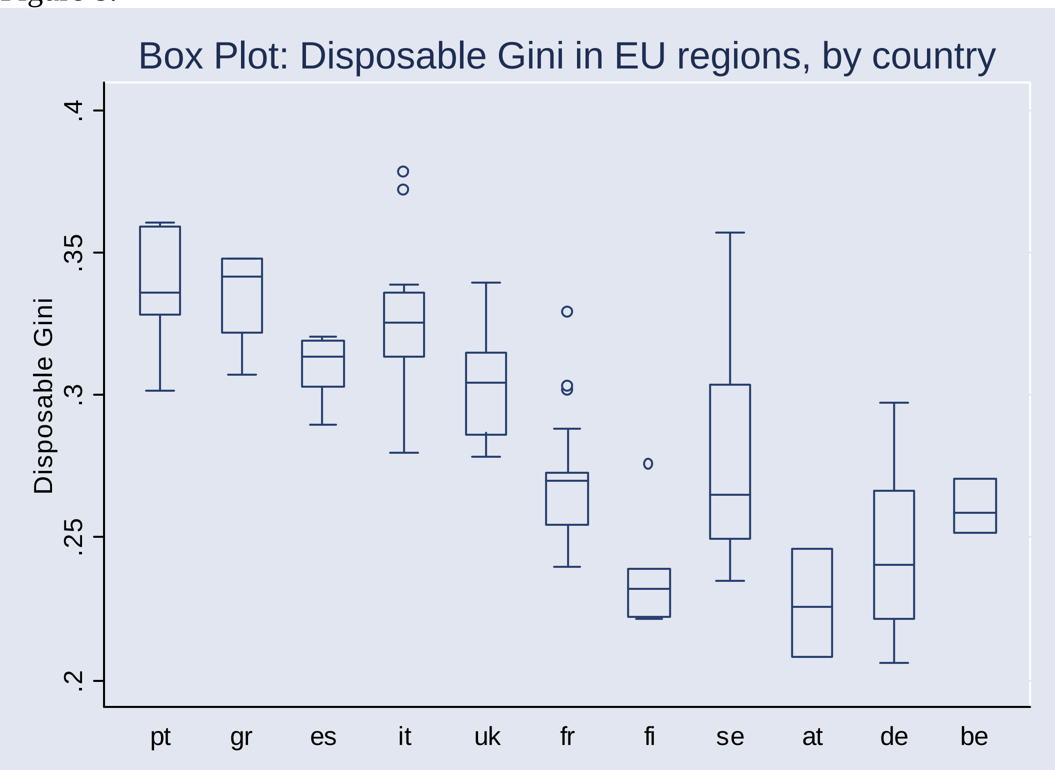
Note Dotted line is shows the Nadaraya-Watson nonparametric regression with a bandwidth of 0.4 The weight function (kernel) to calculate the required univariate densities is Biweight. The number of equally spaced points (which define a grid) used for the regression estimation is 100.

Figure 7.



Note Dotted line is shows the Nadaraya-Watson nonparametric regression with a bandwidth of 0.4 The weight function (kernel) to calculate the required univariate densities is Biweight. The number of equally spaced points (which define a grid) used for the regression estimation is 100.

Figure 8:



Note: Market Gini is calculated using the household income before tax and transfers. The distribution is equivalised using the modified OECD scale. Each household is weighted according to the number of members.

Table 6: Decomposition of the Variance of disposable Gini (ANOVA). Factor Country.

```
anova disp_gini country
                           Number of obs =      100     R-squared     =  0.6887
                           Root MSE      = .024189     Adj R-squared =  0.6537

                  Source |  Partial SS    df       MS           F     Prob > F
              -----------+----------------------------------------------------
                   Model |  .115189568    10  .011518957      19.69     0.0000
                         |
                 country |  .115189568    10  .011518957      19.69     0.0000
                         |
                Residual |  .052076204    89  .000585126
              -----------+----------------------------------------------------
                   Total |  .167265772    99  .001689553
```

Figure 9.

