



Inequality and Education

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Why should we care about inequality in general ?

Why should we care about inequality in incomes ?

Why should we care about inequality in education ?

- quantity of education
- quality of education

Can we affect inequality in education ?

Two policy approaches

People preferences should matter

Inequality often justified by the need to provide incentives (rewarding effort).

However results are the combined effect of
effort + circumstances + luck

Circumstances should not deserve remuneration.

(Bad) luck should be compensated, as well as good luck should be redistributed among participants.

We all live in an uncertain world, and we should take our decision under a veil of ignorance → in general we aim to minimise the likelihood of very negative events (like remaining illiterate)

In addition, inequality (in incomes) is detrimental to political stability and growth.

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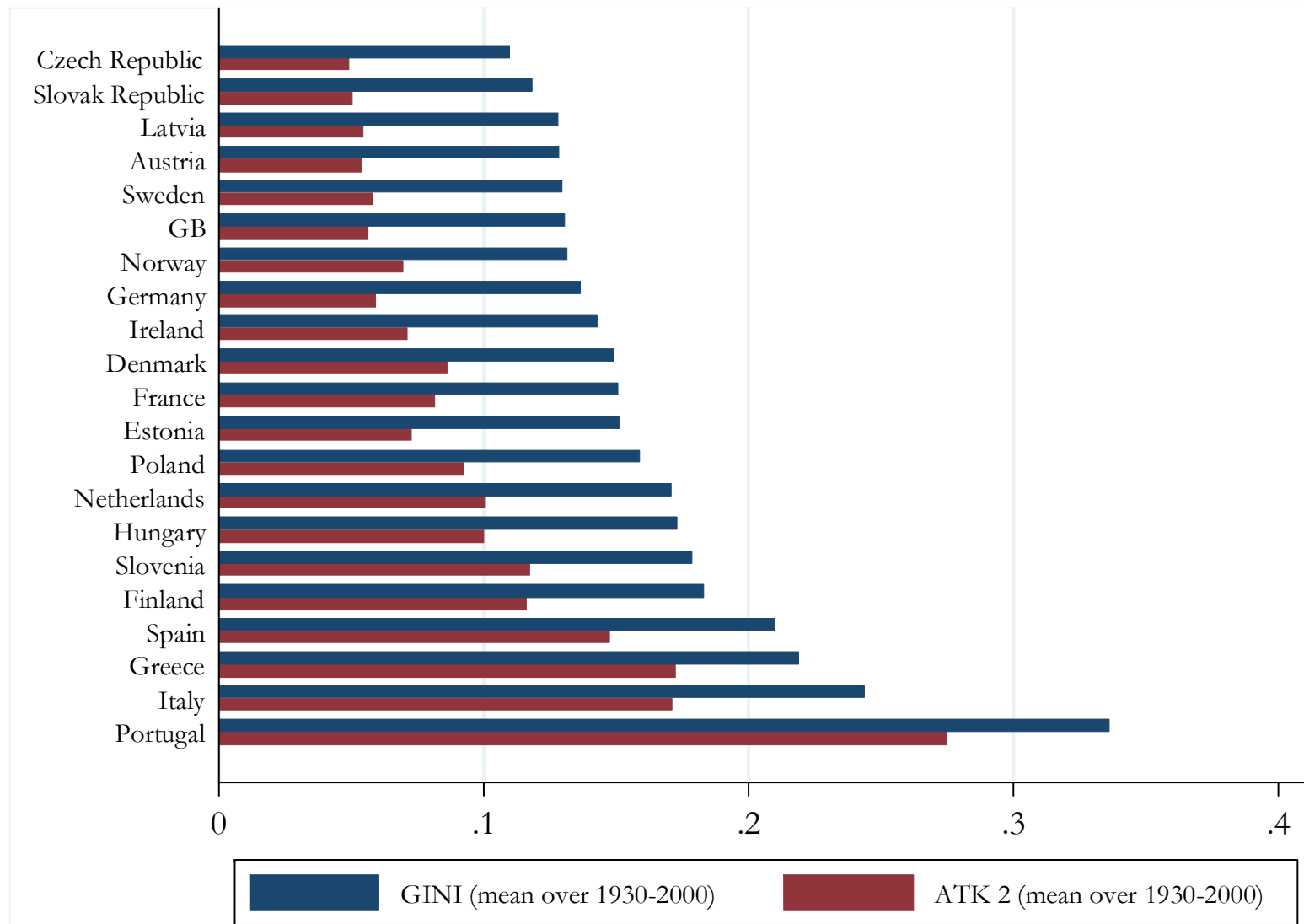
Education is crucial for

