Income Inequality and Opportunity Inequality in Europe:
Recent Trends and Explaining Factors[1]

by

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1. Introduction

This paper studies the recent evolution of economic inequality in Europe. By using the two most recent waves of the EU-SILC database reporting information on family background (2005 and 2011), our analysis provides estimates of inequality in 30 European countries in the two different periods, thereby shading some light on the relationship between the evolution of inequality and institutional dimensions for those countries. By so doing, we complement the standard analysis of income inequality with an analysis of inequality in the space of opportunities.

Our aim is to contribute to a recent and growing literature that, after the influential contributions by Roemer (1993, 1998) and Fleurbaey (1995, 2008), in the last fifteen years has tried to assess the degree of inequality of opportunity in different countries, and to evaluate the opportunity-equalizing effects of public policies. This literature has defended the idea that differences in outcomes due to exogenous circumstances are ethically unacceptable and should be compensated by society (*compensation principle*); while differences due to effort are to be considered ethically acceptable and do not need any intervention (*reward principle*). This literature is now sizable. A number of different measurement and evaluation methodologies have been proposed and an even broader array of empirical applications has been undertaken: for comprehensive reviews of the inequality of opportunity literature see the recent surveys by Ferreira and Peragine (2015), Roemer and Trannoy (2013), Ramos and Van de Gaer (2012).

Measuring the degree of inequality of opportunity is interesting per se, if one believes that "levelling the playing field", rather than equalizing the final results, is the objective of a "just society". In addition to normative reasons, the analysis of opportunity inequality can have an important instrumental value. First, social attitudes towards redistributive policies may be affected by the knowledge, or the perception, of the origin of income inequalities (Alesina and La Ferrara, 2005): existing surveys show that most people judge income inequalities arising from different levels of effort as less objectionable than those due to exogenous circumstances as race, family origin, etc.. Hence, by showing that a large amount of existing inequalities is due to unequal ex-ante opportunities may increase the support for redistributive policies. Second, opportunity inequality, rather than income inequality, can be related to aggregate economic performance: it has been suggested (Bourguignon et al. 2007 and World Bank, 2006) that the existence of strong and persistent inequalities in the initial opportunities open to individuals can generate true inequality traps that represent severe constraints to future perspectives of growth of an economy, by

preventing entire groups from participation into economic and social life.[2] Finally, the analysis of opportunity inequality might help to understand the generation of income inequality and to identify the priorities of public intervention: the knowledge of the factors explaining income inequality can help to identify the more deprived groups in a society, thereby revealing new points of emphasis in social and redistributive policies. We believe that these considerations are relevant for many European countries and for the debate on social protection and social policies in Europe.

The existing literature uses a reduced form model in which the individual income is assumed a function of two classes of factors: factors outside the individual responsibility, called *circumstances*, and factors within the individual responsibility, labelled simply *effort*. Within such model, it has developed two main approaches to measuring opportunity inequality, namely the ex-ante and the ex-post approach. According to the *ex-ante approach*, there is equality of opportunity (EOp) if the set of opportunities is the same for all individuals, regardless of their circumstances. This approach consists of partitioning the population in types formed by individuals endowed with the same circumstances: the income distribution within a circumstance class is interpreted as the opportunity set open to individuals in that class. Hence, in order to measure opportunity inequality, one focuses on the inequality between types. On the other side, according to the *ex-post approach*, there is EOp if and only if all those who exert the same effort end out with the same outcome. This means that opportunity inequality within this approach is measured as inequality within responsibility classes, i.e. within the set of individuals at the same effort level.

These two approaches express different and sometimes conflicting views on equality of opportunity[3] and in fact the rankings they generate may be different. However, most of the existing empirical analysis of opportunity inequality have adopted an ex-ante approach. In this paper we explore both the ex-ante and the ex-post approach and we offer some insights on the different results they provide. The empirical application is divided in two parts. First, we provide estimates of income inequality and opportunity inequality in 30 European countries available in the EU-SILC database. Our results show that although the expected ranking among Northern European and Mediterranean countries is generally respected, our measures of inequality of opportunities shed new light on the distributional patterns of European countries. Our results also highlight the difference between the ex-ante and ex-post approaches: these approaches do capture different aspects of opportunity inequality and are potentially associated to different sets of institutions, corresponding to pre- and post-labour market entry. Existing data indicate that equality of opportunity, in the ex-ante version, is more correlated with educational variables, while ex-post equality of opportunity is also associated to union presence, labour market policies and parental leaves. However, the distinction between the two approaches is not so clear-cut in the empirical analysis.

The paper is organised as follows. Section 2 introduces our methodology for measuring opportunity inequality and decomposing overall income inequality. Section 3 contains our empirical analysis: the data description, the estimating procedure and the discussion of the results. Section 4 concludes with some final remarks and some directions for future research.

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[2] For an empirical analysis of the relationship between growth and inequality of opportunity see Ferreira et al. (2014).
[3] Fleurbaey and Peragine (2013) study the clash between ex-ante and ex-post notions of equality of opportunity.

2. Measuring opportunity inequality: a simple model

Consider a population and a distribution of income x. Suppose that all determinants of x, including the different forms of luck, can be classified into either a vector of circumstances C that lie beyond individual control, or as responsibility characteristics, summarized by a variable e, denoting effort. Circumstances belong to a finite set Ω. For example, suppose that the only circumstance variables are race, which can only take values in the set {black, white}, and parental education, that only takes values in the set {college education, high school education}. In this case the set Ω would be the following: Ω = ({black, parents with high school education}, {black, parents with college education}, {white, parents with high school education}, {white, parents with college education}).

Effort may be treated as either a continuous or a discrete variable belonging to the set Θ. The outcome of interest is generated by a function $g : \Omega \times \Theta = R$ such that:

$$x = g(C,e) \tag{1}$$

This can be seen as a reduced-form model in which incomes are exclusively determined by circumstances and effort, such that all individuals having the same circumstances and the same effort obtain the same income. Neither opportunities themselves, nor the process by which some particular outcomes are chosen, are explicitly modelled in this framework. The idea is to infer the opportunities available to individuals by observing joint distributions of circumstances, effort and outcomes.

Roughly speaking, the source of unfairness in this model is that circumstance variables (which lie beyond individual responsibility) affect outcomes. Thus, we have a population of individuals, each of whom is fully characterised by the triple (x,C,e). For simplicity, treat effort e, as well as each element of the vector of circumstances, C, as discrete variables. Then this population can be partitioned in two ways: into types T_i, within which all individuals share the same circumstances, and into tranches T_j, within which everyone shares the same degree of effort. Denote by x_{ij} the income generated by circumstances C_i and effort e_j. Suppose there are n types, indexed by $i = 1,...,n$, and m tranches, indexed by $j = 1,...,m$. In this discrete setting[4], the population can be represented by a matrix $\lfloor \mathbf{X}_{ij} \rfloor$ with n rows, corresponding to types, and m columns, corresponding to tranches:

Table 1

	e_1	e_2	e_3	...	e_m
C_1	x_{11}	x_{12}	x_{13}	...	x_{1m}
C_2	x_{21}	x_{22}	x_{23}	...	x_{2m}
C_3	x_{31}	x_{32}	x_{33}	...	x_{3m}
...	...	...	...	...	...
C_n	x_{n1}	x_{n2}	x_{n3}	...	x_{nm}

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[4] In an alternative formulation, that would treat effort as a continuous variable, $F_i(x)$ would denote the advantage distribution in type i and q_i denote its population share. The overall distribution for the population as a whole would be $F(x) = \sum_{i=1}^{n} q_i F_i(x)$.

To the $n \times m$ dimensional matrix $\lfloor \mathbf{X}_{ij} \rfloor$ in Table 1, let there be associated a $n \times m$ dimensional matrix $\lfloor \mathbf{P}_{ij} \rfloor$ where each element p_{ij} represents the proportion of total population with circumstances C_i and effort e_j.

Given this model, the measurement of inequality of opportunity can be thought of as a two-step procedure: first, the actual distribution $\lfloor \mathbf{X}_{ij} \rfloor$ is transformed into a counterfactual distribution $\lfloor \widetilde{\mathbf{X}}_{ij} \rfloor$ that reflects only and fully the unfair inequality in $\lfloor \mathbf{X}_{ij} \rfloor$, while all the fair inequality is removed. In the second step, a measure of inequality is applied to $\lfloor \widetilde{\mathbf{X}}_{ij} \rfloor$. In principle, the construction of the counterfactual distribution $\lfloor \widetilde{\mathbf{X}}_{ij} \rfloor$ should reflect both the compensation and the reward principles – the two subcomponents of opportunity egalitarianism – and the specific approach adopted.

In the *ex-ante approach* the focus is on the rows of the matrix above: a given row i is interpreted as the opportunity set of all individual with circumstances C_i. Hence the counterfactual distribution should reflect the inequality between the rows. On the other hand, the ex-post approach should focus on the columns of the matrix: given the effort level, the inequality in each column is interpreted as inequality of opportunity. Hence, the corresponding counterfactual distribution should reflect the inequality within the rows.

Different measures, which are either consistent with the ex-ante or the ex-post approaches, have been proposed in the literature (Ferreira and Peragine (2015), Ramos and Van de Gaer (2012)). In this paper we adopt one measure for each approach and we use a non parametric methodology. The first measure we use, *Between-Types Inequality*, is expression of the ex-ante approach, and was variously proposed by Peragine (2002), Bourguignon, Ferreira and Menéndez (2007), Checchi and Peragine (2010) and Ferreira and Gignoux (2011). The counterfactual distribution it relies on, $\lfloor \widetilde{\mathbf{X}}_{BT} \rfloor$, is obtained by replacing each individual income x_{ij} by the average income of the type she belongs to. This smoothing transformation is intended to remove all inequality within types. Formally:

Between types $\lfloor \widetilde{\mathbf{X}}_{BT} \rfloor$: For all $j \in \{1,...,m\}$ and for all $i \in \{1,...,n\}$, $\widetilde{x}_{ij} = \mu_i$.

Table 2: Between-types inequality ($n = m = 3$)

	e_1	e_2	e_3
C_1	μ_1	μ_1	μ_1
C_2	μ_2	μ_2	μ_2
C_3	μ_3	μ_3	μ_3

Once the smoothed distribution $\lfloor \widetilde{\mathbf{X}}_{BT} \rfloor$ is obtained, any inequality measure I applied to such distribution, $I(\widetilde{\mathbf{X}}_{BT})$ is to be interpreted as a measure of inequality of opportunity. Following Checchi and Peragine (2010) we use the mean logarithmic deviation, which is an additively decomposable inequality index (Theil, 1979a,b) and obtain a useful decomposition of overall inequality (I) into two terms: the between types inequality (I_{BT}), to be interpreted as inequality of opportunity, and the within types inequality (I_{WT}), interpreted as inequality due to effort. That is:

$$I = I_{BT} + I_{WT} \qquad (2)$$

The second measure we use, *Within-Tranches*, is expression of the ex-post approach and has been used by Checchi and Peragine (2010) and Aaberge et al (2011). The Within-Tranches counterfactual distribution $\left[\widetilde{\mathbf{X}}_{WTr}\right]$ is obtained by replacing each individual outcome x_{ij} in a given tranche with the ratio between such outcome and the average income of that tranche: $\mu_j = \sum_{i=1}^{n} p_{ij} x_{ij}$.

This normalization procedure is intended to remove all inequalities between tranches and to leave unchanged the inequality within tranches. Formally:

Within tranches $\left[\widetilde{\mathbf{X}}_{WTr}\right]$: For all $j \in \{1,...,m\}$ and for all $i \in \{1,...,n\}$, $\widetilde{x}_{ij} = g(c_i, e_j)/\mu_j$.

Table 3 – Within tranches inequality ($n = m = 3$)

	e_1	e_2	e_3
C_1	x_{11}/μ_1	x_{12}/μ_2	x_{13}/μ_3
C_2	x_{21}/μ_1	x_{22}/μ_2	x_{23}/μ_3
C_3	x_{31}/μ_1	x_{32}/μ_2	x_{33}/μ_3

Also in this case, following Checchi and Peragine (2010), we use the mean log deviation and obtain a useful decomposition of overall inequality (I) into two terms: within tranches inequality (I_{WTr}), to be interpreted as inequality of opportunity, and between tranches inequality (I_{BTr}), interpreted as inequality due to effort. That is: $I = I_{BTr} + I_{WTr}$.

3. The empirical analysis: income inequality and opportunity inequality in Europe

Data description

We use data from the 2005 and 2011 waves of the European Survey on Income and Living Conditions (EUSILC) which is annually run by national Central Statistics Offices and collects information on the income and living conditions of different household types. The survey contains information on a large number of individual and household characteristics as well as specific information on poverty and social exclusion. Representative random samples of households throughout a large number of European countries are approached to provide the required information. In 2005 we consider 26 countries, while the 2011 sample consists of 29 countries.[5]

Differently from other sources of data, EUSILC provides a common data source with comparable individual and household level micro-data on income and living conditions allowing for significant improvements in the comparability of country-specific measures. EUSILC is becoming the reference source for comparative statistics on income distribution and social exclusion at European level. Indeed, our study has been made possible by the inclusion in both 2005 and 2011 of specific data modules providing data for attributes of each respondent's parents during her childhood period

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[5] The 2005 sample consists of Austria (AT), Belgium (BE), Cyprus (CY), Czech Republic (CZ), Germany (DE), Denmark (DK), Estonia (EE), Spain (ES), Finland (FI), France (FR), Greece (GR), Hungary (HU), Ireland (IE), Iceland (IS), Italy (IT), Lithuania (LT), Luxemburg (LU), Latvia (LV), Netherlands (NL), Norway (NO), Poland (PL), Portugal (PT), Sweden (SE), Slovenia (SI), Slovakia (SK) and the United Kingdom (UK). In the 2011, Bulgaria (BG), Switzerland (CH), Malta (MT) and Romania (RO) are added to the previous list whereas Ireland is dropped, counting 29 countries in total.

when aged 14-16. These additional modules report information on family composition, number of siblings, the educational attainment, occupational as well as the labour market activity status of respondent's mother and father and the presence of financial problems in the household.

We focus on individual data and restrict the sample to individuals working full or part-time, unemployed and those fulfilling domestic tasks and care responsibilities aged between 30 and 60. Our outcome variable is <u>pre-tax individual earnings</u>.[6] Being aware of the fact that welfare indicators estimated from micro-data can be very sensitive to the presence of extreme incomes (Cowell and Victoria-Feser, 1996a, 1996b, 2002) we censored the countries' income distributions by dropping the highest percentile.[7]

Regarding the description of circumstances, we first consider family origins: parental education is measured by the highest educational attainment in the parent couple. Individuals are therefore divided in three groups: group 1 refers to individuals whose parents have at best achieved low levels (pre-primary, primary or lower secondary education), group 2 corresponds to individuals who have at least one of the parents with intermediate levels of education (upper secondary education and post-secondary non-tertiary education) and group 3 are individuals with at least one of parent with college degrees (first stage of tertiary education and second stage of tertiary education).

Parental occupation is also partitioned in three categories: category 1 corresponds to individuals whose parents were employed in elementary occupations (such as plant and machine operator and assembler - groups 8000 and 9000 in the ISCO88 classification); category 2 refers to individuals who have at least one parent employed in semi-skilled occupations (occupied as service worker, shop and market sales worker, skilled agricultural and fishery worker or as craft and related trades workers - groups from 5000 to 7000 in the ISCO88 classification); finally, category 3 refers to individuals who have at least one of the parents working in top-rank occupations (like legislator, senior official, manager, professional, technician, associate professional or clerk - groups from 1000 to 4000 in the ISCO88 classification).