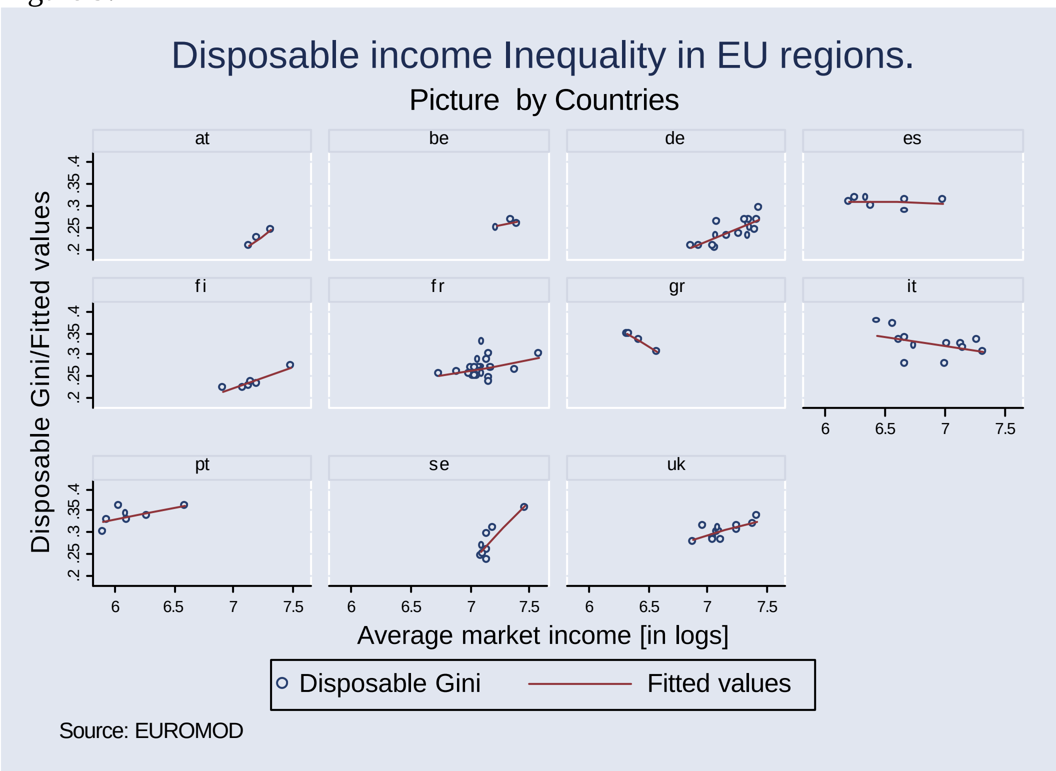
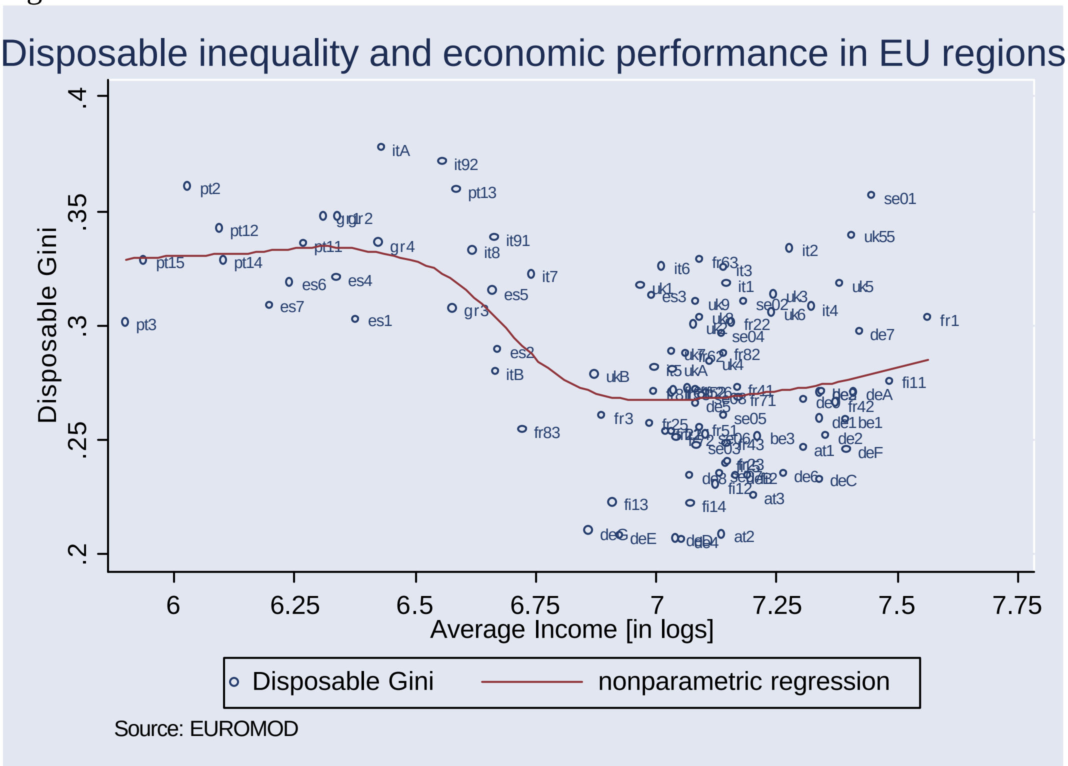
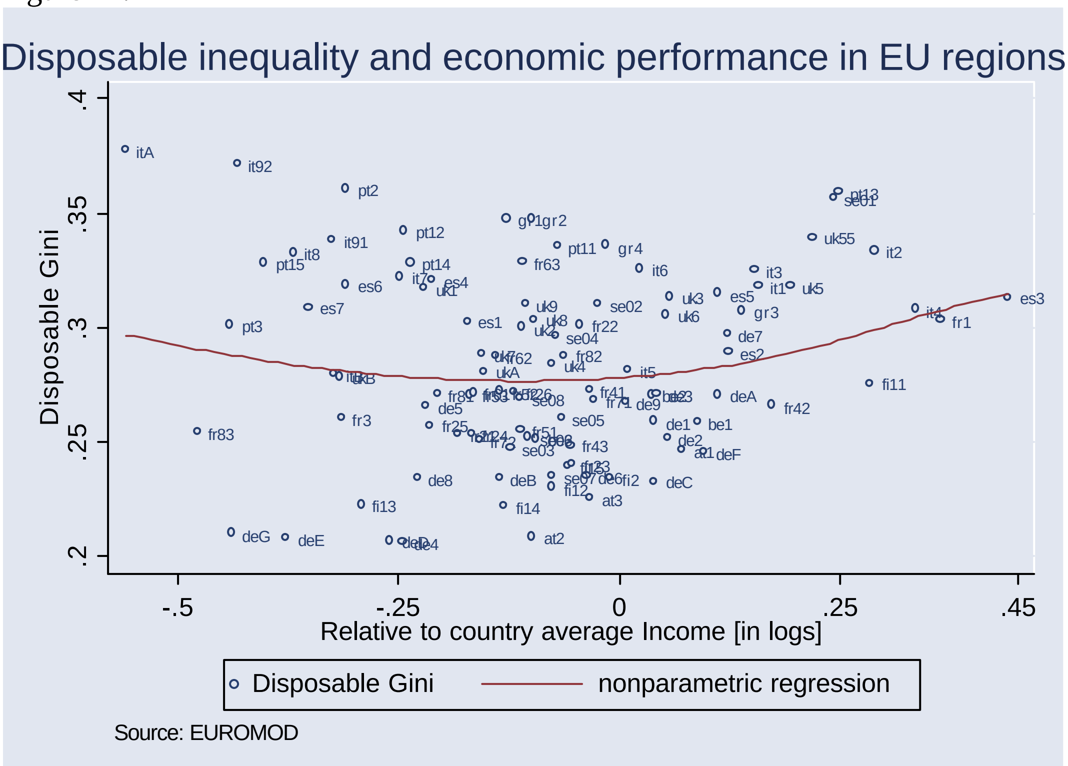