- ✓ developing one's own potential
- ✓ getting socialised
- ✓ improving life chances
 - employment
 - income
 - health

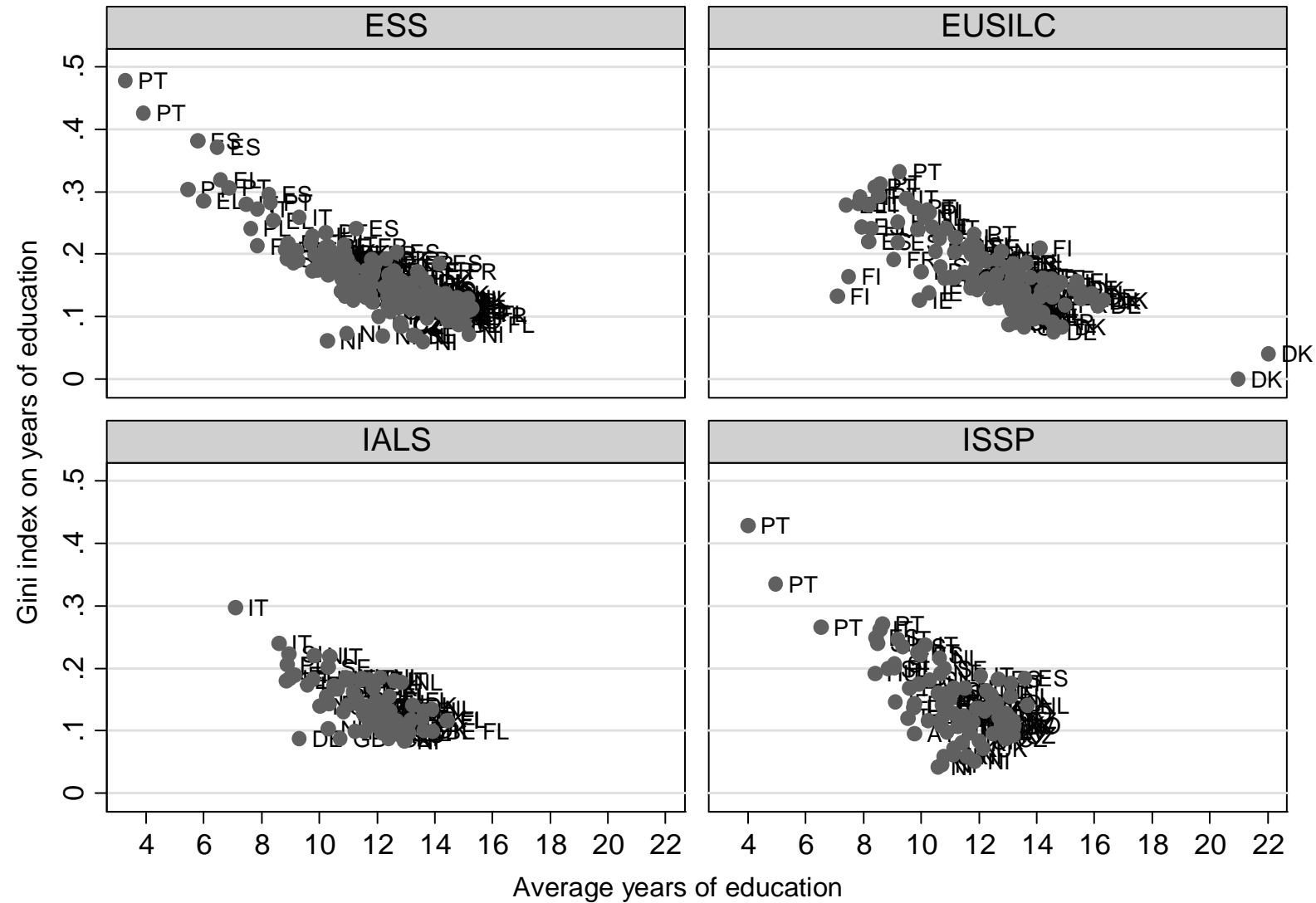