In this empirical application we also consider additional individual characteristics as circumstances. This set comprehends gender, nationality (identifying as native those who declare the country of birth being the same of the country of residence) and age (six cohorts from 30 to 60). Hence, in total we have 144 types (3 parental education categories × 3 parental occupation categories × 2 genders × 2 nationalities × 6 age groups).[8] Table A.1 in the Appendix show summary statistics of both individual and parental characteristics.

In the empirical analysis we consider the case of non observability of effort, hence we need to deduce the degree of effort from some observable behaviour. Following Checchi and Peragine (2010) we adopt Roemer's statistical solution: we assume that all individuals at the pth quantile of the effort distribution in their types have exerted a comparable degree of effort. Given the monotonicity of the income function, this will correspond to the quantile in the effort distribution of

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[6] We exclude pupils, students, those in an unpaid work experience, those in retirement or in early retirement, permanently disabled or/and unfit to work, those in compulsory military community or service and other inactive person.

[7] Van Kerm (2007) discusses how ordinal comparisons of countries are found to be robust to variants of data adjustment procedures such as trimming and winsorizing.

[8] It is important to note that the empirical estimates of "between-types" inequality of opportunity are to be interpreted as lower-bound estimates. A formal proof of the lower-bound result is contained in Ferreira and Gignoux (2011), but the intuition is straight-forward: the set of circumstances which is observed empirically - and used for partitioning the population into types - is a strict subset of the set of all circumstance variables that matter in reality. The existence of unobserved circumstances guarantees that these estimates of Inequality of opportunity could only be higher if more circumstance variables were observed.

the type. Thus, we define the tranche p in a population as the subset of individuals whose income is at the pth rank of their respective type income distributions. Specifically, we partition the type distributions in ten deciles (although results are proved generally consistent when considering a different number of tranches).

We have used gross incomes, which were available for the first time for all countries in 2011. With respect to 2005, few countries have only net incomes available.[9] We estimated the corresponding gross values by estimating a tax schedule on 2011 data and applying it to 2005 values (implicitly assuming invariance of tax rules over the period). Since we are considering equality of opportunity at individual level, we do refer to personal earnings, excluding household equivalisation and capital incomes (since they are recorded at household level).

Income and opportunity inequality rankings in Europe

Given this dataset, we have computed alternative measures of income inequality. Starting with the estimates of overall income inequalities, we notice that the ranking based on Gini index from our data is quite consistent with the ranking provided by OECD and Eurostat (see figure 1 – underlying data are reported in Table A.2 in the Appendix). The Spearman rank correlation between our inequality measures (Gini and Mean Log Deviation-MLD) and the ones calculated by OECD are 0.49 in 2005 and 0.63 in 2011, and even higher if compared to disposable incomes (respectively 0.51 and 0.71). This is considerable when considering that we are comparing personal earnings (excluding unemployed for comparability reasons) with household equivalised incomes. The correlation declines (or even disappears in 2005) if we use the alternative inequality measure given by the MLD (see table 4).

Table 4 – Spearman's rank correlation between alternative inequality measures

2005	Gini gross incomes (OECD)	Gini disposable incomes (OECD)	Gini disposable incomes (Eurostat)	Gini personal incomes (our sample)	MLD personal incomes (our sample)
Gini gross incomes (OECD)	1.000				
Gini disposable incomes (OECD)	0.674***	1.000			
Gini disposable incomes (Eurostat)	0.724***	0.898***	1.000		
Gini personal incomes (our sample)	0.496**	0.514**	0.371*	1.000	
MLD personal incomes (our sample)	0.356	0.210	0.030	0.826***	1.000
2011	Gini gross incomes (OECD)	Gini disposable incomes (OECD)	Gini disposable incomes (Eurostat)	Gini personal incomes (our sample)	MLD personal incomes (our sample)
Gini gross incomes (OECD)	1.000				
Gini disposable incomes (OECD)	0.769***	1.000			
Gini disposable incomes (Eurostat)	0.746***	0.891***	1.000		
Gini personal incomes (our sample)	0.630***	0.716***	0.748***	1.000	
MLD personal incomes (our sample)	0.392*	0.460**	0.490***	0.749***	1.000

statistical significance: *** $p<0.01$, ** $p<0.05$, * $p<0.1$

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[9] Countries with only net incomes in 2005 are Cyprus, Denmark, Finland, Hungary, Netherlands and Norway.

Figure 1 – Different data sources for inequality

Different data sources for inequality - gross incomes
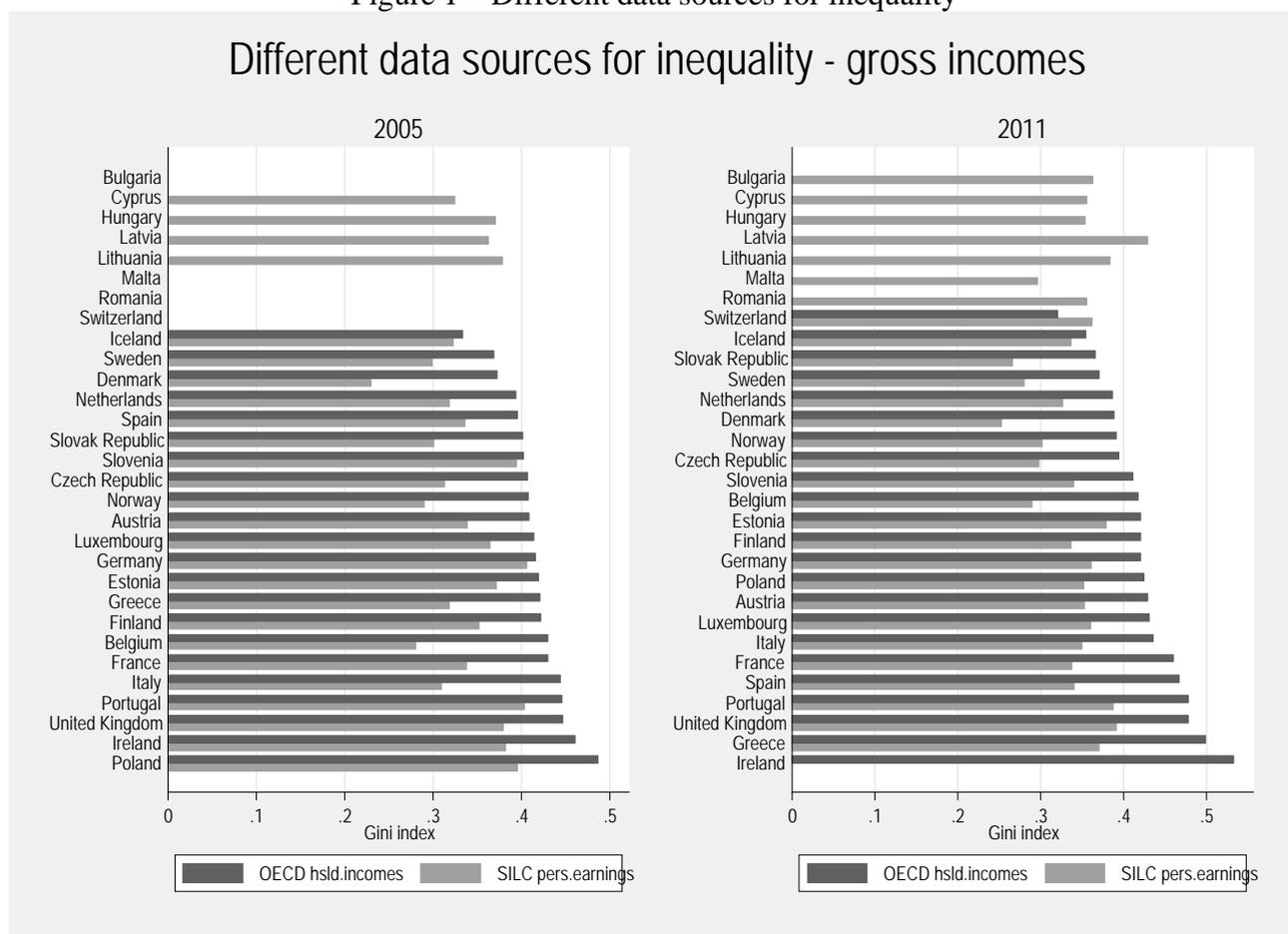
By looking at figure 1 we observe that United Kingdom, Portugal France and Italy appears as the most unequal counties according to OECD household incomes, while Nordic new entrants (Latvia, Lithuania and Estonia) record higher inequalities when considering SILC personal (gross) earnings. At the other extreme, the OECD classifies Iceland, Denmark, Sweden and the Netherlands as the least unequal countries. Two outliers (Germany and Slovenia) are clearly detectable in the data on inequality for the year 2005 (see also figure 2). We attribute this high level of inequality to temporary employment, which boomed in Germany after the Hartz reforms at the beginning of the present century (the so-called "one-euro jobs").

Once we have ascertained that our data are consistent with the received knowledge on country rankings in terms of inequality, we abandon the traditional Gini index for it is not easily decomposable, and focus our attention to the mean log deviation (MLD). This index is the only index that allows for a perfect decomposition of between- and within- components; in such a way that total income inequality can be decomposed in effort inequality and opportunity inequality. The MLD still exhibits a country ranking which is not very dissimilar from the one offered by the Gini index (see figure 2 – rank correlations with corresponding Gini are reported in table 4). Nevertheless nothing grants that once decomposed total inequality, the country ranking remains the same. If this were the case, than working with total inequality indices or with inequality of opportunity measures does not make a big difference. Otherwise, the decomposition provides additional knowledge about the socio-economic mechanisms that underlie the generation and persistence of inequality.

Figure 2 – Alternative measures for earnings inequality

Alternative measures for earnings inequality
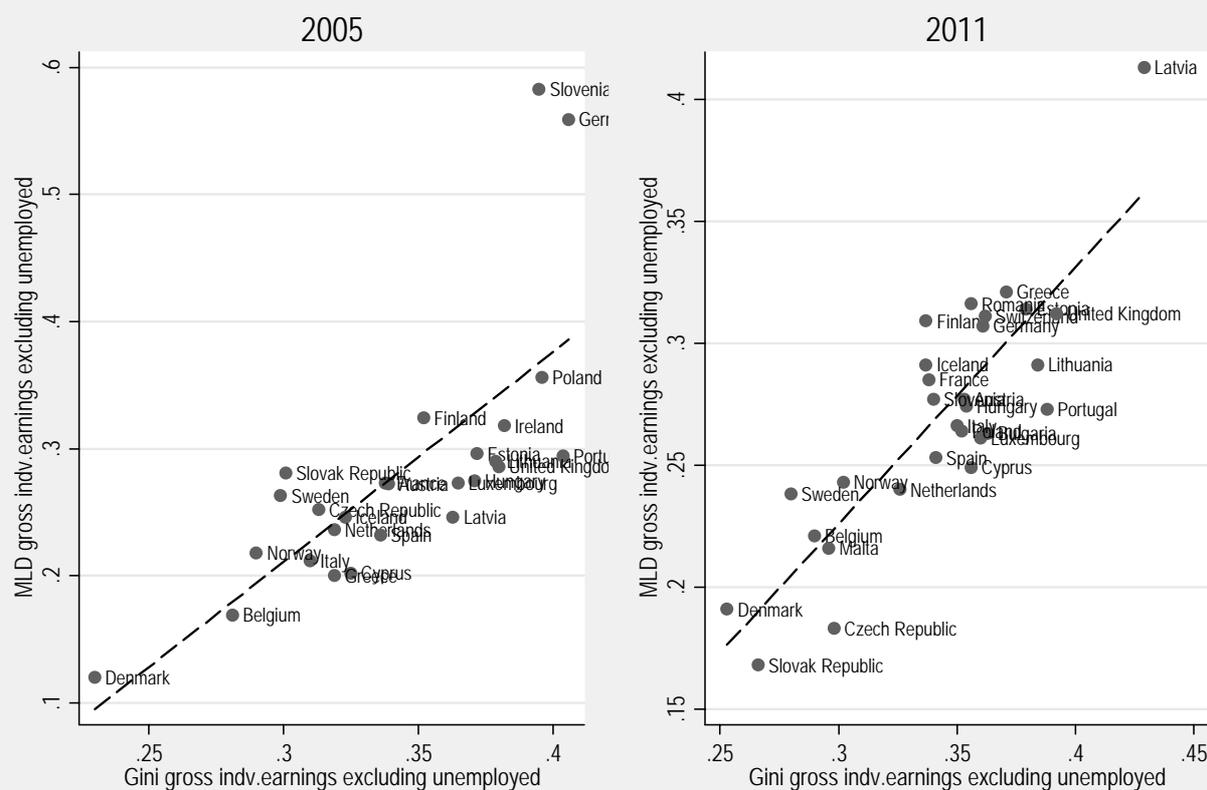
Including or excluding unemployed

If we are to discuss the role of circumstances on life chance, potential employability is a dimension than cannot be neglected by restricting the analysis to individuals with positive incomes, as done in most of the literature (see the review in Ramos and Van de Gaer 2012). In addition, if we are concerned with the role of labour market institutions, they tend to affect the (equilibrium) unemployment rate, and indirectly measured inequality. For this reason we have retained the entire population in the analysis, imputing a unitary income to those with zero income in order to be able to compute log transformations of incomes. The inequality indices obviously increase, though the country ranking tends to remain stable when we use the Gini index, but they are completely different while using the MLD (see bolded values in table 5).

Table 5 – Spearman's rank correlation between inequality indices including/excluding unemployed

2005	Gini including unemployed	Gini excluding unemployed	MLD including unemployed	MLD excluding unemployed
Gini gross earnings (including unemployed)	1.000			
Gini gross earnings (excluding unemployed)	**0.747*****	1.000		
MLD gross earnings (including unemployed)	0.806***	0.357	1.000	
MLD gross earnings (excluding unemployed)	0.474**	0.831***	**0.104**	1.000
2011	Gini gross incomes (OECD)	Gini disposable incomes (OECD)	Gini disposable incomes (Eurostat)	Gini personal incomes (our sample)
Gini gross earnings (including unemployed)	1.000			
Gini gross earnings (excluding unemployed)	**0.735*****	1.000		
MLD gross earnings (including unemployed)	0.887***	0.442**	1.000	
MLD gross earnings (excluding unemployed)	0.409**	0.748***	**0.157**	1.000

statistical significance: *** p<0.01, ** p<0.05, * p<0.1

This is attributable to the fact that the inequality index MLD emphasises the bottom tail of the distribution, while the Gini index is more focussed on the central part of the distribution.[10] Since we aim to retain the comparability of our result on inequality of opportunities with existing literature, in the text we will report regression results using inequality measures that exclude the unemployment (the common practice in inequality analysis), while in the Appendix we retain the same analysis including the unemployed population.

The impact of circumstances

Table 6 reports the correlation between earnings and circumstances, described by the 144 types described above. In the first four columns our dependent variable considers only positive earnings (thus leaving unemployed out of the regressions), while the second group of columns bring them into the picture. In both groups, earnings are increasing in parental education and occupational prestige; in addition men, natives and older people are characterised by higher earnings. The correlations with circumstances are higher when we include the unemployment, confirming that selection into employment depends on circumstance as well. However goodness of fit declines significantly in presence of a mass of zero-earnings unemployed, given a mass of approximately one fifth of individual in the unemployment condition (19% in 2005, 17% in 2011).