Figure 10.



Note Dotted line is shows the Nadaraya-Watson nonparametric regression with a bandwidth of 0.4 The weight function (kernel) to calculate the required univariate densities is Biweight. The number of equally spaced points (which define a grid) used for the regression estimation is 100.

Figure 11.



Note Dotted line is shows the Nadaraya-Watson nonparametric regression with a bandwidth of 0.4 The weight function (kernel) to calculate the required univariate densities is Biweight. The number of equally spaced points (which define a grid) used for the regression estimation is 100.

Figure 12: Redistributive effect of the tax-benefit system in EU regions.

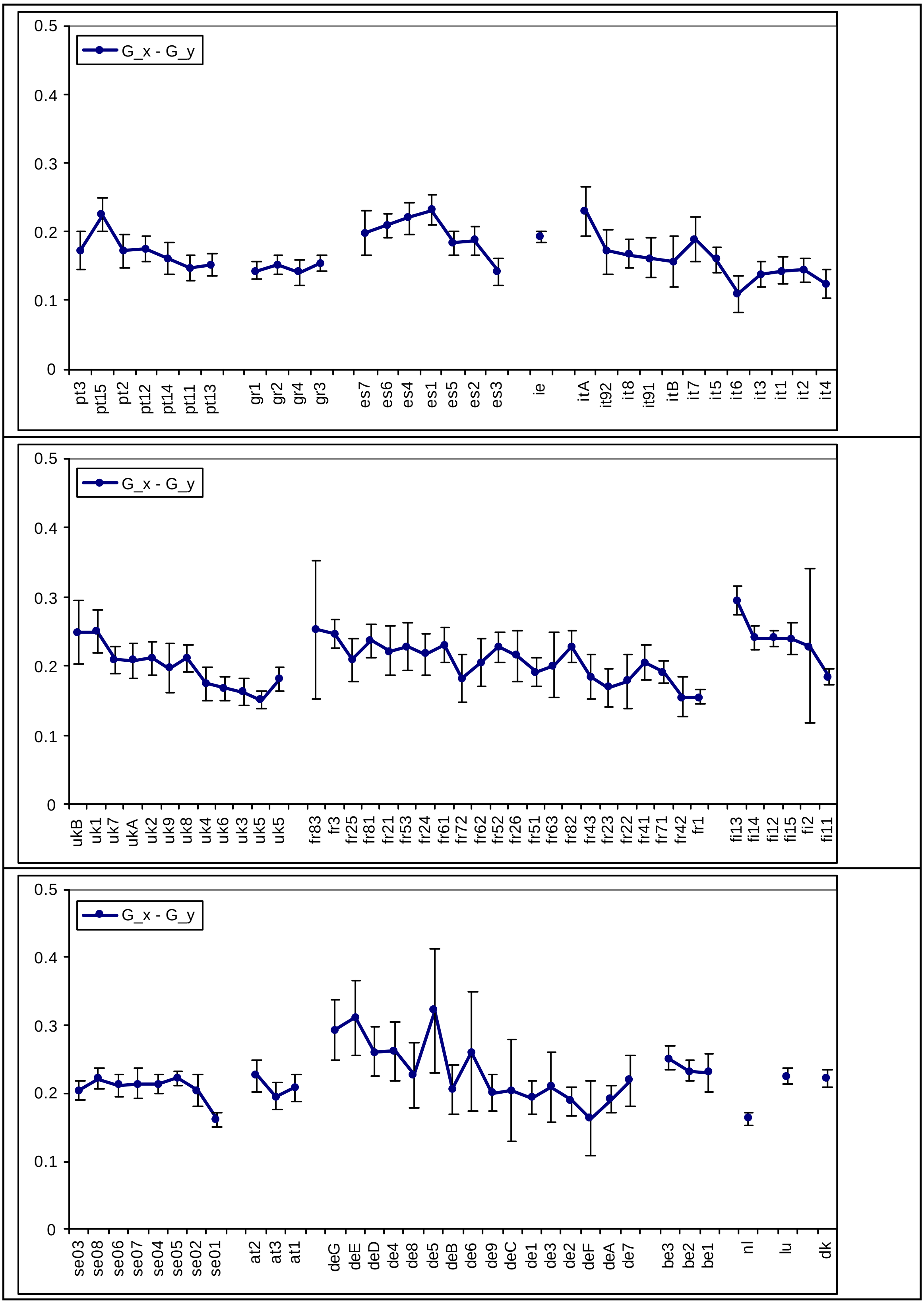
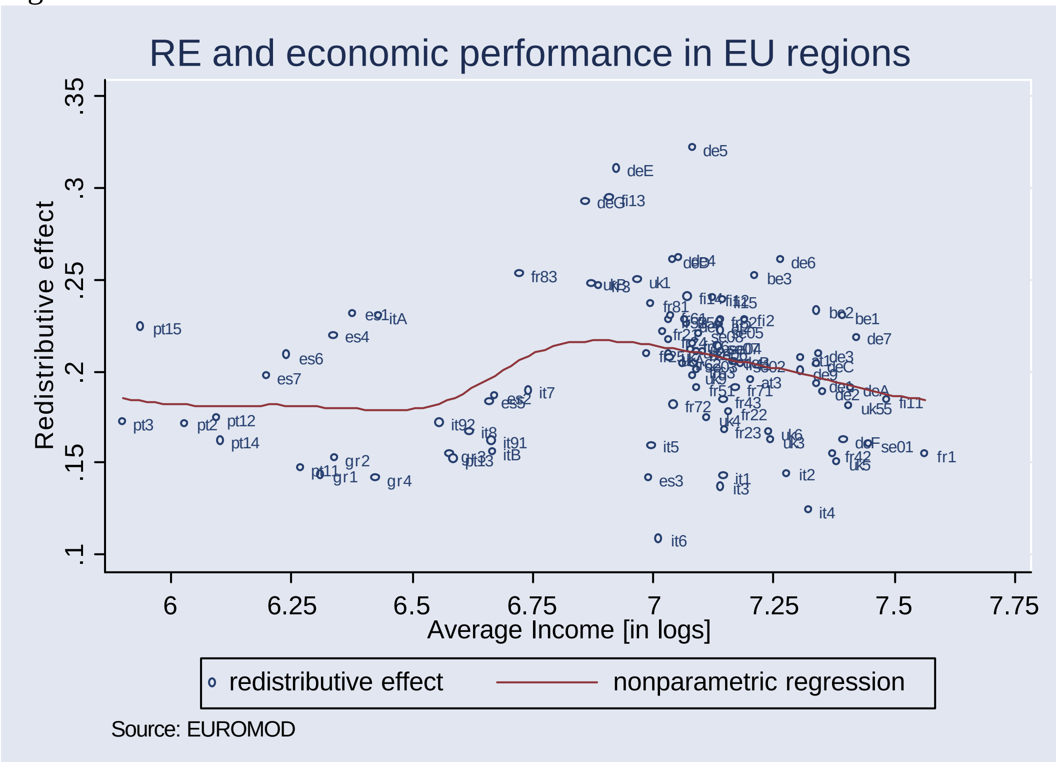
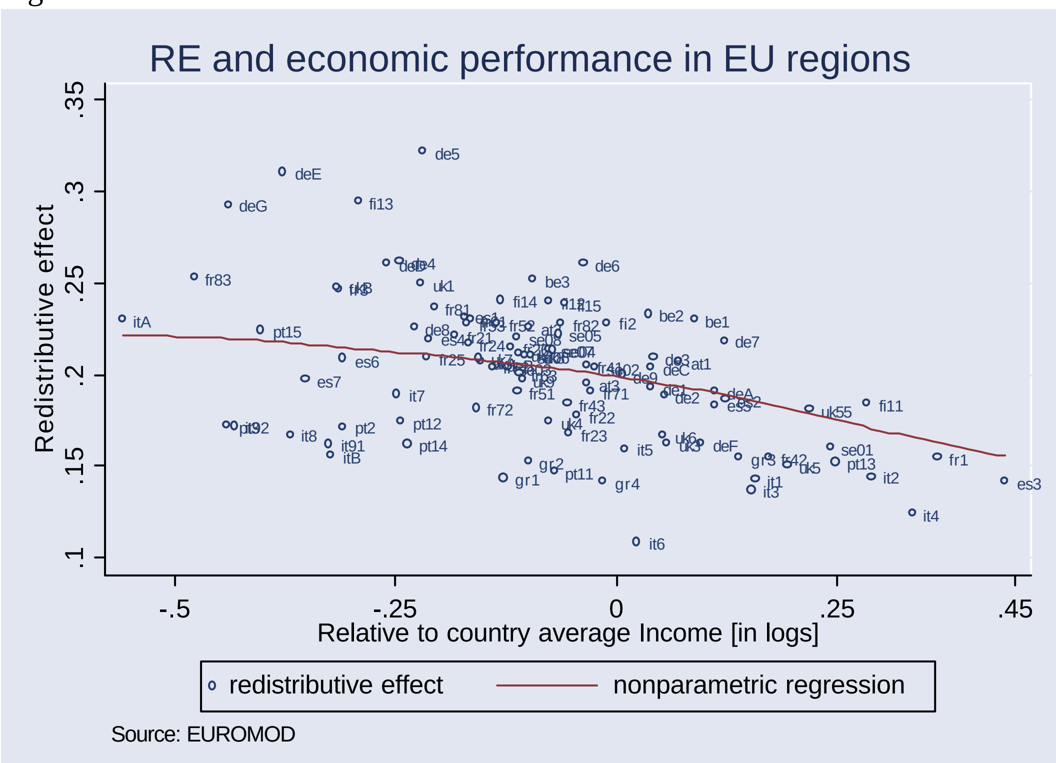


Figure 13.