but also

- ✓ getting access to the mankind history
- ✓ enjoying culture and arts

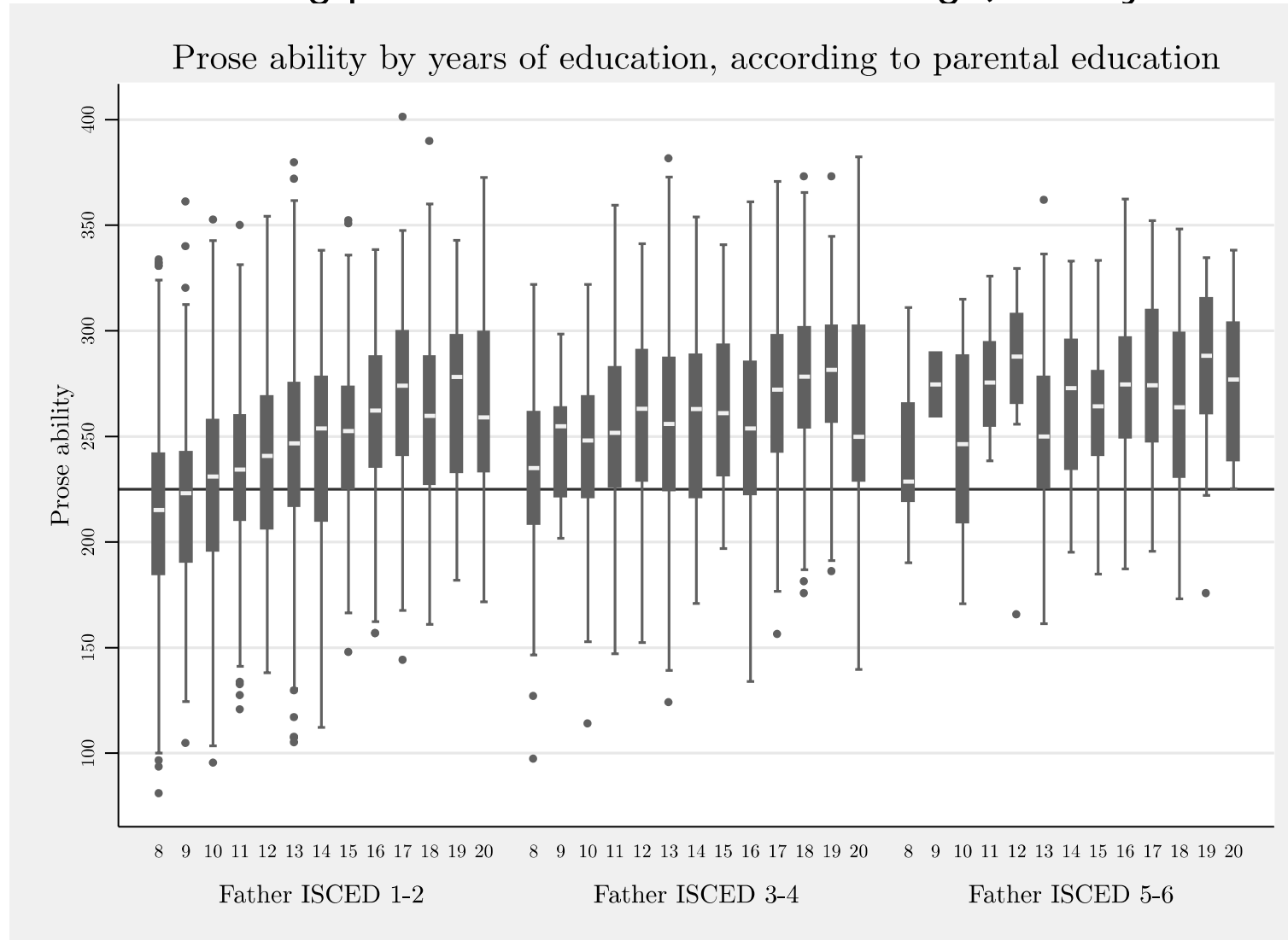
Educational inequality measures by country