What is more important to grant comparability is that the intergenerational transmission of economic status is stable over two surveys: the advantage of having at least one college graduate parent and/or one parent in high skill occupation remains of comparable magnitude. On the contrary we observe a slight decline in the gender gap and an increase in the native/foreign divide. The aging is captured with two alternative specifications: in odd-numbered columns we use cohort order as proxy for age, while in even-numbered columns we resort to the more traditional strategy of using age and age squared. In both cases the other coefficients are substantially unaffected.

Table 6 – Correlation between earnings and circumstances - including/excluding unemployed - OLS

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
dependent variable = log(earnings)	2005 excluding unemployed	2005 excluding unemployed	2011 excluding unemployed	2011 excluding unemployed	2005 including unemployed	2005 including unemployed	2011 including unemployed	2011 including unemployed
at least one parent with secondary degree	0.20***	0.21***	0.21***	0.21***	0.43***	0.46***	0.51***	0.52***
at least one parent with college degree	0.24***	0.25***	0.30***	0.31***	0.47***	0.51***	0.66***	0.68***
middle-skilled parental occupation	-0.17***	-0.17***	-0.16***	-0.15***	-0.36***	-0.35***	-0.34***	-0.33***
low-skilled parental occupation	-0.17***	-0.18***	-0.19***	-0.19***	-0.47***	-0.49***	-0.44***	-0.45***
male	0.43***	0.43***	0.38***	0.38***	1.57***	1.57***	1.29***	1.29***
native	0.19***	0.20***	0.26***	0.26***	0.43***	0.45***	0.69***	0.70***
age groups	0.00		0.02***		-0.37***		-0.27***	
age		0.11***		0.08***		0.59***		0.51***
age²		-0.001***		0.00		-0.01***		-0.01***
observations	130385	130385	147606	147606	160913	160913	178909	178909
R²	0.46	0.47	0.49	0.49	0.18	0.20	0.13	0.15

Note: Robust standard errors in brackets - *** p<0.01, ** p<0.05, * p<0.1 - errors clustered by country – constant and country fixed effect included – in case of unemployment a virtual earnings of 1 euro is imputed

With earnings increasing with age, we can expect earnings inequality also be rising in a parallel way. However figure 3 shows that this is not necessarily the case, especially when we restrict to positive incomes: if we abstract from the case of Slovenia (and partly of Germany) in the first survey, earnings inequality among employed members of the labour force remain constant across generations. On the contrary, when we also include the unemployed (as it is done in figure A.2 in

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[10] When observing the most evident rank reversals (see the figure A.1 in the Appendix) the countries that come to forefront of inequality when unemployment is considered are Poland, Greece, Spain, Portugal, UK and Luxemburg (both in 2005 and 2011), plus Belgium (in 2005) and Malta (in 2011).

the Appendix) the decline in the employment rate for older members of the society induces an increase in inequality with age.

Figure 3

Earnings inequality across age groups - excluding unemployed
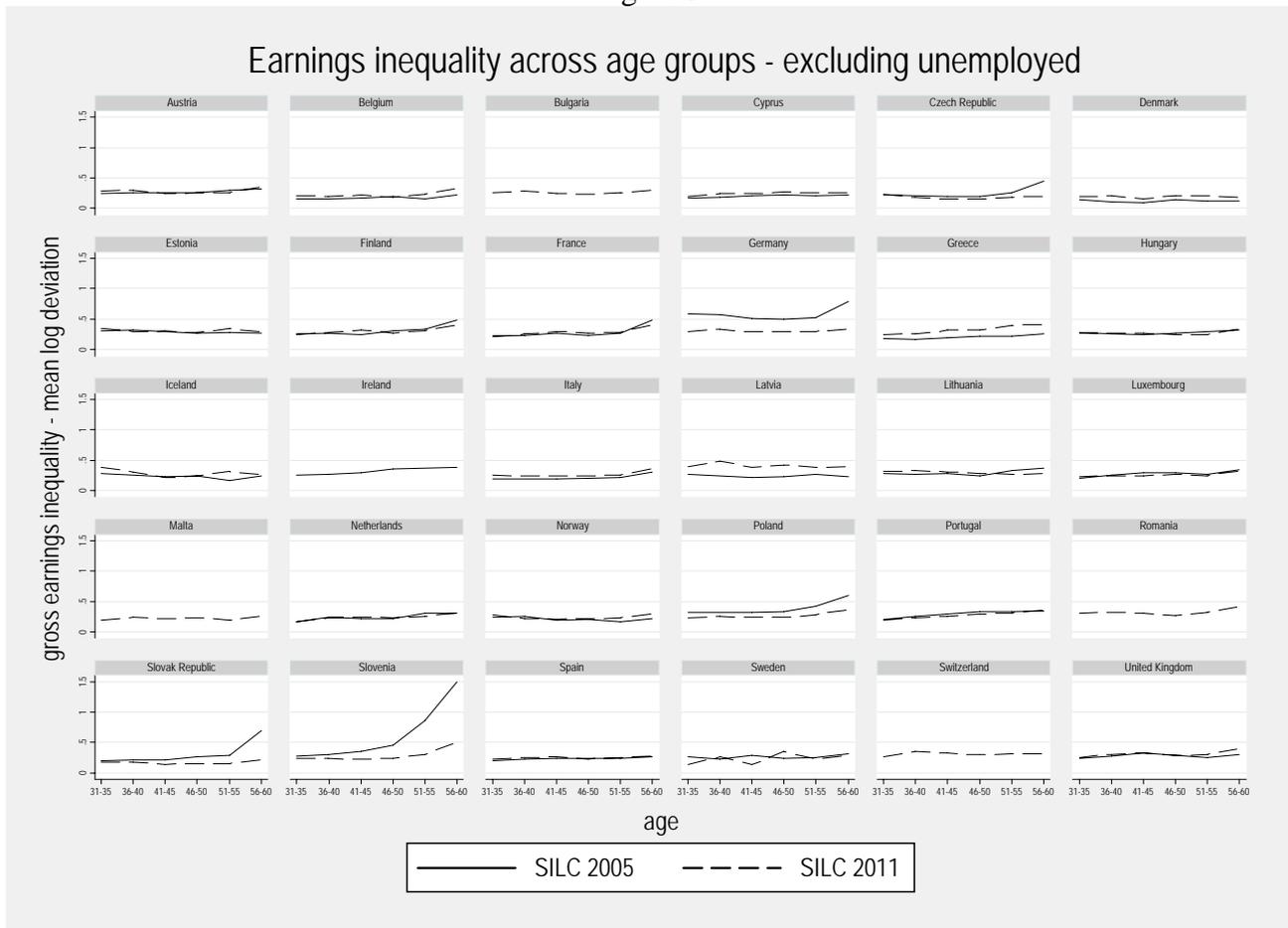
Measuring the inequality of opportunities

We are now in the condition of being able to compute the inequality of opportunities, under alternative assumptions. In the sequel we put more emphasis on the ex-ante approach, but we have also computed the corresponding ex-post measures. Intuitively, the ex-ante approach considers as unfair the portion of variance explained by regressors corresponding to circumstances, whereas the ex-post approach considers as unfair the variance across circumstances at any given percentile (interpreted as proxy for effort). In both approaches we have followed a non-parametric estimation, but results are rather similar should we take a parametric stance.

The ex-ante inequality of opportunity is shown in figure 4: it accounts on average for 15% of total inequality (as measured by mean log deviation), reaching peaks of 29% in the case of Cyprus (in both surveys) and Luxemburg. The countries where the share of inequality attributable to circumstances is high in relative terms are Sweden, Norway, Netherlands and United Kingdom, while at the other extreme we find Poland, Slovak Republic, Finland and Slovenia. The continental Europe (France, Germany, Italy, Spain and Denmark) lies in an intermediate position in terms of inequality of opportunity.

Figure 4

Total inequality and inequality due to circumstances - excluding unemployed


mean log deviation

total inequality   inequality ex-ante
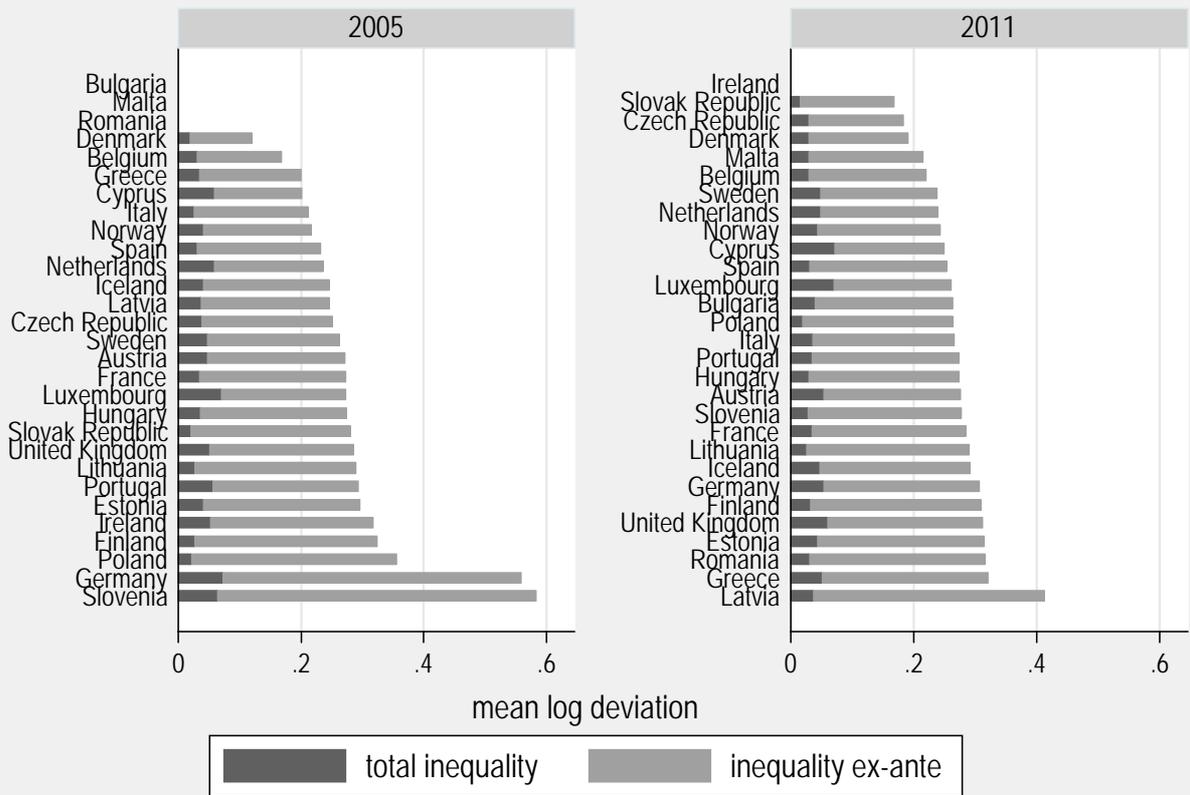
Figure 5

Total inequality and inequality for identical effort - excluding unemployed

mean log deviation

total inequality   inequality ex-post
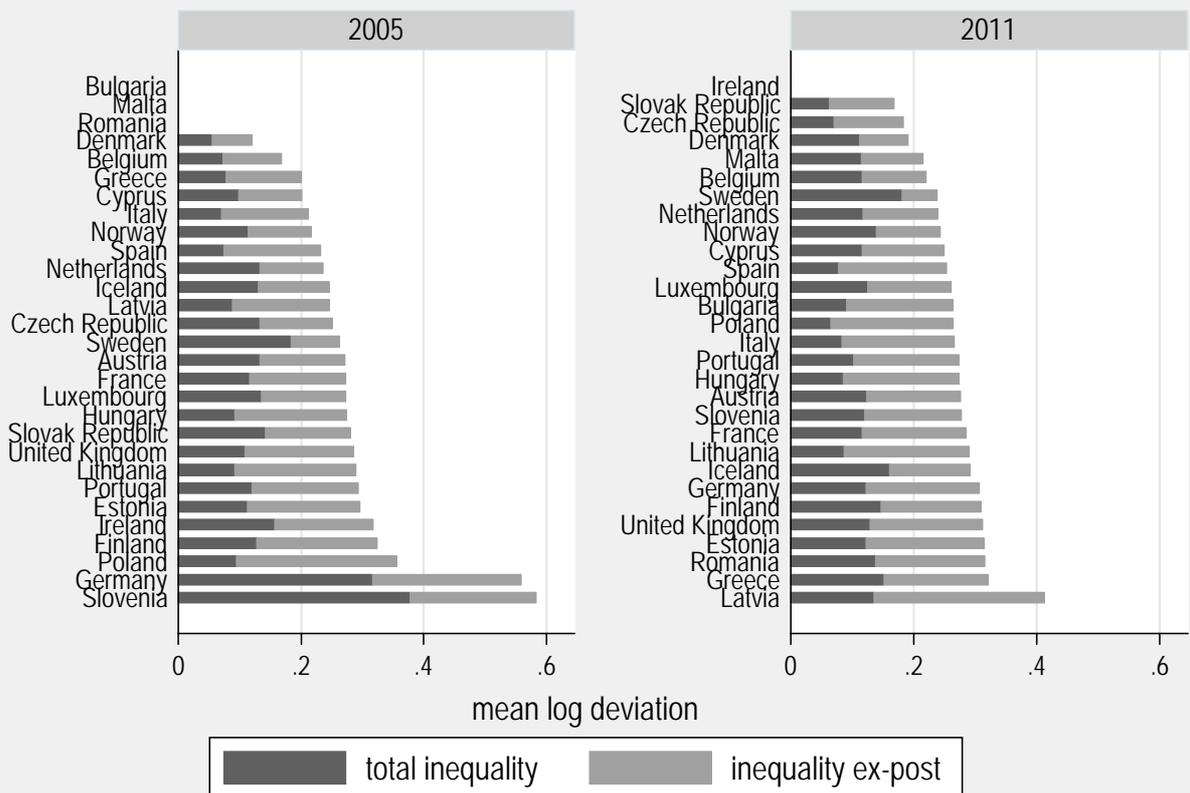
A similar picture emerges when we look at ex-post inequality of opportunity, shown in figure 5.[11] In such a case the incidence of inequality of opportunity is higher, on average accounting for 44% of total inequality. Even in this case formerly planned economies rank low in relative terms (Poland and Lithuania being the lowest), while some Nordic countries (Sweden, Norway and Iceland) reach the highest positions.