Note Dotted line is shows the Nadaraya-Watson nonparametric regression with a bandwidth of 0.4 The weight function (kernel) to calculate the required univariate densities is Biweight. The number of equally spaced points (which define a grid) used for the regression estimation is 100.

Figure 14.



Note Dotted line is shows the Nadaraya-Watson nonparametric regression with a bandwidth of 0.4 The weight function (kernel) to calculate the required univariate densities is Biweight. The number of equally spaced points (which define a grid) used for the regression estimation is 100.

Table 7: Inequality, redistribution and economic performance

Market Gini

$$G^j_{xi} = \mathbf{b}_0 + \mathbf{b}_1 \ln(\frac{X^j}{X}) + \mathbf{b}_2 \ln(\frac{X^j_i}{X^j})$$

Source	SS	df	MS
Model	.032102403	2	.016051202
Residual	.09943722	97	.001025126
Total	.131539624	99	.001328683

Number of obs	=	100
F(2, 97)	=	15.66
Prob > F	=	0.0000
R-squared	=	0.2441
Adj R-squared	=	0.2285
Root MSE	=	.03202

orig_gini	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
country_rel	-.0225833	.010596	-2.13	0.036	-.0436135	-.001553
region_rel	-.0826846	.0166385	-4.97	0.000	-.1157074	-.0496619
_cons	.4761226	.0035369	134.61	0.000	.4691027	.4831424

Disposable Gini

$$G^j_{Yi} = \mathbf{b}_0 + \mathbf{b}_1 \ln(\frac{X^j}{X}) + \mathbf{b}_2 \ln(\frac{X^j_i}{X^j})$$

Source	SS	df	MS
Model	.06957101	2	.034785505
Residual	.097694762	97	.001007162
Total	.167265772	99	.001689553

Number of obs	=	100
F(2, 97)	=	34.54
Prob > F	=	0.0000
R-squared	=	0.4159
Adj R-squared	=	0.4039
Root MSE	=	.03174

disp_gini	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
country_rel	-.0865462	.0105028	-8.24	0.000	-.1073913	-.0657011
region_rel	.0296075	.016492	1.80	0.076	-.0031246	.0623397
_cons	.2805361	.0035058	80.02	0.000	.273578	.2874942

Redistributive effect

$$G^j_{XI} - G^j_{Yi} = \mathbf{b}_0 + \mathbf{b}_1 G^j_{Xi} + \mathbf{b}_2 \ln(X^j / X) + \mathbf{b}_3 \ln(X^j_i / X^j)$$

Source	SS	df	MS
Model	.09494863	3	.031649543
Residual	.064291802	96	.000669706
Total	.159240432	99	.001608489

Number of obs	=	100
F(3, 96)	=	47.26
Prob > F	=	0.0000
R-squared	=	0.5963
Adj R-squared	=	0.5836
Root MSE	=	.02588

re	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
orig_gini	.4204138	.0820668	5.12	0.000	.2575125	.5833152
country_rel	.0734572	.0087626	8.38	0.000	.0560635	.0908509
region_rel	-.0775304	.0150633	-5.15	0.000	-.1074307	-.0476301
_cons	-.004582	.0391783	-0.12	0.907	-.0823503	.0731863

Table 8: Redistributive effect with country dummies

$$G^{j}_{XI} - G^{j}_{Yi} = \boldsymbol{b}_0 + \boldsymbol{b}_1 G^{j}_{Xi} + \boldsymbol{b}_3 \ln(X^{j}_{i} / X^{j}) + \sum_{j=1}^{11} \boldsymbol{b}_{2j} P_{ji}$$