Mean years of Education and GINI concentration index, by country and 5-years cohorts



Schooling is not enough to acquire capabilities. People with the same amount of schooling possess different functioning (literacy, numeracy).



Both inequality in schooling (quantity of education) and competences (quality of education) matter for earnings inequality (via unemployment and incomes)

We consider a linear version of income determination, which reads

$$y_{ij} = a_j + \alpha_j h_i + \beta_j q_i + \boldsymbol{\gamma}' \mathbf{X}_{ij} + \varepsilon_{ij}$$

The inequality observed in the distribution of earnings y depends on the inequality in both quality q and quantity h of education, as well as on any other observable in the vector \mathbf{X}_i (like age, gender, and ethnicity) or unobservable ε . Given the non-zero correlation between education and other observables and unobservables, it is generally impossible to decompose observed earnings inequality into separated contributions of underlying factors.

Nevertheless we can resort to the more modest strategy of studying the correlation among inequality measures, from which we can still deduce educational policy relevant propositions.

By indicating with $I(x)$ a generic inequality indicator, an equivalent of previous equation can be expressed as

$$I(y) = \delta_j + \alpha I(h) + \beta I(q) + \omega_j$$

where δ_j is a country/year fixed effect capturing any other sort of earnings inequality variation, while α and β measure the correlation between various dimensions of human capital (quantity and quality) to earnings (or income) inequality.

We are tempted to a causal interpretation of statements like “a reduction in inequality in test scores is associated to a β -reduction in income inequality”.

Current adult surveys (like PIACC) provide information on current variables (income, employment status, competences)

$$y_{ijt} = a_j + \alpha_j h_{it} + \beta_j q_{it} + \gamma' \mathbf{X}_{ij} + \varepsilon_{ijt}$$

while we need past values of competences and degrees to study their impact on current employment and income.

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while we need past values of competences and degrees to study their impact on current employment and income.

$$y_{ijt} = a_j + \alpha_j h_{it-n} + \beta_j q_{it-n} + \gamma' \mathbf{X}_{ij} + \varepsilon_{ijt}$$

Such an ideal dataset exists only for few countries (UK, US, Norway and Sweden) because student testing is a recent issue, and we do not keep track of them for confidentiality reasons.

Our exercise (Checchi and van de Werfhorst 2014) consider data on students' competences obtained from three surveys on mathematical competences of 14-year-old students conducted in past decades (FIMS 1964 on students born in 1950, SIMS 1980-82 on students born in 1966 and TIMSS 1995 on students born in 1981).

Data on schooling and labour market outcomes of the same cohorts can be obtained from representative samples of the corresponding population at later stages.

However, if observed at the same point in time, we would be confusing cohorts and age effects (namely, older cohorts are characterised by higher level of competences and/or earnings inequality). For this reason, we have resorted to two available datasets existing at European level and reporting data on earnings and incomes. The first one is the European Community Household Panel (ECHP), while the second is the European Union Statistics on Income and Living Conditions (EUSILC).