What is rather impressive is that in absolute terms country rankings are rather stable over time, irrespective on whether we consider the ex-ante or the ex-post approach (and even irrespective whether we include or exclude the unemployed – see figure A.5 in the Appendix). In figure 6 we plot what is going to be our dependent variable, the inequality of opportunity under the two approaches (ex-ant and ex-post). Among the largest European countries, United Kingdom, Germany, Netherlands and Sweden are countries characterised by large inequality of opportunities, while Italy, France, Spain and Finland, together with Poland, Slovenia, Czech and Slovak Republics are the countries with the lowest inequality. Given the partial observability of circumstances, our measures can only be considered as lower bound estimates.[12]

Figure 6
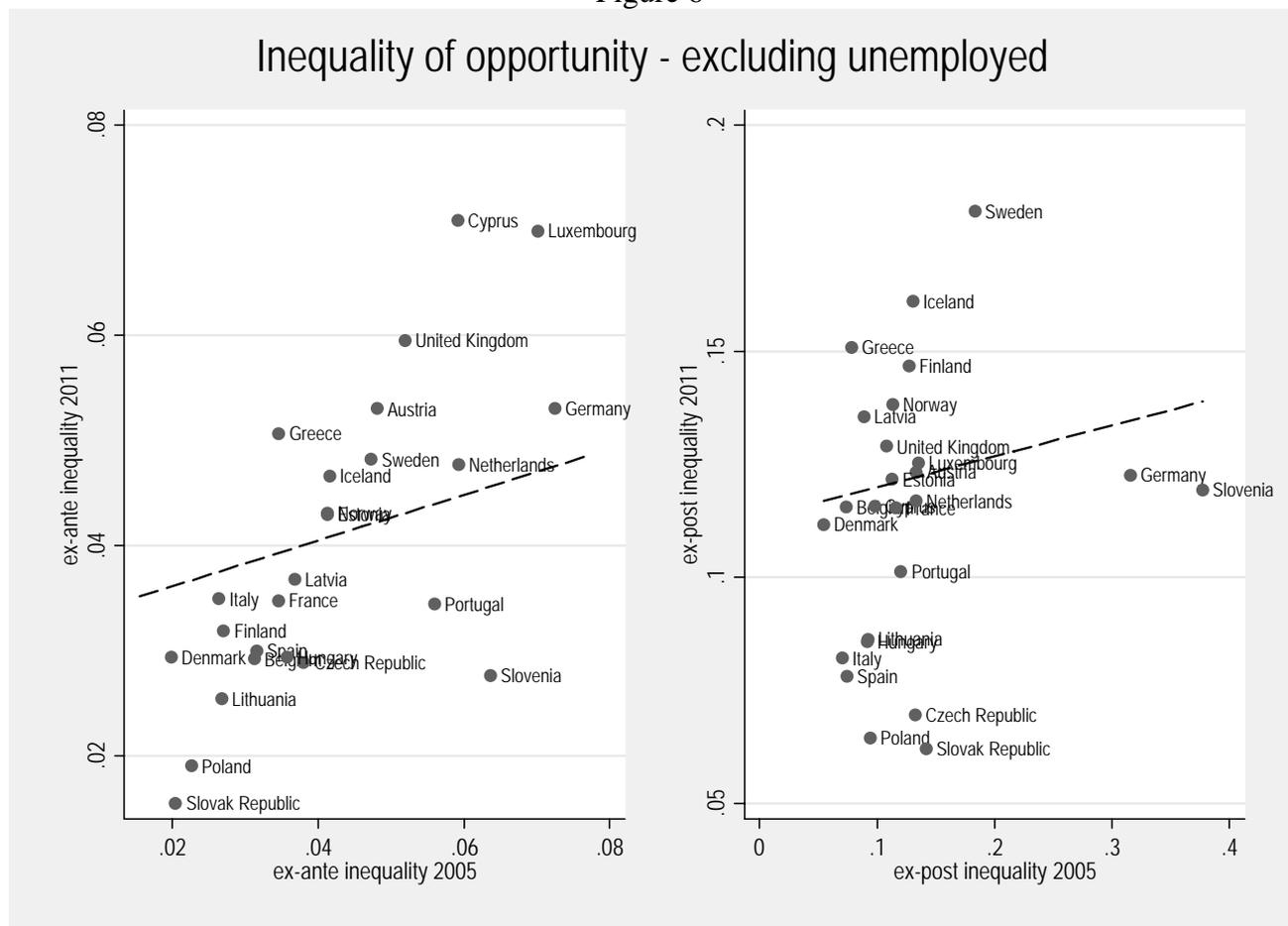
The robustness of country ranking (confirmed by the rank correlations reported in table 7) seems to suggest the existence of country specific features in generating inequality. There is a wide literature that aims to classify countries according to the ways in which markets and institutions operate, and the extent of state intervention (think of the variety of capitalism literature, distinguishing between

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[11] Both figures 4 and 5 exclude the unemployed, which are instead included in figures A.3 and A.4 in the Appendix.
[12] To account for their estimate nature, we have bootstrapped 200 times the estimation procedure, in order to get standard errors for the measurement of inequality of opportunity. They are not reported in the graphs for clarity of exposition, but country ranking are substantially preserved even when we allow for confidence intervals around the estimates. In regressions we will weight the observations for the inverse of the standard errors.

coordinated market economies and liberal market economies – Hall and Soskice 2001). In our case we are interested in channels through which circumstances affect the generation of income. There are large arrays of channels through which this may operate: educational attainments, family networking, gender/age/ethnic group discrimination, to quote the most evident ones. Different countries have different institutions regulating these dimensions, with different degree of effectiveness. We ask ourselves whether there is any correlation between institutional framework and observed variations (cross-country and over-time) in inequality attributable to circumstances.

Table 7 – Spearman's rank correlation between inequality of opportunity measures including/excluding unemployed

2005	ex-ante excluding unemployed	ex-post excluding unemployed	ex-ante including unemployed	ex-post including unemployed
Ex-ante inequality of opportunity (excluding unemployed)	1.000			
Ex-post inequality of opportunity (excluding unemployed)	**0.637***	1.000		
Ex-ante inequality of opportunity (including unemployed)	0.477**	0.269	1.000	
Ex-post inequality of opportunity (including unemployed)	0.180	-0.188	**0.620***	1.000
2011	ex-ante excluding unemployed	ex-post excluding unemployed	ex-ante including unemployed	ex-post including unemployed
Ex-ante inequality of opportunity (excluding unemployed)	1.000			
Ex-post inequality of opportunity (excluding unemployed)	**0.660***	1.000		
Ex-ante inequality of opportunity (including unemployed)	0.577***	0.431**	1.000	
Ex-post inequality of opportunity (including unemployed)	-0.052	-0.232	**0.435**	1.000

statistical significance: *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Accounting for inequality of opportunity: cross-country evidence

In this section we analyze the potential association between institutional characteristics and opportunity inequality. We are perfectly aware that we cannot go beyond suggested correlations, given the limited number of cases in this cross-country analysis. Nevertheless some theoretical expectation can be confronted with the data. For example, we expect the ex-ante measure of inequality of opportunity to be mostly correlated with institutional features of the educational system, because acquired education shape the earning capability of individuals. On the contrary, fiscal redistribution and labour market variables, which are more related to overall income differentials among individuals, are expected to be more correlated to ex-post inequality of opportunity.

Institutional measures are themselves problematic, for they are mostly derived from categorical variables that describe procedures (presence/absence of a provision, alternatives available, stages to be accomplished). However we may (partially) account for the role of institutions by resorting to proxy variables, obtained from observed behaviour of people acting under a given institution. To provide an example, we know that for historical and/or cultural reasons, countries differ in childcare availability. Counting the number of available kindergartens would be a possible candidate for this institutional feature, but data are difficult to collect on a comparable cross-country basis. Resorting to the fraction of children attending kindergarten constitutes a reasonable alternative, which is much simpler to be collected from international/national statistical offices. As with most of institutional measures, this variable is potentially endogenous, since we ignore whether children do not attend kindergartens because they are not available, because their mothers prefer housewifery and/or because most of the population still live in enlarged families (where grandparents take care of nursing). Nevertheless, the literature suggests that early schooling may contribute to reducing the role of parental background in competence formation (for example Heckman et al, 2002, and Cunha and Heckman, 2007). Therefore, other things constant we expect that countries where children attend kindergarten more be also characterised by lower inequality of opportunity, since income

differences by types (ex-ante inequality) should be lower. In the same vein, we know that the stratification of the educational system may reinforce the impact of parental education, since low educated parents may prevents their kids from aspiring to more academic oriented careers (see for example Hanushek and Wößmann, 2006, and Brunello and Checchi, 2007). The quality of education may also play a role, since it may compensate the disadvantage of students coming from poor environment. Unfortunately, data on school quality are not easily available (unless one is ready to consider students achievements as a proxy for "revealed" quality). More modestly, we have considered the student/teacher ratio as proxy for quality of education. We have put our best effort to collect information in educational features that were available for the largest set of countries in our sample. In order to minimise the endogeneity risk, we take the institutional measures averaged over the previous five years. Descriptive statistics are reported in table 8, while data sources are in table A.3 in the Appendix.

Table 8 – Descriptive statistics – 2000-2004 and 2006-2010

Variable	Obs	countries	Mean	Std. Dev.	Min	Max
inequality measures						
total inequality (MLD) - gross individual earnings (excluding richest 1% – excluding unemployed)	55	30	0.275	0.076	0.120	0.583
ex-ante inequality of opportunities (MLD) - gross individual earnings (excluding richest 1% - excluding unemployed	55	30	0.041	0.015	0.016	0.077
ex-post inequality of opportunities (MLD) - gross individual earnings (excluding richest 1% - excluding unemployed	55	30	0.122	0.053	0.055	0.377
total inequality (MLD) - gross individual earnings (excluding richest 1% – including unemployed)	55	30	1.576	0.553	0.259	2.839
ex-ante inequality of opportunities (MLD) - gross individual earnings (excluding richest 1% - including unemployed)	55	30	0.093	0.035	0.028	0.227
ex-post inequality of opportunities (MLD) - gross individual earnings (excluding richest 1% - including unemployed	55	30	1.106	0.360	0.183	2.019
educational institutions						
Expenditure per student, primary (% of GDP per capita)	55	28	20.529	4.662	10.963	31.072
Expenditure per student, secondary (% of GDP per capita)	56	29	25.603	5.411	14.144	38.640
Expenditure per student, tertiary (% of GDP per capita)	53	27	31.984	11.600	15.955	69.811
Government expenditure on education as % of GDP (%)	56	29	5.403	1.164	3.285	8.385
Expenditure on education as % of total government expenditure (%)	54	28	12.324	2.418	4.531	16.813
Primary education, duration (years)	58	29	5.475	1.073	4.000	8.000
Adjusted savings: education expenditure (% of GNI)	58	29	5.074	1.179	2.899	8.173
Pupil-teacher ratio in primary education	51	26	13.981	2.945	9.640	19.495
Pupil-teacher ratio in secondary education	50	26	11.097	1.697	7.252	15.213
Percentage of students in secondary education enrolled in vocational programmes	58	26	24.911	10.255	6.477	46.810
Gross enrolment ratio, pre-primary, both sexes (%)	57	29	86.716	17.131	47.525	123.083
Expenditure on pre-primary as % of government expenditure on education (%)	54	27	8.961	3.534	0.059	19.777
labour market institutions						
union density	58	29	35.395	21.343	7.232	89.609
coverage rate	57	29	62.846	25.269	11.156	100.000
bargaining centralisation	56	28	0.386	0.152	0.102	0.928
employment protection legislation	42	23	2.422	0.666	1.198	4.550
minimum wage/mean wage	58	29	0.590	0.304	0.287	1.000
unemployment subsidy replacement rate	56	29	35.454	15.799	5.945	61.774
tax wedge	56	29	25.162	7.906	8.167	40.593
active labour market policy/GDP	54	28	0.591	0.439	0.044	1.872
passive labour market policy/GDP	54	28	0.909	0.663	0.130	2.456
social expenditure/GDP	57	29	2.184	0.864	1.048	3.678
parental leave - weeks of absence	42	21	59.482	49.340	16.000	214.000

When we consider labour market institutions, we expect that wage compressing institutions may reduce within-group variance in earnings, thus affecting the ex-post inequality more than the ex-ante one. Here data availability, especially for new entrants in the EU, is limited (since some of them do not belong to OECD, which is our main source of information). We consider here the traditional measures of the degree of institutionalisation: the presence of unions (proxied by union membership over dependent employment, the degree of bargaining coverage, the degree of bargaining centralisation), the degree of employment protection, the presence of minimum wages (relative to mean wages), the unemployment benefit and the tax wedge (which are often correlated, since the latter partially finances the former), the existence of active and passive labour market programmes, the generosity of the welfare state (proxied by social expenditure over the gross domestic product) and the possibility of intra-household redistribution housewifing (proxied by the availability of parental leaves).

In accordance with the literature, we expected that when the labour market is heavily regulated, wages are less related to individual features, since unions press for job-related pay scales (Visser and Checchi, 2009). In addition, employment protection reduces labour turnover, reducing individual income variability (and therefore aggregate wage inequality). Both measures have been proved to reduce total income inequality in the aggregate (Checchi and García Peñalosa, 2008). Minimum wages also contribute to the containment of total inequality, which may reflect into the abatement of inequality of opportunity (Salverda and Checchi 2015). When we consider the role of welfare provisions, we do not have apriori theoretical expectation on their correlation with inequality of opportunity, since taxes and subsidies aim to contain income inequality (through taxation) and to provide income insurance against unforeseeable events (through subsidies), but in few cases they include compensatory measures which attenuate the impact of circumstances. However, as long as fiscal redistribution sustains low incomes (that may be correlated to disadvantaged conditions), we could find some positive correlation with such inequality.

Before moving to the correlations existing in the data, let us recall the main problems associated to the study of relationship between aggregate macro variables (institutions) and individual micro behaviours (earnings). The first one is that institutions are slow-changing variables (even more if one takes multi-year averages), in many cases their change requires legislative decrees, while market dynamics are much more volatile. The second one is that institutions are endogenous, since they do reflect the attitude and culture of local populations. As such they are determined by unobservable factors (like religion, past history, geographical position, weather, and so on) which may produce spurious correlations. If more than one observation per country is available (in the present case we have 2 observations per countries, which increase to 12 when we disaggregate the data by birth cohort), we can partly account for these (time-invariant) confounding factors using country/age group fixed (or random) effects, but we cannot take the exogeneity of institutional variables for granted. The third and more serious problem is that institutions come in clusters (namely, they tend to be collinear) and therefore it is difficult to isolate the contribution of one specific feature other institutions constant. Having raised all these caveats, let us now turn to the correlation analysis.

Despite fully recognising the clustered nature of institutions, we start initially with bivariate correlation between different measures of inequality of opportunity and institutional proxies. In table 9 we report total inequality as reference (in column (1) when excluding the unemployed and in column (4) when including them), ex-ante inequality of opportunity (columns (2) and (5), according to exclusion/inclusion of unemployed) and ex-post inequality (columns (3) and (6)). We observe that total inequality is reduced in country/years where/when public expenditure in education is high, while ex-ante inequality of opportunity is negatively correlated with public investment in pre-primary education.

When we consider labour market institutions, they are hardly correlated with inequality measures excluding the unemployed labour force, while correlations are statistically significant when we include them. Signs are consistent with theoretical expectations: unions and centralised bargaining reduce total inequality, and similar correlation obtains for minimum wage, unemployment benefit and active labour market policies. The ex-ante inequality of opportunity is independent from labour market institutions, while the ex-post inequality exhibits negative correlation with union membership, unemployment benefit (and the associated measure of tax wedge) and active labour market policies.