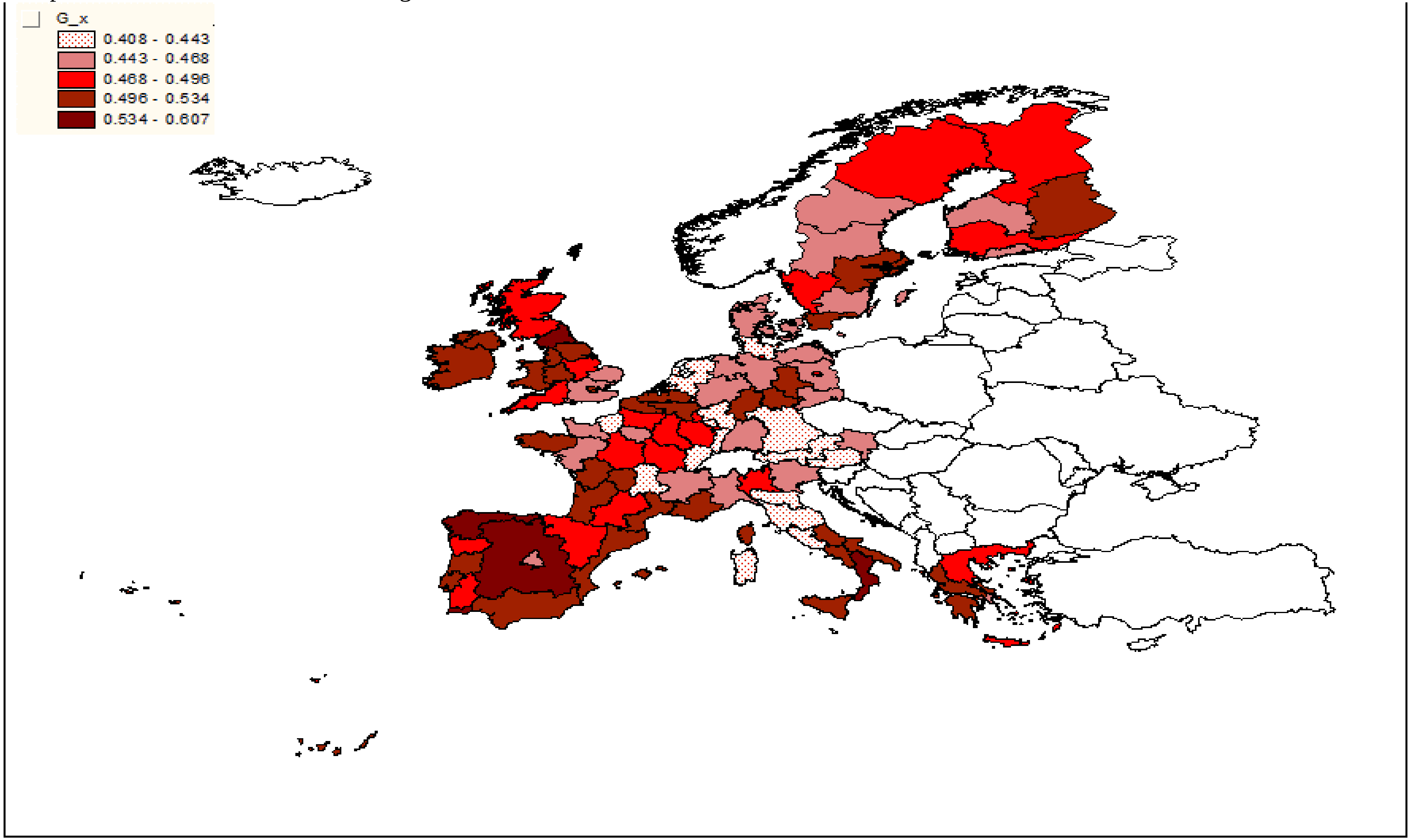
```
      Source |       SS       df       MS              Number of obs =     100
-------------+------------------------------           F( 12,    87) =   43.94
       Model |  .136688554    12  .011390713           Prob > F      =  0.0000
    Residual |  .022551878    87  .000259217           R-squared     =  0.8584
-------------+------------------------------           Adj R-squared =  0.8388
       Total |  .159240432    99  .001608489           Root MSE      =   .0161

------------------------------------------------------------------------------
          re |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
   orig_gini |   .4476115   .0557062     8.04   0.000     .3368895    .5583336
    rel_oeqy |  -.0820596   .0098666    -8.32   0.000    -.1016706   -.0624487
     Belgium |   .0034392   .0136377     0.25   0.801    -.0236673    .0305456
     Germany |  -.0008049   .0103125    -0.08   0.938    -.0213022    .0196923
     Spain   |  -.0474551   .0117142    -4.05   0.000    -.0707384   -.0241718
     Finland |   .0088255   .0115687     0.76   0.448    -.0141685    .0318195
     France  |  -.0288338   .0100989    -2.86   0.005    -.0489064   -.0087612
     Greece  |  -.0826269   .0125598    -6.58   0.000     -.107591   -.0576629
     Italy   |  -.0801624   .0106562    -7.52   0.000    -.1013427   -.0589821
     Portugal|   -.085192   .0116504    -7.31   0.000    -.1083485   -.0620355
     Sweden  |  -.0267723   .0112054    -2.39   0.019    -.0490444   -.0045003
     UK      |  -.0441652   .0109399    -4.04   0.000    -.0659094    -.022421
       _cons |   .0125502   .0259257     0.48   0.630      -.03898    .0640804
------------------------------------------------------------------------------
```

Table 8: Country fixed effect on regional inequality. Tests by pairs of country dummies ($ß_{3j}$)