Table 1 – Construction of the sample – matching rule

Birth year	Aged 14	Aged 28	Aged 43-44	Aged 59	matched cohorts/countries
1950	1964 (from FIMS: BE,FI,FR,DE,NL,UK)	1978 (data not available)	1994 (from ECHP1994: BE,FR,DE,NL,UK)	2009 (from SILC2009: BE,FI,FR,DE,NL,UK)	11
1966	1980 (from SIMS: (BE,FI,FR,HU,NL,SE,UK)	1994 (from ECHP1994: BE,FR,NL,UK)	2009 (from SILC2009: BE, FI,FR,HU,NL,SE,UK)		11
1981	1995 (from TIMS: AT,BE,CZ,DK,FR,DE, GR,HU,IE,IT,LV,NL,NO, PT,SK,SI,ES,SE,UK)	2009 (from SILC2009: AT,BE,CZ,DK,FR,DE, GR,HU,IE,IT,LV,NL,NO, PT,SK,SI,ES,SE,UK)			19

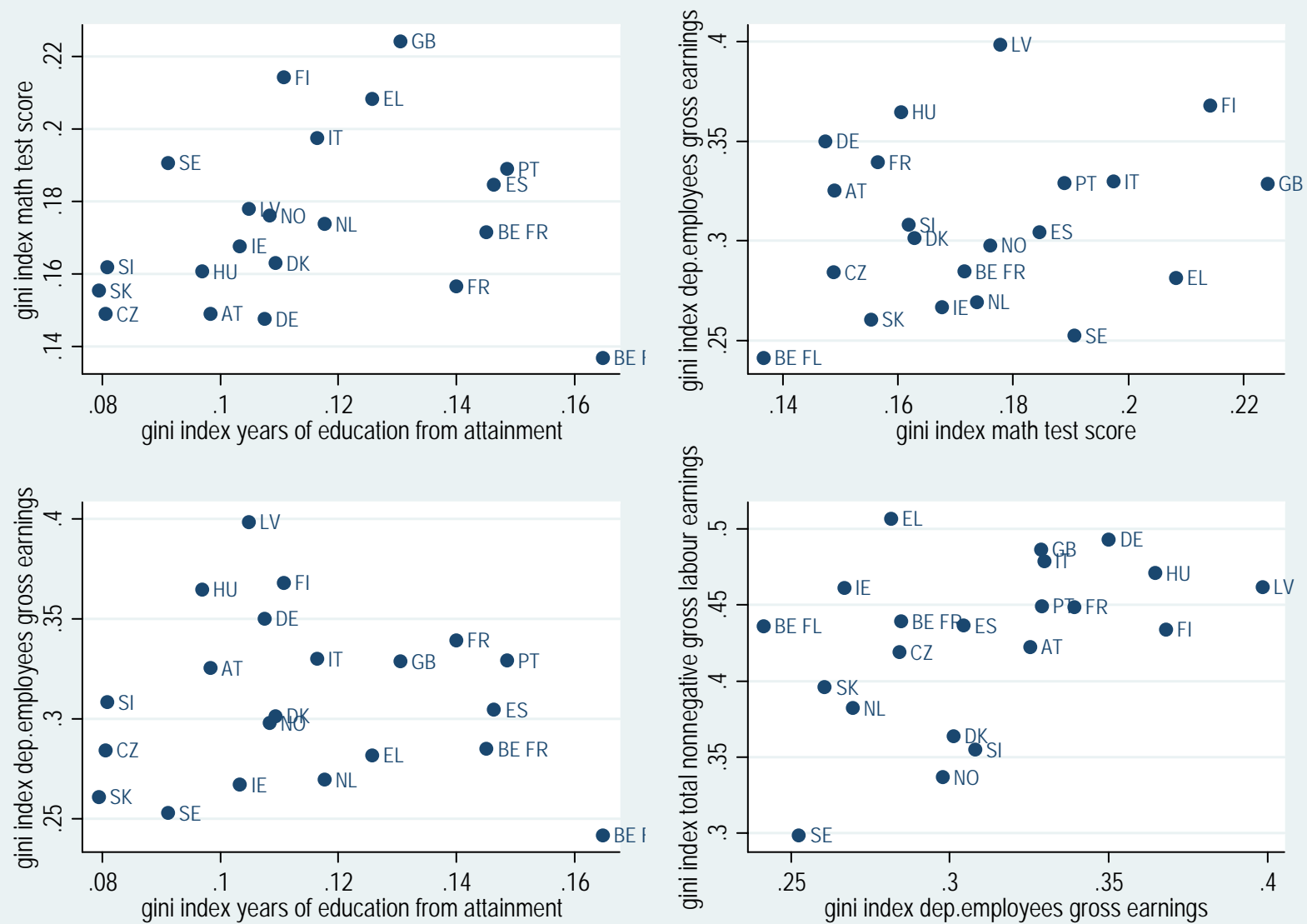
Overall we possess an unbalanced panel covering 20 countries with 82 observations (41 country/cohort \times 2 genders).