Table 9 – Pair-wise correlations – 30 countries – earnings inequality measured in 2005 and 2011 – institutions measured by average of previous five years

	(1) total earnings inequality (mld) excluding unemployed	(2) ex-ante inequality of opportunity excluding unemployed	(3) ex-post inequality of opportunity excluding unemployed	(4) total earnings inequality (mld) including unemployed	(5) ex-ante inequality of opportunity including unemployed	(6) ex-post inequality of opportunity including unemployed
educational institutions						
Expenditure per student, primary (% of GDP per capita)	0.188	0.120	0.179	–0.115	0.040	–0.157
Expenditure per student, secondary (% of GDP per capita)	–0.175	0.147	0.013	–0.204	0.079	–0.060
Expenditure per student, tertiary (% of GDP per capita)	**–0.431*****	0.245*	0.055	**–0.492*****	0.168	**–0.294****
Government expenditure on education as % of GDP (%)	–0.196	0.050	0.089	**–0.582*****	–0.110	**–0.526*****
Expenditure on education as % of total government expenditure (%)	–0.205	–0.031	–0.074	**–0.425*****	–0.169	**–0.427*****
Primary education, duration (years)	–0.235*	0.157	–0.065	–0.134	0.201	–0.071
Adjusted savings: education expenditure (% of GNI)	–0.136	–0.025	0.096	**–0.579*****	–0.176	**–0.550*****
Pupil-teacher ratio in primary education	0.069	0.029	0.070	–0.205	–0.241	–0.142
Pupil-teacher ratio in secondary education	0.265*	0.193	0.273*	–0.136	–0.082	–0.259*
Percentage of students in secondary education enrolled in vocational program	–0.064	–0.104	0.144	–0.239*	0.014	–0.215
Gross enrolment ratio, pre-primary, both sexes (%)	–0.229*	–0.040	–0.067	–0.076	0.032	0.052
Expenditure on pre-primary as % of government expenditure on education (%)	–0.062	**–0.456*****	–0.301**	0.147	**–0.336****	–0.041
labour market institutions						
union density	–0.208	0.114	0.189	**–0.508*****	0.082	**–0.351*****
coverage rate	–0.073	0.106	0.275*	**–0.338****	0.037	–0.185
bargaining centralisation	–0.026	0.091	0.192	**–0.371*****	–0.062	–0.255*
employment protection legislation	0.024	0.064	0.033	0.087	0.096	0.187
minimum wage/mean wage	–0.101	0.148	0.138	**–0.460*****	0.000	**–0.342****
unemployment subsidy replacement rate	0.060	0.159	0.158	**–0.456*****	–0.253*	**–0.358*****
tax wedge	0.106	–0.140	0.173	**–0.318****	–0.252*	**–0.384*****
active labour market policy/GDP	–0.204	0.020	0.077	**–0.439*****	–0.149	**–0.372*****
passive labour market policy/GDP	–0.093	–0.027	0.033	–0.154	–0.112	–0.142
social expenditure/GDP	–0.201	0.173	0.057	**–0.366*****	0.069	–0.224
parental leave - weeks of absence	–0.018	–0.337**	–0.086	0.076	–0.064	–0.072

statistical significance: *** $p<0.01$, ** $p<0.05$, * $p<0.1$

When we take these correlations to more stringent tests using multivariate analysis (and even controlling for either country random or fixed effects), only few institutional dimensions survive. Some of them have limited variation and are likely to be absorbed by country effects. A serious

problem is the limited number of degrees of freedom, due to missing values.[13] In order not to lose information, we have imputed missing values using the sample means over each year, introducing a dummy variable controlling for imputation. In table 10 we report the OLS regressions when pooling countries and controlling for either random or fixed country effects.[14] Educational expenditure in pre-primary education and student/teacher ratios are the only educational variables retaining statistical significance with inequality of opportunity: other things constant, an increase in the allocation of public educational expenditure to pre-primary education reduces the inequality of opportunity, but an increase in resources in primary education (proxied by a decline in the student/teacher ratio) works in the opposite direction, raising the inequality of opportunity. This holds true for both ex-ante and ex-post measures. In addition an increase in union density and/or in active labour market expenditure seems reducing total inequality without affecting inequality of opportunity.

Table 10 – Inequality and institutions – 30 countries – 2005 and 2011 (excluding unemployment)

	1	2	3	4	5	6	7	8	9
	total inequality (MLD)			ex-ante inequality of opportunity			ex-post inequality of opportunity		
	pooled	random effects	fixed effects	pooled	random effects	fixed effects	pooled	random effects	fixed effects
Adjusted savings: education expenditure (% of GNI)	2.065	0.899	2.66	0.043	0.006	0.16	0.677	-0.051	1.63
	[1.288]	[1.421]	[3.061]	[0.410]	[0.291]	[0.326]	[0.629]	[1.105]	[2.777]
Pupil-teacher ratio in primary education	0.038	-0.186	-4.720***	0.044	-0.126	-0.596***	0.175	-0.146	-3.689***
	[0.278]	[0.525]	[0.989]	[0.078]	[0.126]	[0.112]	[0.156]	[0.387]	[0.774]
% students in secondary education enrolled in vocational programmes	0.065	0.058	0.048	-0.007	-0.004	-0.066	0.064	0.085	-0.053
	[0.133]	[0.204]	[0.390]	[0.023]	[0.024]	[0.067]	[0.068]	[0.147]	[0.213]
Expenditure on pre-primary as % of govern. expenditure on education	-0.387	-0.542	-1.211	-0.180***	-0.203***	-0.175	-0.431***	-0.597**	-1.121
	[0.299]	[0.393]	[1.313]	[0.055]	[0.061]	[0.105]	[0.155]	[0.251]	[0.937]
union density	-0.174**	-0.119*	1.052*	-0.025	-0.02	0.087	-0.047	-0.006	0.844*
	[0.076]	[0.071]	[0.610]	[0.017]	[0.014]	[0.057]	[0.043]	[0.049]	[0.450]
parental leave - weeks of absence	-0.023	0.008	0.023	-0.008	0	-0.006	-0.009	0.018	0.015
	[0.030]	[0.042]	[0.107]	[0.008]	[0.007]	[0.008]	[0.014]	[0.028]	[0.073]
unemployment subsidy replacement rate	-0.04	0.053	0.219	-0.021	0.001	0.061	-0.032	0.056	0.204
	[0.113]	[0.133]	[0.322]	[0.023]	[0.022]	[0.046]	[0.058]	[0.097]	[0.246]
active labour market policy/GDP	-9.634**	-8.032**	-1.944	0.43	-0.193	-1.802*	-0.76	0.471	0.546
	[3.838]	[3.734]	[9.143]	[0.953]	[0.846]	[0.999]	[1.810]	[2.614]	[5.685]
passive labour market policy/GDP	3.707	3.93	9.474	0.169	0.239	1.043	0.738	-0.18	4.063
	[3.413]	[4.804]	[6.739]	[0.640]	[0.593]	[0.759]	[1.670]	[3.421]	[4.162]
minimum wage/mean wage	2.256	-0.136	36.696	1.621*	1.136	4.27	1.365	0.382	44.689
	[4.840]	[5.091]	[72.951]	[0.870]	[1.003]	[12.189]	[2.458]	[3.218]	[46.527]
Observations	55	55	55	55	55	55	55	55	55
R-squared (within)	0.182	0.104	0.662	0.479	0.229	0.628	0.245	0.164	0.698
Number of country	30	30	30	30	30	30	30	30	30
Hausman test (p-value)	55.2 (0.00)			55.9 (0.00)			30.8 (0.00)		

Robust standard errors in brackets - *** p<0.01, ** p<0.05, * p<0.1 - errors clustered by country - pooled ols weighted using the inverse of bootstrapped st.error – constant, survey and dummy for imputed institutional variables controls included – inequality measures multiplied by 100 for readability of coefficients

Notice that random and fixed effects model provide rather different pictures (as also indicated by the Hausman test), the latter being characterised by low (or nil) statistical significance on most

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[13] Notice that we cannot include time invariant variables (like duration of primary education, coverage or bargaining centralisation) because they are alternative to country fixed effects. In addition, when we use only non missing information on all available institutional variables, we are left with 30 observations and 15 countries, which renders the model estimated in table 10 meaningless.

[14] Table 10 considers the case of inequality measures that exclude unemployed. When they are included (as done in table A.4 in the Appendix) results are very similar.

coefficients. While in general fixed effect models provide the safer strategy against the potential role of unobservales at country level, in the present case we deem that random effects are a more appropriate statistical model. Since our aim is accounting for cross-country differences in the decomposition of total inequality based on institutions, using country fixed effects eliminates all cross-differences, leaving only the time variation due to the two surveys (2005 and 2011). Since institutions have limited variation in such a short time interval, we are likely to simply capture some noise in the data. For this reason, while in the sequel we keep on reporting both random and fixed effects model, we will restrict our comments to the former.

Accounting for inequality of opportunity: (pseudo)panel evidence

The analysis conducted so far is limited by lack of variations in the data. For this reason we have explored the possibility of taking the age structure of the sample population as a pseudo-panel, in order to include within-country over-time variations. Once again the reduced number of institutional measures that go back in time limits our effort, but we do our best to exploit available information. In table 11 we have divided the population in 7 birth-cohorts, which corresponds to 6 age groups at the time they are interviewed in 2005 and 2011. We adopt two strategies to match inequality measures computed over age groups: one rule matches individuals to the institutions prevailing at their age of school attendance (conventionally assumed to be 10 year-old) and at the entry in the labour market (conventionally assumed at age 25). Another matching possibility considers both institutional persistence (institutions are slow changing variables) and different exposure to an institutional environment (variable treatment). In this second perspective, older individuals are supposed to have been exposed to an institutional framework which has been (on average) available over their entire working life. Thus the second matching rule associates inequality measures of the older age groups to the institutional means prevailing since their entry in schools or in the labour market.

Table 11 – Matching between age group and institutions

birth years	cohort code	age in 2005 (when inequality is measured)	age code (2005)	age in 2011 (when inequality is measured)	age code (2011)	match rule 1		match rule 2	
						educational variables (aged 10)	labour market variables (aged 25)	educational variables (aged 10)	labour market variables (aged 25)
1975-79	1	na	na	32-36	1	1986-90	2001-05	1986-90	2001-05
1970-74	2	31-35	1	37-41	2	1981-85	1996-00	1981-90	1996-05
1965-69	3	36-40	2	42-46	3	1976-80	1991-95	1976-90	1991-05
1960-64	4	41-45	3	47-51	4	1971-75	1986-90	1971-90	1986-05
1955-59	5	46-50	4	52-56	5	1966-70	1981-85	1966-90	1981-05
1950-54	6	51-55	5	57-62	6	1961-65	1976-80	1961-90	1976-05
1645-49	7	56-60	6	na	na	1956-60	1971-75	1956-90	1971-05

Irrespective of the chosen matching, we significantly increase the degrees of freedom in the estimation. The second strategy implies reduced variation in the institutional variables (given the smoothing produced by backward moving average) but longer time span (since when missing, it extends backward to older age groups the mean values observed for younger groups). Some countries are excluded by the lack of one or more institutional variables. For the remaining ones, the different time coverage of institutional measures yields an unbalanced panel (under matching rule 1), where we control for country and age group fixed effects.[15] The errors are clustered at country level. As a consequence the present results are more robust than previous cross-section estimates reported in table 10. In table 12 we present the estimates corresponding to the first matching rule (which includes 89 observations referred to 18 countries observed for the youngest 3 or 4 age

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[15] Since institutional variables are matched according to the birth cohorts, we cannot structure our pseudo-panel in terms of country and age birth.

groups), while in table 13 we report the estimates corresponding to the second matching rule (which includes 210 observations referred to the same 18 countries over all age groups).

In table 12 we obtain results that are partly different from previous findings from cross-country analysis. Inequality and inequality of opportunity (both ex-ante and ex-post) are decreasing in teacher resources (captured by a lower pupil-teacher ratio), though they also exhibit positive correlation with public expenditure in education (as fraction of GDP). Total inequality and ex-post inequality of opportunity also exhibit significant correlation with labour market institutions: if unemployed are excluded, union density reduces total inequality, while passive labour market policies (or unemployment benefit when unemployed are included) exhibit negative correlation with total inequality.[16] Active and passive labour policies have opposite effects on ex-post inequality of opportunities: the former, by activating marginal workers, increases inequality, while the latter, by sustaining the permanence out of employment, reduces it.

Table 12 – Inequality, inequality of opportunities and institutions – population aged 31-60 –
6 age-cohorts – excluding unemployed – SILC 2005 and 2011

	1	2	3	4	5	6	7	8	9
	total inequality (MLD)			ex-ante inequality of opportunity			ex-post inequality of opportunity		
	pooled	random effects	fixed effects	pooled	random effects	fixed effects	pooled	random effects	fixed effects
Adjusted savings: education expenditure (% of GNI)	1.055**	0.819*	0.812	0.582***	0.404	0.776	1.111***	0.840***	1.636
	[0.487]	[0.458]	[2.173]	[0.193]	[0.271]	[0.456]	[0.307]	[0.321]	[1.404]
Pupil-teacher ratio in primary education	0.301**	0.375***	-0.048	0.103**	0.084*	-0.045	0.234**	0.225***	0.296
	[0.137]	[0.086]	[0.415]	[0.037]	[0.043]	[0.134]	[0.083]	[0.071]	[0.294]
Share of students in secondary education enrolled in vocational programmes	0.016	0.027	-0.051	-0.003	0.017	0.075*	-0.014	-0.007	-0.032
	[0.051]	[0.040]	[0.198]	[0.017]	[0.018]	[0.037]	[0.033]	[0.033]	[0.116]
Gross enrolment ratio, pre-primary, both sexes (%)	-0.035	-0.037*	0.04	-0.003	0.002	0.081**	-0.008	-0.002	0.071
	[0.028]	[0.020]	[0.163]	[0.006]	[0.007]	[0.036]	[0.013]	[0.014]	[0.123]
union density	-0.122***	-0.091**	0.22	-0.009	-0.004	-0.057	0.015	0.035	0.004
	[0.039]	[0.036]	[0.278]	[0.013]	[0.016]	[0.092]	[0.028]	[0.033]	[0.176]
parental leave - weeks of absence	-0.007	-0.011	0	0.001	-0.004	0.002	0.005	0.006	0.003
	[0.016]	[0.015]	[0.041]	[0.007]	[0.006]	[0.009]	[0.015]	[0.013]	[0.021]
unemployment subsidy replacement rate	-0.075	-0.062	-0.059	-0.004	-0.002	0.012	0.021	0.016	0.026
	[0.043]	[0.042]	[0.305]	[0.023]	[0.025]	[0.048]	[0.050]	[0.040]	[0.271]
active labour market policy/GDP	-0.05	-0.056	1.914	-0.506	-0.448	-0.343	0.756	1.537***	-0.099
	[1.259]	[0.838]	[2.699]	[0.500]	[0.476]	[0.923]	[1.191]	[0.538]	[2.066]
passive labour market policy/GDP	-1.162	-1.386*	-4.401	-0.29	-0.417	-0.796	-1.516**	-1.956***	-2.666
	[0.932]	[0.763]	[2.926]	[0.251]	[0.279]	[0.705]	[0.678]	[0.637]	[1.786]
minimum wage/mean wage	7.638**	9.227***	-2.377	0.963	1.943	-4.753**	0.979	2.428	-3.875
	[2.879]	[2.454]	[8.546]	[1.312]	[1.453]	[1.819]	[2.683]	[3.003]	[5.747]
Observations	89	89	89	89	89	89	89	89	89
R²	0.528	0.181	0.253	0.35	0.185	0.482	0.428	0.267	0.318
Country x year x cohort	18 countries x 2 years x 3/4 cohorts			18 countries x 2 years x 3/4 cohorts			18 countries x 2 years x 3/4 cohorts		
Hausman test (p-value)		8.02 (0.71)		failure to meet asymptotic assumptions			failure to meet asymptotic assumptions		

Robust standard errors in brackets - *** p<0.01, ** p<0.05, * p<0.1 - errors clustered by country - pooled OLS weighted using the inverse of bootstrapped st.error - constant, time and survey controls included – panel structure defined over country x age groups - Countries included: Austria, Belgium, Czech Republic, Denmark, Spain, Finland, France, Greece, Hungary, Ireland, Italy, Luxemburg, Netherlands, Norway, Poland, Portugal, Sweden, United Kingdom - **Institutions are measured as 5-years averages:** labour market institutions are matched to a conventional age of entry in the labour market (25 year old), while educational institutions are conventionally matched at the age of 10

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[16] These findings are consistent with Salverda and Checchi 2015.