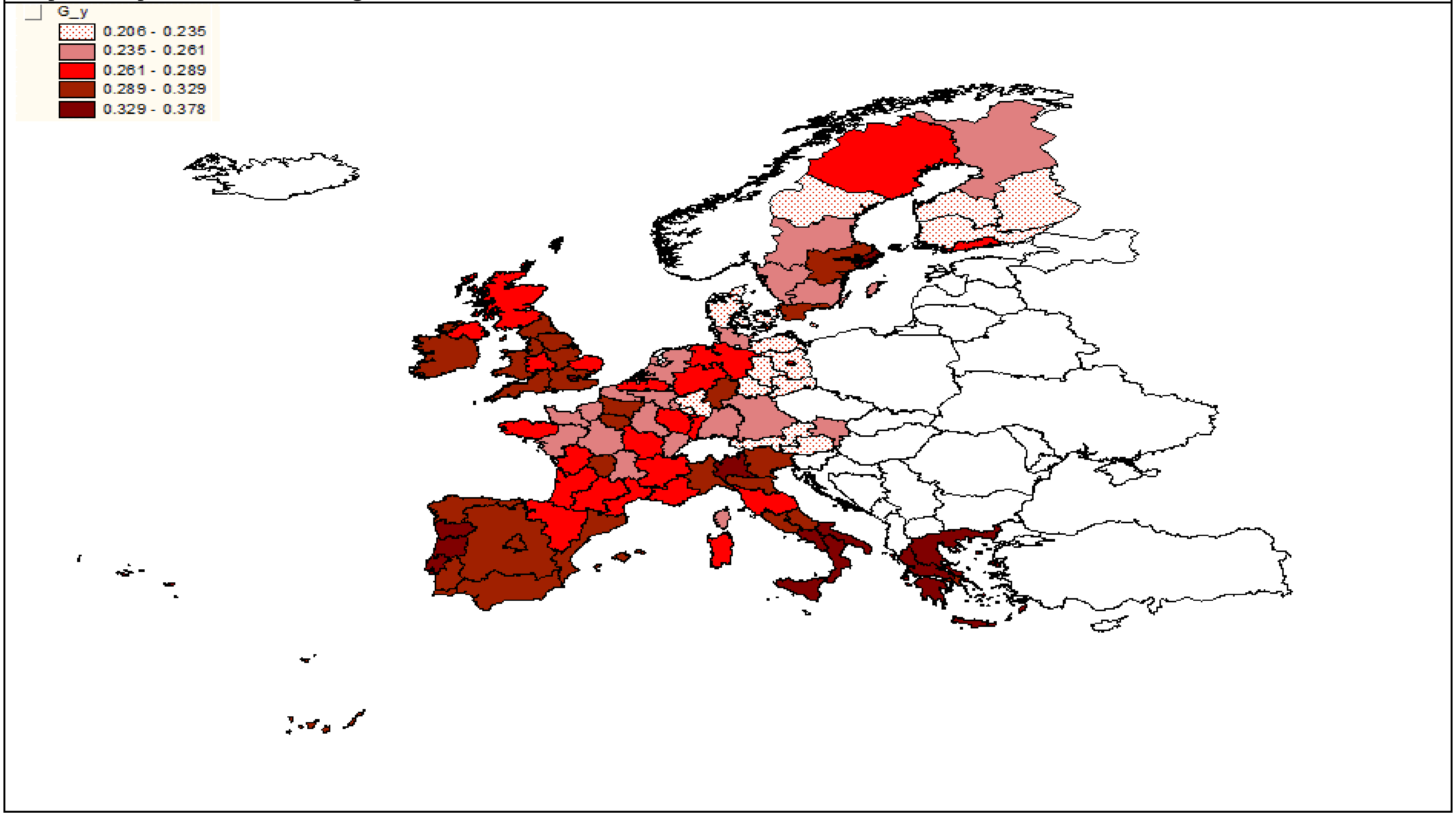
	A	B	FI	GE	SW	FR	UK	SP	IT	PT	GR
A		=	=	=	+	+	+	+	+	+	+
B			=	=	+	+	+	+	+	+	+
FI				=	+	+	+	+	+	+	+
GE					+	+	+	+	+	+	+
SW						=	+	+	+	+	+
FR							+	+	+	+	+
UK								=	+	+	+
SP									+	+	+
IT										=	=
PT											=
GR											

An '=' means that the redistributive effect in regions in the two countries compared is not statistically different p=0.05. '+' implies that a region in country in row show a larger redistributive effect than a region in country in column.

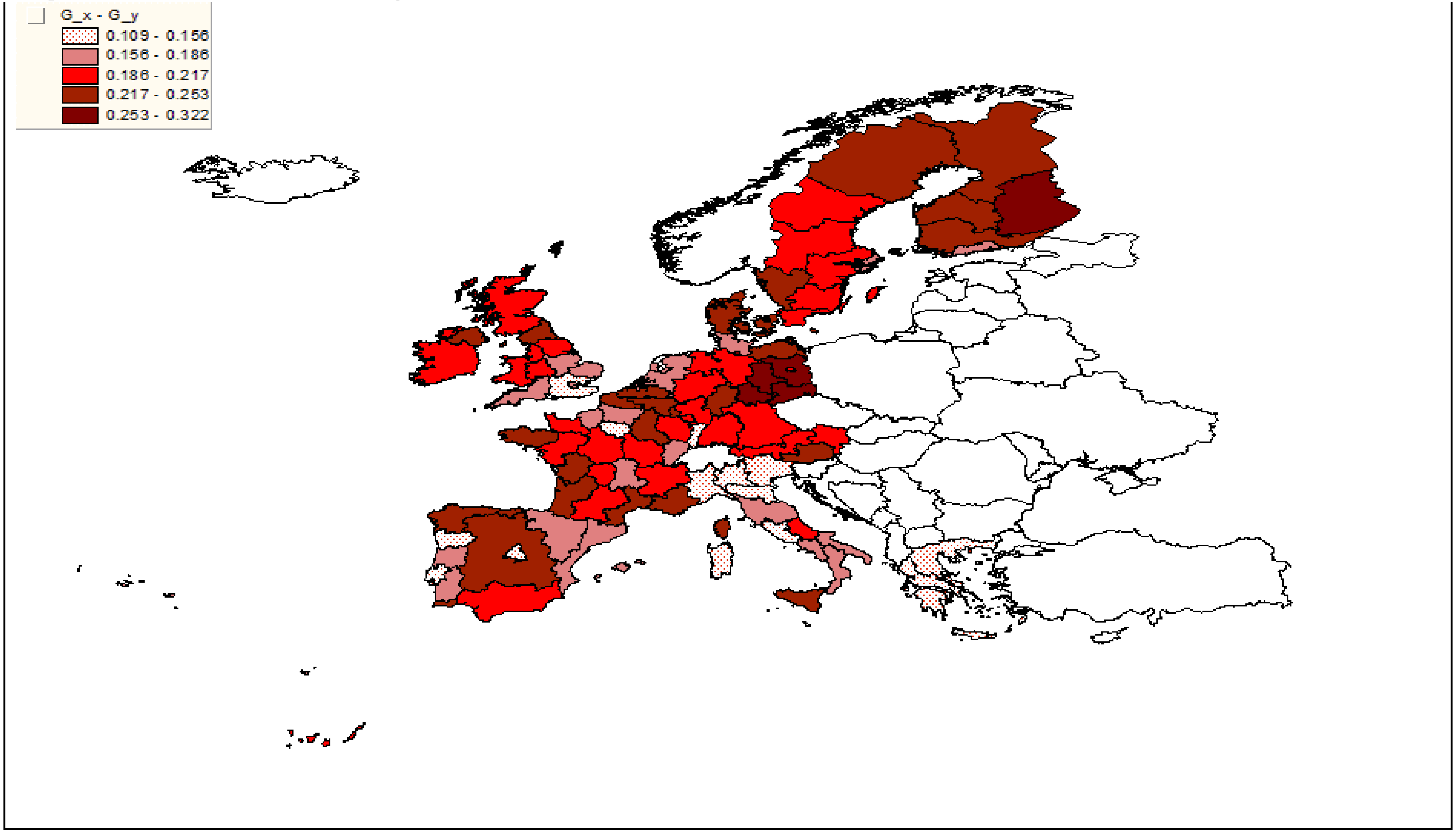
Map 1 – Market Gini market in EU regions