Table 2 – Inequality in earnings and educational attainment – EUSILC 2009

1st number: Gini index on gross total labour earnings of employed – 2nd number: Gini index on years of education (from maximal educational attainment) – 3rd number: Gini index on math test scores – 4th number of observations included in the sample:

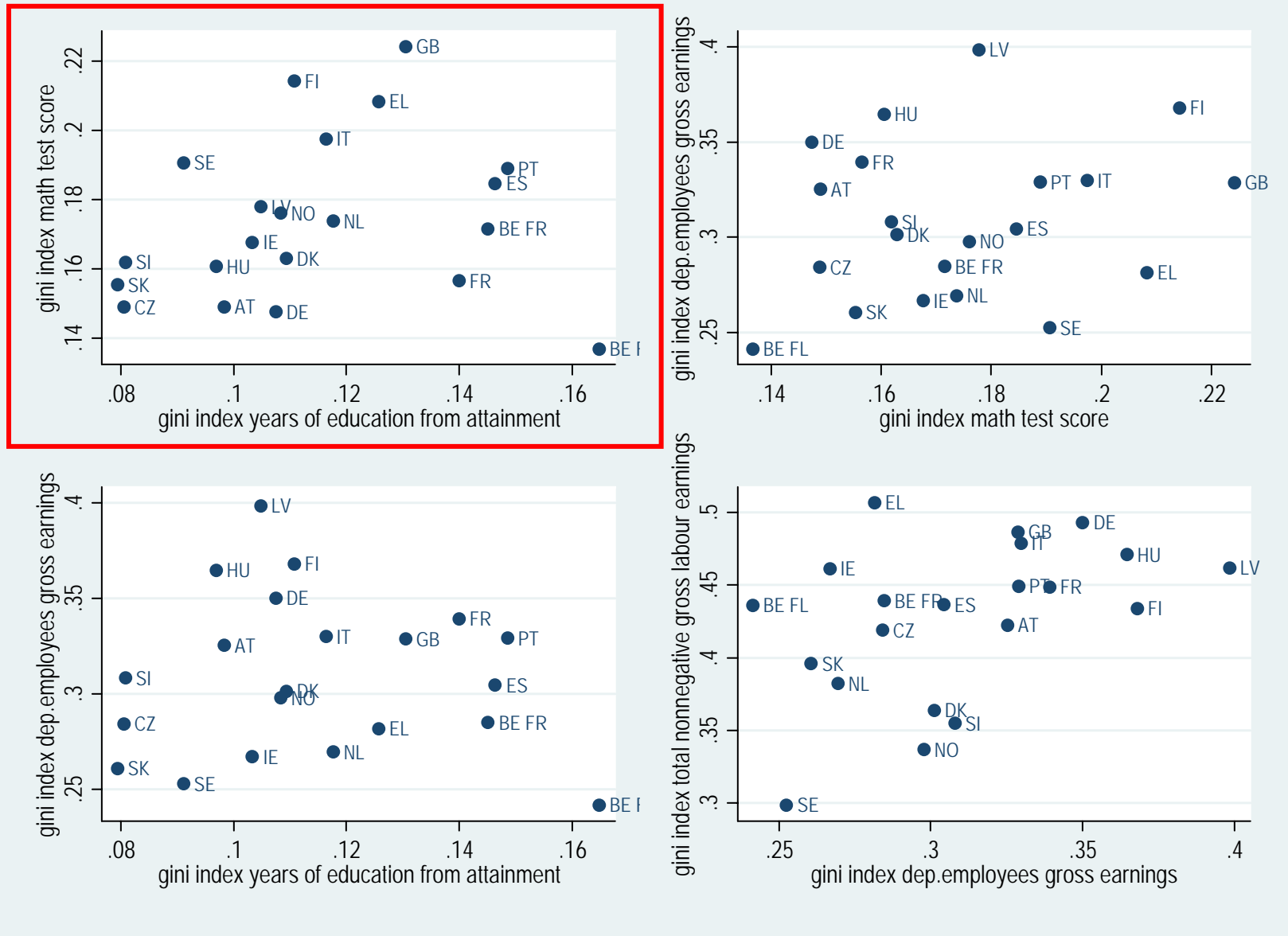
	1950	1966	1981	Total		1950	1966	1981	Total		1950	1966	1981	Total
Austria			0.32	0.32	Hungary		0.35	0.37	0.36	Slovenia			0.30	0.30
			0.10	0.10			0.09	0.09	0.09				0.08	0.08
			0.15	0.15			0.16	0.16	0.16				0.16	0.16
			2	2			2	2	4				2	2
Belgium	0.32	0.25	0.21	0.27	Ireland			0.26	0.26	Spain			0.31	0.31
	0.15	0.12	0.10	0.13				0.10	0.10				0.14	0.14
	0.17	0.15	0.12	0.15				0.17	0.17				0.18	0.18
	4	4	2	10				2	2				2	2
Czech Republic			0.3	0.3	Italy			0.33	0.33	Sweden		0.23	0.28	0.25
			0.08	0.08				0.11	0.11			0.09	0.09	0.09
			0.15	0.15				0.2	0.2			0.22	0.16	0.19
			2	2				2	2			2	2	4