Finally we notice the change reversal of the correlation with minimum wage, which is positive with total inequality when unemployed are excluded, but changes to negative when unemployed are brought into picture, especially with ex-post inequality of opportunity. Two effects counterbalance here: by raising the bottom wages, inequality should decrease irrespective of circumstances; by pricing low wage earners out of the market, inequality should decrease among the employed and increase when unemployed are kept in. However the literature suggests the existence of spillover effects on the entire distribution, when wages are bargained over in relative terms. Overall we cannot conclude with a single general prediction, but we recall that most of the literature is consistent with a negative correlation.[17]

When we move to the largest sample size, that includes also the older age groups, we get additional evidence supporting our theoretical expectations about ex ant and ex-post inequalities of opportunity. The ex-ante component rises in accordance to less teachers (higher pupil per teachers) and more segregation of students in vocational tracks, but is also positively correlated with total expenditure. The ex-post component also exhibit negative correlation with pre-primary enrolment.

Table 13 – Inequality, inequality of opportunities and (roll-back means) institutions – population aged 31-60 – 6 age-cohorts – excluding unemployed – SILC 2005 and 2011

	1	2	3	4	5	6	7	8	9
	total inequality (MLD)			ex-ante inequality of opportunity			ex-post inequality of opportunity		
	pooled	random effects	fixed effects	pooled	random effects	fixed effects	pooled	random effects	fixed effects
Adjusted savings: education expenditure (% of GNI)	2.954***	2.971***	-1.521	1.017***	0.858***	0.419	1.791***	1.286***	0.586
	[0.915]	[1.129]	[4.318]	[0.210]	[0.232]	[1.183]	[0.404]	[0.492]	[3.038]
Pupil-teacher ratio in primary education	0.133	0.533**	-0.136	0.113***	0.169***	0.014	0.299**	0.376***	-0.166
	[0.263]	[0.220]	[0.915]	[0.038]	[0.044]	[0.215]	[0.104]	[0.113]	[0.738]
Share of students in secondary education enrolled in vocational programmes	0.103	0.147*	-0.05	0.021	0.040***	0.094	0.074**	0.071**	-0.045
	[0.078]	[0.075]	[0.389]	[0.016]	[0.015]	[0.107]	[0.031]	[0.035]	[0.262]
Gross enrolment ratio, pre-primary, both sexes (%)	-0.103**	-0.105***	0.272	-0.002	-0.005	0.122***	-0.039**	-0.031*	0.288*
	[0.044]	[0.040]	[0.288]	[0.007]	[0.008]	[0.041]	[0.017]	[0.018]	[0.160]
union density	-0.104*	-0.025	0.573	0.004	0.016	0.048	0.027	0.052	0.480*
	[0.060]	[0.065]	[0.412]	[0.012]	[0.014]	[0.034]	[0.029]	[0.037]	[0.241]
parental leave - weeks of absence	-0.061**	-0.079***	-0.344***	-0.016**	-0.018***	-0.002	-0.033***	-0.029**	-0.178*
	[0.022]	[0.028]	[0.117]	[0.005]	[0.005]	[0.015]	[0.011]	[0.013]	[0.099]
unemployment subsidy replacement rate	-0.213**	-0.250**	0.028	0.042*	0.04	-0.033	0.051	0.028	-0.218
	[0.081]	[0.097]	[0.369]	[0.024]	[0.024]	[0.085]	[0.048]	[0.044]	[0.405]
active labour market policy/GDP	-3.357	-4.537	17.318**	-2.724	-1.562**	-1.015	-0.788	1.772	3.165
	[3.525]	[2.831]	[6.939]	[1.597]	[0.704]	[2.056]	[2.971]	[1.617]	[5.730]
passive labour market policy/GDP	0.611	0.803	-6.157	-0.635	-1.184***	-1.968	-2.077**	-2.720***	-2.527
	[1.515]	[1.342]	[4.990]	[0.458]	[0.342]	[1.382]	[0.825]	[0.585]	[4.188]
minimum wage/mean wage	0.039	3.058	-8.613	-0.063	0.554	-6.343*	-0.315	1.18	-8.802
	[2.919]	[3.864]	[22.245]	[0.847]	[1.296]	[3.558]	[2.110]	[3.136]	[13.320]
Observations	209	209	209	209	209	209	209	209	209
R²	0.363	0.012	0.206	0.391	0.080	0.174	0.371	0.047	0.147
Country x year x cohort	18 countries x 2 years x 6 cohorts			18 countries x 2 years x 6 cohorts			18 countries x 2 years x 6 cohorts		

Robust standard errors in brackets - *** p<0.01, ** p<0.05, * p<0.1 - errors clustered by country - pooled OLS weighted using the inverse of bootstrapped st.error - constant, time and survey controls included – panel structure defined over country x age groups – The Hausman test fails to meet the asymptotic assumptions - Countries included: Austria, Belgium, Czech Republic, Denmark, Spain, Finland, France, Greece, Hungary, Ireland, Italy, Luxemburg, Netherlands, Norway, Poland, Portugal, Sweden, United Kingdom - **Institutions are measured as roll-back means:** labour market institutions are matched to a conventional age of entry in the labour market (25 year old), while educational institutions are conventionally matched at the age of 10

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[17] See an extended discussion of the issue in Salverda and Checchi 2015.

Both active and passive labour market policies are negatively correlated with inequality of opportunities when unemployed workers are excluded, while the same correlations are statistically insignificant when including them. It is interesting to note that the more consistent correlation between both total inequality and inequality of opportunities is found with a measure of labour standard, the weeks of absence mothers (and in some cases also fathers) have right to for child-care needs after birth. Since gender is one of our circumstances, generous welfare provisions allowing for easier reconciliation of work and care may be associated to a reduction of the gender wage differential (which then translates into a lower inequality of opportunity).

Similar correlations are also found in the case of total inequality, where in addition to parental leave we also detect negative correlation with union density, unemployment subsidy and the minimum wage (relative to the mean, the so called Kaitz index – see table A.6 in the appendix). Can we take these results as causal ? Obviously not because we cannot take for granted that these institutional variables be fully exogenous to the process we are analysing. In addition in some cases (minimum wage, parental leave) it is not even well clear through which channels inequality reduction operates. However, there is sufficient variation in the data to believe that the other country/other age groups experience does represent a good counterfactual against which we may assess the impact of institutional measures in terms of inequality.

4. Concluding remarks

In this paper we have presented alternative approaches to measuring inequality of opportunities. After a brief review of both ex-ante and ex-post approaches to inequality of opportunity, we have then obtained these measures for 30 European countries. We have shown that standard income inequality and inequality of opportunities do not necessarily offer the same type of rankings (especially when comparing formerly non-market economies with coordinated market economies, like Nordic ones). Moreover, the inequality of opportunity measures do not exhibit significant variations over time, suggesting that they reflect embedded features of national socio-economic systems.

In order to explore this connection, we have then analysed the correlation between inequality measures and institutional dimensions regarding both the educational system and the labour market. We pursue alternative strategies for matching measured inequality and institutional variables. In order to increase the degrees of freedom, we consider the EUSILC survey as a pseudo-panel distinguishing between age groups. By so doing we are able to show that ex-ante inequality of opportunities is reduced in countries characterised by lower student/teachers ratios in primary schools and/or smaller fraction of students in the vocational track. We also show that labour market policies are effective in reducing the ex-post inequality, while the most consistent negative correlation with different inequality measures is found for a measure of parental leave opportunities during child caring.

Our apriori theoretical expectation of finding stronger association of ex-ante inequality with measures associated to the educational system (which are encountered before entering the labour market) is not rejected by the data. Similarly we expected that ex-post inequality measures be more correlated with labour market variables, and this is only partially confirmed by our empirical analysis.

We also show that including or excluding the unemployed makes a difference in terms of measuring inequality (and consequent country rankings), but this does not produce significant differences when looking at the correlation with institutions, reinforcing our view of inequality of opportunity as embeddedness in national socio-economic systems.

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Table A.1 – Descriptive statistics – EUSILC – population aged 30 to 60 (excluding students, retirees and inactive/disabled)

2005	AT	BE			CY	CZ	DE	DK	EE	ES	FI	FR	GR	HU	IE
obs	5050	4131			4356	4241	11471	2736	4265	13532	5476	9258	5258	6552	3118
mean income	22070	24504			16124	4931	23977	40238	3779	12392	24773	20577	13390	3838	28337
median income	21000	24840			14956	4802	21682	38525	3283	11645	23228	19177	12781	3131	24332
age	44.6	44.8			44.7	45.6	45.4	44.6	45.4	44.1	46.5	44.9	44.5	45.0	45.1
female	0.49	0.51			0.49	0.48	0.44	0.48	0.46	0.51	0.52	0.48	0.54	0.47	0.45
foreign	0.08	0.05			0.09	0.01	0.05	0.03	0.15	0.05	0.01	0.08	0.06	0.02	0.03
parental college education	0.06	0.21			0.07	0.09	0.34	0.22	0.25	0.09	0.15	0.10	0.09	0.13	0.15
high ranked parnt. occupation	0.16	0.37			0.12	0.19	0.36	0.31	0.20	0.15	0.21	0.25	0.18	0.17	0.45
unemployed	0.16	0.21			0.16	0.17	0.14	0.01	0.15	0.23	0.08	0.16	0.23	0.22	0.10
2011	AT	BE	BG	CH	CY	CZ	DE	DK	EE	ES	FI	FR	GR	HU	
obs	5752	4636	5953	6374	4274	6366	10365	2297	4699	12748	2892	9608	4649	12270	
mean income	28192	28975	3311	52115	20692	8272	27360	45879	6489	14798	30925	24313	13881	4933	
median income	25300	28819	2826	49030	18282	8068	25268	45304	5521	13812	29703	22775	12560	4356	
age	45.36	44.95	46.24	45.75	45.51	45.78	46.45	46.39	45.77	44.93	46.30	45.72	44.71	46.05	
female	0.48	0.50	0.50	0.47	0.46	0.42	0.47	0.46	0.47	0.50	0.53	0.48	0.52	0.46	
foreign	0.09	0.08	0.00	0.09	0.11	0.01	0.06	0.04	0.12	0.07	0.02	0.06	0.08	0.00	
parental college education	0.16	0.25	0.13	0.18	0.09	0.10	0.30	0.27	0.22	0.10	0.23	0.13	0.08	0.10	
high ranked parnt. occupation	0.17	0.40	0.16	0.38	0.14	0.20	0.35	0.33	0.21	0.23	0.25	0.31	0.19	0.15	
unemployed	0.14	0.18	0.13	0.08	0.14	0.18	0.15	0.06	0.18	0.25	0.11	0.12	0.23	0.21	

Table A.1 (continued) – Descriptive statistics – EUSILC – population aged 30 to 60 (excluding students, retirees and inactive/disabled)

2005	IS	IT	LT	LU	LV		NL	NO	PL	PT		SE	SI	SK	UK
obs	1435	20814	4844	3939	3561		4059	2828	17821	4710		876	3822	6196	6564
mean income	33873	19024	2935	32609	2607		27445	36756	2984	9282		24010	11250	3081	27790
median income	32584	18668	2357	26463	2142		26865	35574	2088	7095		24708	10561	3123	23062
age	43.9	44.3	45.6	44.2	45.0		44.3	44.1	45.5	45.1		44.2	44.8	45.4	45.0
female	0.50	0.53	0.45	0.49	0.45		0.48	0.51	0.48	0.49		0.49	0.49	0.47	0.47
foreign	0.02	0.04	0.06	0.08	0.16		0.03	0.03	0.00	0.01		0.05	0.11	0.00	0.08
parental college education	0.23	0.04	0.24	0.18	0.19		0.18	0.43	0.06	0.03		0.19	0.09	0.09	0.35
high ranked parnt. occupation	0.31	0.22	0.14	0.30	0.19		0.48	0.33	0.13	0.11		0.34	0.16	0.18	0.30
unemployed	0.06	0.16	0.19	0.25	0.21		0.10	0.02	0.36	0.23		0.07	0.06	0.20	0.20

2011	IS	IT	LT	LU	LV	MT	NL	NO	PL	PT	RO	SE	SI	SK	UK
obs	1532	17002	4732	6055	5779	3508	4914	2381	13114	5279	5163	567	4259	6203	5538
mean income	26194	22941	4592	38949	5053	12827	35654	51421	5817	10741	2491	28769	15513	6811	24256
median income	24599	21439	3528	31923	3840	12673	33750	50402	5043	8392	2403	28497	14125	6978	19640
age	45.02	45.20	47.66	44.46	46.09	45.18	45.53	45.14	46.18	46.03	45.50	45.25	44.69	45.56	45.71
female	0.50	0.51	0.45	0.48	0.44	0.51	0.47	0.53	0.47	0.48	0.52	0.48	0.48	0.46	0.45
foreign	0.03	0.06	0.06	0.09	0.13	0.06	0.04	0.04	0.00	0.06	0.00	0.06	0.11	0.00	0.08
parental college education	0.17	0.06	0.12	0.14	0.16	0.07	0.24	0.34	0.07	0.04	0.03	0.30	0.12	0.08	0.22
high ranked parnt. occupation	0.25	0.26	0.15	0.33	0.20	0.30	0.44	0.34	0.13	0.13	0.10	0.29	0.19	0.19	0.31
unemployed	0.06	0.14	0.22	0.21	0.19	0.28	0.08	0.07	0.28	0.22	0.20	0.06	0.12	0.15	0.19

Table A.2 – Alternative measures of income inequality, using gross and net definitions of income

	equivalised household incomes before taxes and transfers - population 18-65 (Gini OECD)		equivalised household disposable incomes after taxes and transfers - population 18-65 (Gini OECD)		equivalised household disposable incomes after taxes and transfers - (Gini Eurostat)		personal (positive) incomes before taxes and transfers - (Gini our sample)		personal (positive) incomes before taxes and transfers - (MLD our sample)	
Year	2005	2011	2005	2011	2005	2011	2005	2011	2005	2011
Austria	0.409	0.429	0.259	0.283	0.263	0.274	0.339	0.353	0.272	0.277
Belgium	0.430	0.418b	0.277	0.262b	0.280	0.263	0.281	0.290	0.169	0.221
Bulgaria					0.250	0.350		0.363		0.263
Cyprus					0.287	0.292	0.325	0.356	0.202	0.249
Czech Republic	0.407	0.394	0.259	0.256	0.260	0.252	0.313	0.298	0.252	0.183
Denmark	0.373	0.389	0.227	0.250	0.239	0.278	0.230	0.253	0.120	0.191
Estonia	0.420	0.421	0.328	0.324	0.341	0.319	0.372	0.379	0.296	0.314
Finland	0.422	0.421	0.266	0.268	0.260	0.258	0.352	0.337	0.324	0.309
France	0.430	0.460	0.288	0.310	0.277	0.308	0.338	0.338	0.273	0.285
Germany	0.416a	0.421	0.304	0.298	0.261	0.290	0.406	0.361	0.559	0.307
Greece	0.421	0.499	0.343	0.341	0.332	0.335	0.319	0.371	0.200	0.321
Hungary			0.300	0.293c	0.276	0.268	0.371	0.354	0.275	0.274
Iceland	0.334	0.355	0.279	0.250	0.251	0.236	0.323	0.337	0.246	0.291
Ireland	0.461	0.533	0.321	0.308	0.319	0.298	0.382		0.318	
Italy	0.444a	0.436	0.325a	0.324	0.328	0.319	0.310	0.350	0.212	0.266
Latvia					0.362	0.351	0.363	0.429	0.246	0.413
Lithuania					0.363	0.330	0.379	0.384	0.290	0.291
Luxembourg	0.414	0.431	0.287	0.275	0.265	0.272	0.365	0.360	0.273	0.261
Malta					0.270	0.272		0.296		0.216
Netherlands	0.394	0.387b	0.285	0.287b	0.269	0.258	0.319	0.326	0.236	0.240
Norway	0.408a	0.392	0.284a	0.260	0.282	0.229	0.290	0.302	0.218	0.243
Poland	0.487	0.425	0.333	0.306	0.356	0.311	0.396	0.352	0.356	0.264
Portugal	0.446	0.478	0.370	0.339	0.381	0.342	0.404	0.388	0.294	0.273
Romania					0.310	0.332		0.356		0.316
Slovak Republic	0.402	0.366	0.280	0.258	0.262	0.257	0.301	0.266	0.281	0.168
Slovenia	0.403	0.411	0.241	0.245	0.238	0.238	0.395	0.340	0.583	0.277
Spain	0.396	0.467	0.307	0.348	0.322	0.340	0.336	0.341	0.232	0.253
Sweden	0.369a	0.371	0.236a	0.268	0.234	0.244	0.299	0.280	0.263	0.238
Switzerland		0.321		0.278		0.297		0.362		0.311
United Kingdom	0.447	0.478	0.335	0.346	0.346	0.330	0.380	0.392	0.286	0.312