Map 2 – Disposable Gini in EU regions



Map 3 – Redistributive effect in EU regions



APPENDIX

Table A.1: Market income, market Gini and disposable Gini rankings in EU regions.

NUTS	Average Market Income	Position in ranking Market Income	Position in ranking Market Gini	Position in Ranking Disposable Gini
PT3	364.46	1	41	63
PT15	378.81	2	97	84
PT2	415.61	3	93	98
PT12	443.29	4	85	93
PT14	446.99	5	57	85
ES7	492.19	6	72	70
ES6	513.25	7	91	79
PT11	527.64	8	51	89
GR1	551.09	9	58	95
ES4	565.83	10	95	80
GR2	566.35	11	66	94
ES1	588.79	12	94	64
GR4	616.87	13	45	90
ITA	620.38	14	100	100
IT92	704.24	15	96	99
GR3	719.39	16	29	68
PT13	725.18	17	78	97
IT8	750.33	18	65	87
ES5	781.33	19	63	75
IT91	784.29	20	67	91
ITB	786.18	21	10	51
ES2	791.31	22	43	58
FR83	832.24	23	74	28
IT7	846.94	24	80	81
DEG	954.85	25	69	5
UKB	966.25	26	90	50
FR3	980.22	27	76	33
FI13	1003.01	28	86	7
DEE	1015.35	29	88	3
UK1	1062.21	30	98	76
FR25	1083.19	31	33	30
ES3	1085.13	32	20	73
FR81	1092.40	33	73	43
IT5	1095.18	34	14	53
IT6	1110.73	35	8	83
FR21	1118.31	36	42	27
FR53	1133.27	37	62	41
UK7	1134.32	38	61	57
FR24	1134.91	39	39	26
UKA	1136.22	40	54	52
FR61	1137.68	41	68	45
DED	1142.54	42	35	2
FR72	1145.55	43	6	22
DE4	1159.46	44	36	1
FR62	1166.08	45	59	55
FR52	1173.35	46	64	47
DE8	1177.62	47	25	13
FI14	1178.51	48	30	6

UK2	1186.58	49	79	61
DE5	1189.91	50	99	35
FR26	1190.73	51	53	46
UK9	1191.68	52	75	72
SE03	1192.80	53	17	20
FR51	1200.77	54	15	29
UK8	1202.31	55	82	66
FR63	1203.48	56	92	86
SE08	1205.60	57	56	39
SE06	1216.14	58	32	25
UK4	1227.46	59	22	54
FI12	1243.89	60	38	9
SE07	1249.88	61	16	14
SE04	1255.12	62	77	59
AT2	1256.47	63	9	4
FR82	1261.23	64	84	56
SE05	1262.72	65	52	34
IT3	1264.01	66	28	82
FI15	1267.50	67	48	16
IT1	1269.88	68	26	78
FR43	1270.14	69	7	21
FR23	1272.27	70	1	17
FR22	1283.55	71	49	62
DEB	1292.26	72	12	11
FR41	1297.74	73	47	48
FR71	1303.61	74	23	38
SE02	1316.46	75	81	71
FI2	1328.66	76	31	12
AT3	1340.91	77	3	8
BE3	1355.33	78	70	23
UK6	1396.33	79	40	67
UK3	1402.45	80	44	74
DE6	1427.66	81	60	15
IT2	1447.87	82	46	88
AT1	1487.42	83	19	19
DE9	1491.01	84	34	37
IT4	1515.08	85	5	69
DEC	1539.45	86	11	10
DE1	1540.15	87	18	32
BE2	1543.80	88	71	42
DE3	1544.97	89	50	44
DE2	1562.18	90	13	24
FR42	1594.38	91	4	36
UK5	1608.73	92	37	77
BE1	1626.62	93	55	31
DEF	1629.55	94	2	18
UK55	1647.79	95	89	92
DEA	1656.25	96	27	40
DE7	1673.16	97	83	60
SE01	1717.49	98	87	96
FI11	1781.73	99	24	49
FR1	1929.72	100	21	65