Note: [a] refers to 2004 – [b] refers to 2010 – [c] refers to 2012 – Data from OECD are downloaded from http://stats.oecd.org/ (section "social protection and well being/income distribution and poverty") – Data from Eurostat are based on the SILC database and are downloaded from http://ec.europa.eu/eurostat/web/income-and-living-conditions/data/main-tables)

Table A.3 – Data sources

educational institutions variables	sources
Expenditure per student, primary (% of GDP per capita)	World Bank (http://data.worldbank.org/indicator)
Expenditure per student, secondary (% of GDP per capita)	World Bank (http://data.worldbank.org/indicator)
Expenditure per student, tertiary (% of GDP per capita)	World Bank (http://data.worldbank.org/indicator)
Government expenditure on education as % of GDP (%)	Unesco (http://data.uis.unesco.org/)
Expenditure on education as % of total government expenditure (%)	Unesco (http://data.uis.unesco.org/) – updated using World Bank growth rates when missing
Primary education, duration (years)	World Bank (http://data.worldbank.org/indicator)
Adjusted savings: education expenditure (% of GNI)	World Bank (http://data.worldbank.org/indicator)
Pupil-teacher ratio in primary education	headcount based - Unesco (http://data.uis.unesco.org/)
Pupil-teacher ratio in secondary education	headcount based - Unesco (http://data.uis.unesco.org/)
Percentage of students in secondary education enrolled in vocational programmes	both sexes - Unesco (http://data.uis.unesco.org/)
Gross enrolment ratio, pre-primary, both sexes (%)	both sexes - Unesco (http://data.uis.unesco.org/)
Expenditure on pre-primary as % of government expenditure on education (%)	Unesco (http://data.uis.unesco.org/)
labour market institutions	
union density	ICTWSS database (Visser 2013 - http://www.uva-aias.net/208)
coverage rate	ICTWSS database (Visser 2013 - http://www.uva-aias.net/208)
bargaining centralisation	ICTWSS database (Visser 2013 - http://www.uva-aias.net/208)
employment protection legislation	Strictness of employment protection – overall - version 1 - source: OECD http://www.oecd.org/employment/emp/oecdindicatorsofemploymentprotection.htm)
minimum wage/mean wage	Minimum relative to mean wages of full-time workers – set equal to 1 if minimum wage provision is absent - source: OECD (except Iceland) http://stats.oecd.org/Index.aspx?DataSetCode=RMW
unemployment subsidy replacement rate	Unemployment insurance and unemployment assistance benefits - gross replacement rate for a full-time adult worker - source: OECD historical series - combination of GRR(APW) until 2001 and GRR(AW) afterward - available in odd years, interyear means introduced in even years - http://www.oecd.org/els/benefitsandwagesstatistics.htm)
tax wedge	Average tax wedge (sum of social contributions and income taxes to the average wage) - average between single worker and one-earner married couple with two children - source: OECD http://www.oecd.org/tax/tax-policy/taxing-wages.htm)
active labour market policy/gdp	OECD http://stats.oecd.org/Index.aspx?DatasetCode=LMPEXP
passive labour market policy/gdp	OECD http://stats.oecd.org/Index.aspx?DatasetCode=LMPEXP
social expenditure/gdp	cash benefit + benefit in kind in percentage of GDP - source: OECD (available on quinquennial base then interpolated) http://www.oecd.org/social/expenditure.htm
parental leave - weeks of absence	weeks of paid leave for child birth - source: Thévenon, O. and A. Solaz (2013), "Labour Market Effects of Parental Leave Policies in OECD Countries", OECD Social, Employment and Migration Working Papers, No. 141, OECD Publishing. - further documentation at http://www.oecd.org/social/soc/oecdfamilydatabase.htm

Table A.4 – Inequality and institutions – 30 countries – 2005 and 2011 - including unemployment

	1	2	3	4	5	6	7	8	9
	total inequality (MLD)			ex-ante inequality of opportunity			ex-post inequality of opportunity		
	pooled	random effects	fixed effects	pooled	random effects	fixed effects	pooled	random effects	fixed effects
Adjusted savings: education expenditure (% of GNI)	-4.86	-4.9	-1.896	0.389	0.086	0.608	-17.749**	-8.832*	-3.589
	[11.812]	[7.391]	[4.217]	[0.782]	[0.575]	[0.755]	[6.769]	[5.121]	[3.793]
Pupil-teacher ratio in primary education	-4.428*	-1.988	0.249	-0.142	-0.254	-0.143	-1.674	-1.323	-0.271
	[2.263]	[2.429]	[3.595]	[0.146]	[0.175]	[0.230]	[1.410]	[1.704]	[2.405]
% students in secondary education enrolled in vocational programmes	-1.063	-1.577**	-1.755	0.021	-0.032	-0.069	-1.027**	-1.183**	-1.13
	[0.733]	[0.689]	[1.102]	[0.050]	[0.051]	[0.155]	[0.441]	[0.519]	[0.899]
Expenditure on pre-primary as % of govern. expenditure on education	-0.296	0.335	-1.388	-0.351***	-0.332***	-0.387	-2.153*	-1.344	-2.474
	[1.646]	[1.676]	[2.467]	[0.116]	[0.101]	[0.277]	[1.160]	[1.247]	[1.938]
union density	-0.366	-0.375	-0.234	-0.035	0.003	0.069	0.19	-0.049	-1.142
	[0.522]	[0.540]	[1.666]	[0.037]	[0.047]	[0.179]	[0.335]	[0.426]	[1.184]
parental leave - weeks of absence	-0.194	-0.153	-0.447	-0.017	-0.005	0.004	-0.107	-0.127	-0.184
	[0.193]	[0.164]	[0.275]	[0.015]	[0.011]	[0.016]	[0.142]	[0.126]	[0.191]
unemployment subsidy replacement rate	-1.301	-1.821**	-1.791	-0.104**	-0.110**	-0.016	-0.216	-1.026*	-1.276
	[0.786]	[0.768]	[1.204]	[0.041]	[0.048]	[0.113]	[0.419]	[0.525]	[0.989]
active labour market policy/GDP	-100.4***	-65.06***	-37.572	-2.895	-2.266	-3.226	-31.030*	-18.918	5.851
	[25.722]	[18.602]	[23.576]	[2.067]	[2.168]	[2.814]	[17.808]	[15.594]	[19.042]
passive labour market policy/GDP	53.186***	49.153***	58.223***	1.577	0.961	0.604	14.442	16.691*	18.139
	[13.558]	[11.162]	[15.728]	[1.254]	[1.490]	[2.322]	[11.120]	[9.974]	[12.349]
minimum wage/mean wage	-39.250*	-25.631	-144.932	0.697	2.011	42.958	-23.135	-7.924	46.364
	[19.277]	[29.224]	[277.702]	[1.560]	[2.330]	[33.579]	[17.744]	[24.310]	[266.311]
Observations	55	55	55	55	55	55	55	55	55
R-squared (within)	0.715	0.162	0.46	0.369	0.398	0.376	0.674	0.270	0.465
Number of country	30	30	30	30	30	30	30	30	30

Robust standard errors in brackets - *** p<0.01, ** p<0.05, * p<0.1 errors clustered by country - pooled OLS weighted using the inverse of bootstrapped st.error – constant, year and dummy for imputed institutional variables controls included – the Hausman test fails to meet asymptotic assumptions

Table A.5 – Inequality, inequality of opportunities and institutions – population aged 31-60 –
6 age-cohorts – including unemployed – SILC 2005 and 2011

	1	2	3	4	5	6	7	8	9
	total inequality (MLD)			ex-ante inequality of opportunity			ex-post inequality of opportunity		
	pooled	random effects	fixed effects	pooled	random effects	fixed effects	pooled	random effects	fixed effects
Adjusted savings: education expenditure (% of GNI)	-5.733	-5.103	-8.731	0.978***	0.595	-0.401	-1.779	-0.655	-14.355**
	[7.953]	[7.336]	[13.128]	[0.285]	[0.388]	[1.352]	[5.659]	[4.703]	[6.329]
Pupil-teacher ratio in primary education	1.76	0.995	0.263	0.218**	0.162**	-0.71	1.359	0.438	1.883
	[1.223]	[0.802]	[3.928]	[0.084]	[0.073]	[0.457]	[0.904]	[0.927]	[2.330]
Share of students in secondary education enrolled in vocational programmes	-0.08	-0.057	-0.798	-0.045	-0.019	-0.002	-0.218	-0.219	-0.802
	[0.457]	[0.405]	[0.704]	[0.030]	[0.032]	[0.087]	[0.322]	[0.277]	[0.557]
Gross enrolment ratio, pre-primary, both sexes (%)	-0.17	-0.172	2.012***	-0.005	0.007	0.223**	0.162	0.098	1.802***
	[0.294]	[0.215]	[0.506]	[0.015]	[0.014]	[0.100]	[0.212]	[0.189]	[0.434]
union density	-0.272	-0.365	0.895	-0.001	0.065	-0.022	0.253	0.182	-0.965
	[0.520]	[0.477]	[4.032]	[0.040]	[0.043]	[0.295]	[0.352]	[0.314]	[2.264]
parental leave - weeks of absence	0.031	0.04	-0.35	0.029*	0.020*	-0.027	0.077	0.051	-0.356**
	[0.163]	[0.146]	[0.221]	[0.015]	[0.010]	[0.043]	[0.144]	[0.101]	[0.142]
unemployment subsidy replacement rate	-1.451**	-1.401**	-0.994	-0.046	-0.032	0.183**	-0.871	-0.905*	-0.714
	[0.674]	[0.602]	[1.482]	[0.055]	[0.057]	[0.084]	[0.581]	[0.478]	[1.340]
active labour market policy/GDP	-25.432	-18.001	11.688	0.489	-0.821	-3.379**	-23.187	-17.897	14.322
	[20.109]	[16.142]	[18.161]	[1.274]	[0.737]	[1.247]	[15.220]	[11.529]	[11.357]
passive labour market policy/GDP	13.216	10.993	-9.705	-0.73	-0.7	-1.252	1.349	1.261	-4.633
	[8.608]	[7.524]	[11.041]	[0.473]	[0.851]	[1.585]	[5.124]	[4.246]	[9.317]
minimum wage/mean wage	-36.209	-40.284*	-53.151	-1.438	-1.92	-21.66***	-39.344	-44.805**	-31.165
	[28.369]	[21.522]	[65.268]	[2.079]	[2.504]	[6.340]	[23.725]	[21.829]	[36.432]
Observations	89	89	89	89	89	89	89	89	89
R²	0.74	0.009	0.286	0.527	0.000	0.577	0.684	0.001	0.412
Country x year x cohort	18 countries x 2 years x 3/4 cohorts			18 countries x 2 years x 3/4 cohorts			18 countries x 2 years x 3/4 cohorts		
Hausman test (p-value)		fails to meet asymptotic assumptions			fails to meet asymptotic assumptions			314.4 (0.00)	

Robust standard errors in brackets - *** p<0.01, ** p<0.05, * p<0.1 - errors clustered by country - pooled OLS weighted using the inverse of bootstrapped st.error - constant, time and survey controls included – panel structure defined over country x age groups - Countries included: Austria, Belgium, Czech Republic, Denmark, Spain, Finland, France, Greece, Hungary, Ireland, Italy, Luxemburg, Netherlands, Norway, Poland, Portugal, Sweden, United Kingdom - **Institutions are measured as 5-years averages:** labour market institutions are matched to a conventional age of entry in the labour market (25 year old), while educational institutions are conventionally matched at the age of 10

Table A.6 – Inequality, inequality of opportunities and (roll-back means) institutions – population aged 31-60 – 6 age-cohorts – including unemployed – SILC 2005 and 2011

	1	2	3	4	5	6	7	8	9
	total inequality (MLD)			ex-ante inequality of opportunity			ex-post inequality of opportunity		
	pooled	random effects	fixed effects	pooled	random effects	fixed effects	pooled	random effects	fixed effects
Adjusted savings: education expenditure (% of GNI)	-7.737	-8.342	18.71	1.484***	0.753	-3.888*	-7.411	-8.39	0.227
	[11.344]	[12.571]	[28.874]	[0.435]	[0.634]	[1.860]	[6.668]	[6.491]	[22.785]
Pupil-teacher ratio in primary education	1.31	5.493***	-2.833	0.181**	0.478***	-0.383	2.108	1.23	-0.413
	[1.991]	[2.051]	[5.432]	[0.075]	[0.119]	[0.712]	[1.927]	[1.286]	[3.124]
Share of students in secondary education enrolled in vocational programmes	1.818**	2.025***	-1.434	0.090***	0.181***	-0.271	-0.46	0.437	-1.938***
	[0.635]	[0.738]	[1.012]	[0.029]	[0.036]	[0.160]	[0.683]	[0.409]	[0.669]
Gross enrolment ratio, pre-primary, both sexes (%)	-0.449	-0.352	4.048*	-0.008	-0.01	0.305**	0.565	0.268	2.617*
	[0.282]	[0.385]	[2.106]	[0.018]	[0.021]	[0.124]	[0.354]	[0.229]	[1.408]
union density	-0.331	0.88	2.802	0.012	0.100**	-0.004	0.062	0.352	1.377
	[0.478]	[0.624]	[2.194]	[0.032]	[0.046]	[0.142]	[0.679]	[0.384]	[1.316]
parental leave - weeks of absence	-0.673***	-0.733***	0.095	-0.050***	-0.056***	-0.015	-0.420*	-0.367***	-0.056
	[0.203]	[0.239]	[0.381]	[0.012]	[0.012]	[0.040]	[0.217]	[0.120]	[0.293]
unemployment subsidy replacement rate	-2.228***	-1.198	3.608	-0.023	0.019	0.16	-0.162	0.219	2.547
	[0.729]	[1.013]	[3.052]	[0.053]	[0.060]	[0.298]	[0.852]	[0.540]	[2.989]
active labour market policy/GDP	-40.228	-53.296	87.577	-5.954	-1.661	-4.118	-29.707	-21.779	62.68
	[34.429]	[37.046]	[56.569]	[3.895]	[2.745]	[5.244]	[42.232]	[25.672]	[45.204]
passive labour market policy/GDP	12.188	5.141	-53.092**	0.274	-2.457**	-5.702	-12.329	-13.985	-37.176**
	[16.044]	[13.226]	[20.285]	[1.022]	[1.093]	[3.539]	[13.349]	[10.156]	[14.470]
minimum wage/mean wage	-56.061**	-40.919	-177.096*	-1.135	-0.314	-19.377**	13.188	-23.945	-72.867
	[24.132]	[37.557]	[96.105]	[1.813]	[3.179]	[8.857]	[35.189]	[30.810]	[63.452]
Observations	209	209	209	209	209	209	209	209	209
R²	0.633	0.002	0.244	0.371	0.008	0.114	0.382	0.024	0.177
Country x year x cohort	18 countries x 2 years x 6 cohorts			18 countries x 2 years x 6 cohorts			18 countries x 2 years x 6 cohorts		
Hausman test (p-value)		96.1 (0.00)			25.6 (0.00)			211.3 (0.00)	

Robust standard errors in brackets - *** p<0.01, ** p<0.05, * p<0.1 - errors clustered by country - pooled OLS weighted using the inverse of bootstrapped st.error - constant, time and survey controls included – panel structure defined over country x age groups – The Hausman test fails to meet the asymptotic assumptions - Countries included: Austria, Belgium, Czech Republic, Denmark, Spain, Finland, France, Greece, Hungary, Ireland, Italy, Luxemburg, Netherlands, Norway, Poland, Portugal, Sweden, United Kingdom - **Institutions are measured as roll-back means:** labour market institutions are matched to a conventional age of entry in the labour market (25 year old), while educational institutions are conventionally matched at the age of 10

Figure A.1 – Inclusion or exclusion of unemployment using mean log deviation – SILC

MLD gross individual earnings

excluding unemployed   Including unemployed
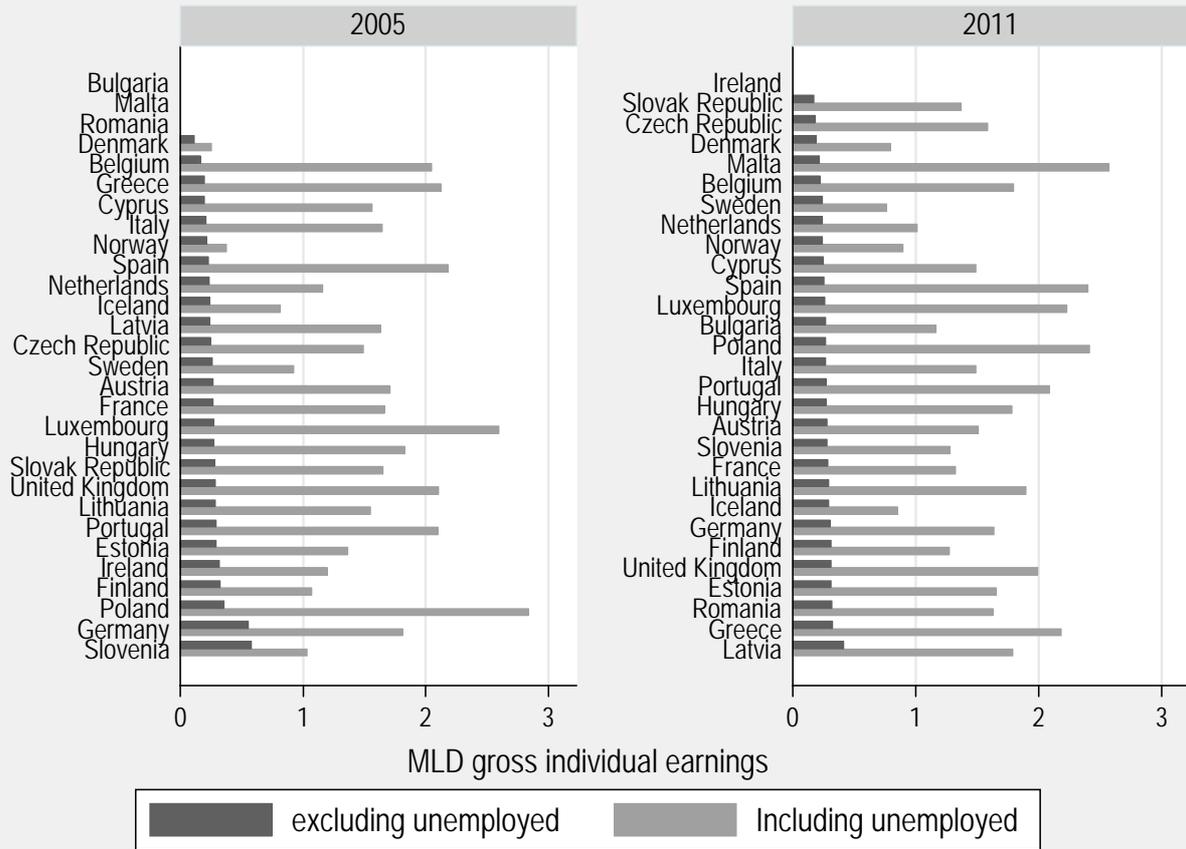
Figure A.2 – Inequality across age cohorts including unemployed – SILC

Earnings inequality across age groups - including unemployed

gross earnings inequality - mean log deviation

age

SILC 2005   SILC 2011
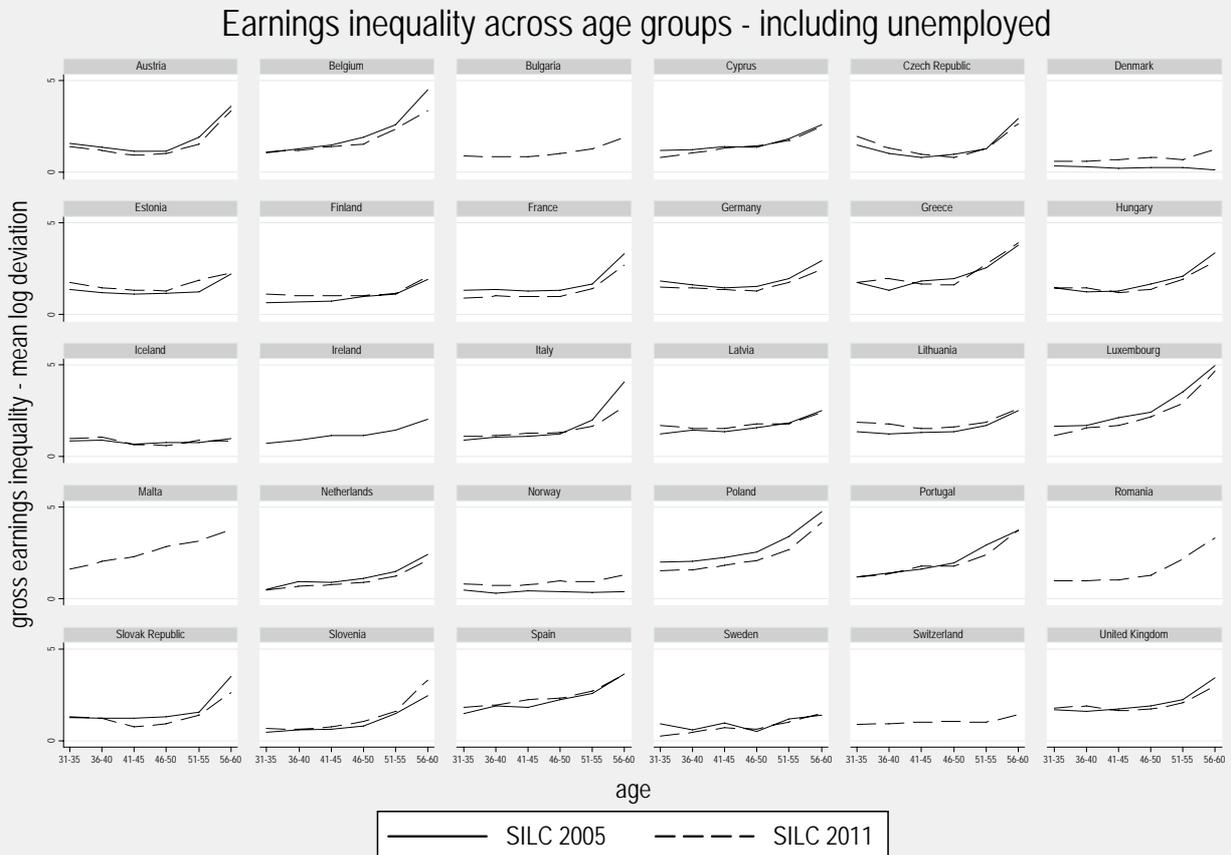
Figure A.3 – Inequality ex-ante and total inequality including unemployed – SILC

Total inequality and inequality due to circumstances - including unemployed

mean log deviation

total inequality   inequality ex-ante
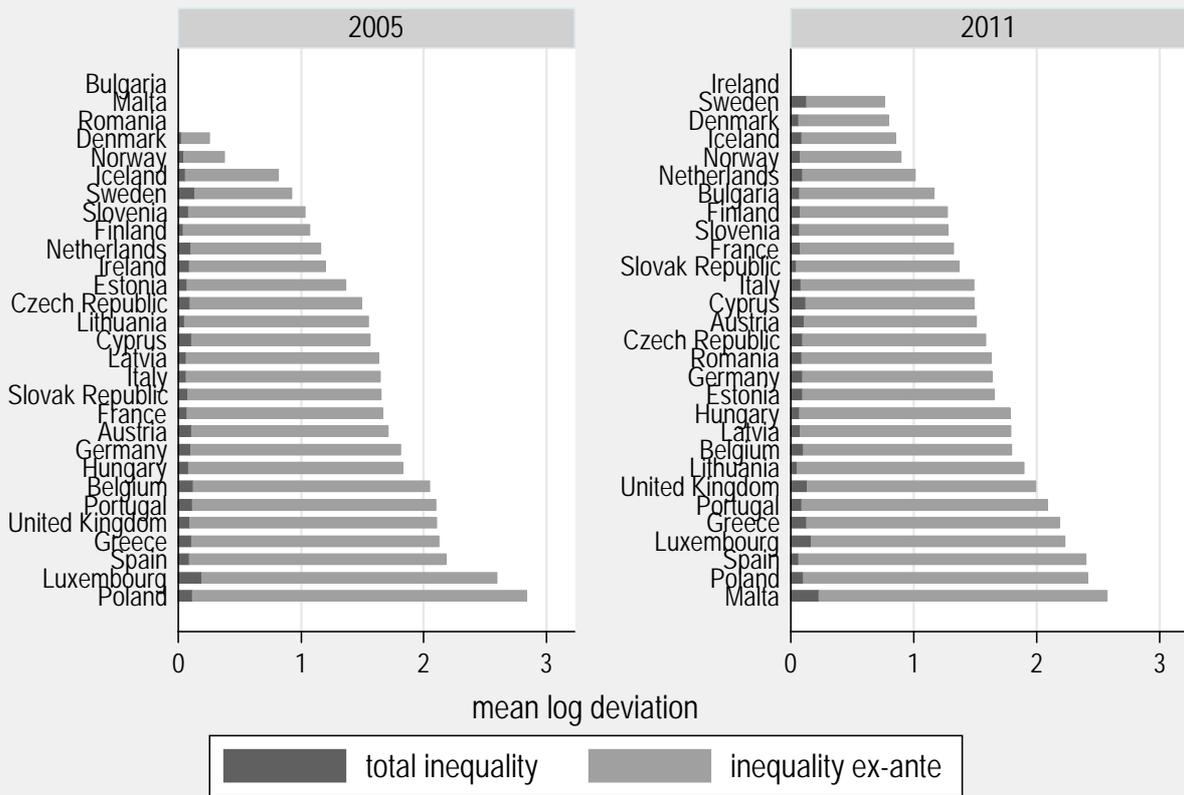
Figure A.4 – Inequality ex-post and total inequality including unemployed – SILC

Total inequality and inequality for identical effort - including unemployed

mean log deviation

total inequality   inequality ex-post
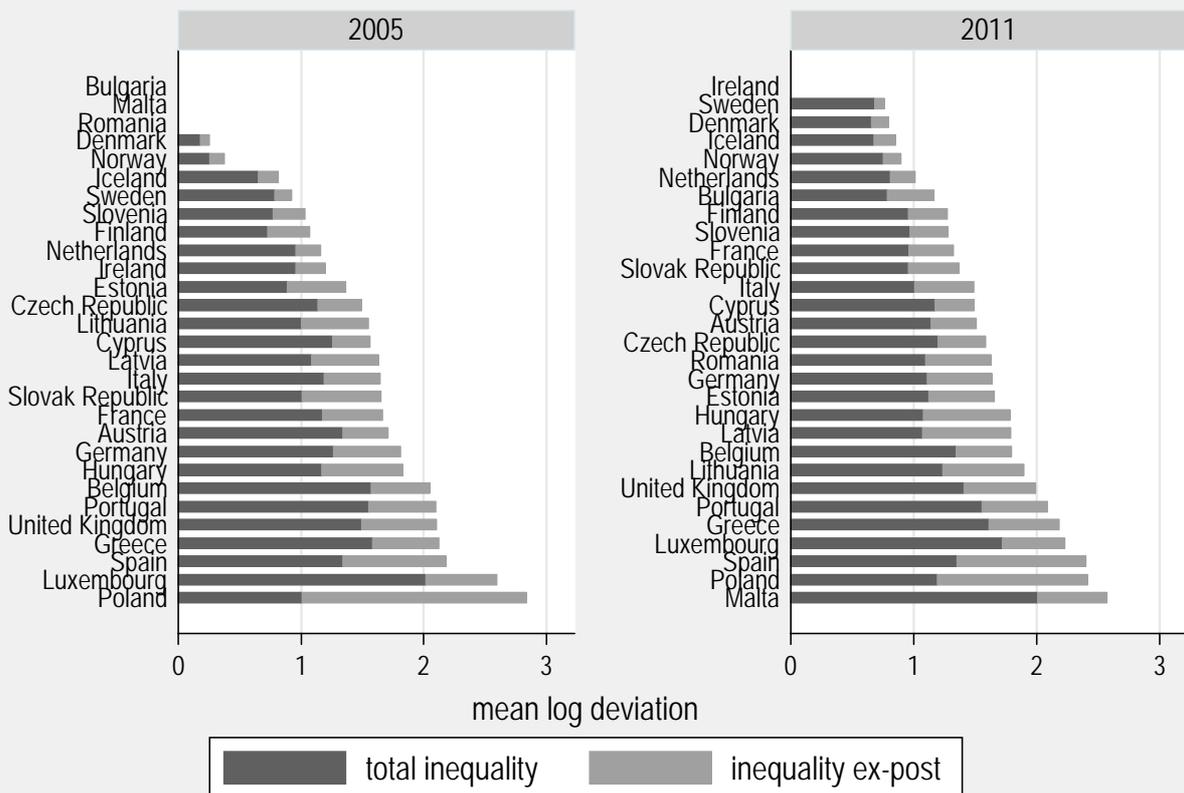
Figure A.5 – Inequality ex-ante and ex-post including unemployed – SILC

Inequality of opportunity - including unemployed