Denmark			0.30	0.30	Latvia			0.39	0.39	United Kingdom	0.37	0.36	0.29	0.35
			0.11	0.11				0.10	0.10		0.14	0.13	0.09	0.13
			0.16	0.16				0.18	0.18		0.23	0.24	0.18	0.22
			2	2				2	2		4	4	2	10
Finland	0.37	0.35		0.36	Netherlands	0.32	0.28	0.22	0.28	Total	0.35	0.30	0.30	0.32
	0.12	0.10		0.11		0.12	0.11	0.10	0.11		0.14	0.11	0.1	0.11
	0.21	0.22		0.21		0.18	0.18	0.14	0.17		0.18	0.19	0.17	0.18
	2	2		4		4	4	2	10		22	22	38	82
France	0.41	0.33	0.26	0.35	Norway			0.30	0.30					
	0.17	0.12	0.10	0.14				0.11	0.11					
	0.18	0.15	0.14	0.16				0.18	0.18					
	4	4	2	10				2	2					
Germany	0.35		0.36	0.35	Portugal			0.33	0.33					
	0.12		0.09	0.11				0.15	0.15					
	0.14		0.16	0.15				0.19	0.19					
	4		2	6				2	2					
Greece			0.31	0.31	Slovak Republic			0.26	0.26					
			0.11	0.11				0.08	0.08					
			0.21	0.21				0.16	0.16					
			2	2				2	2					

Figure 1 – Inequality in competences, years of schooling, gross labour earnings (from dependent employment and from total employment)



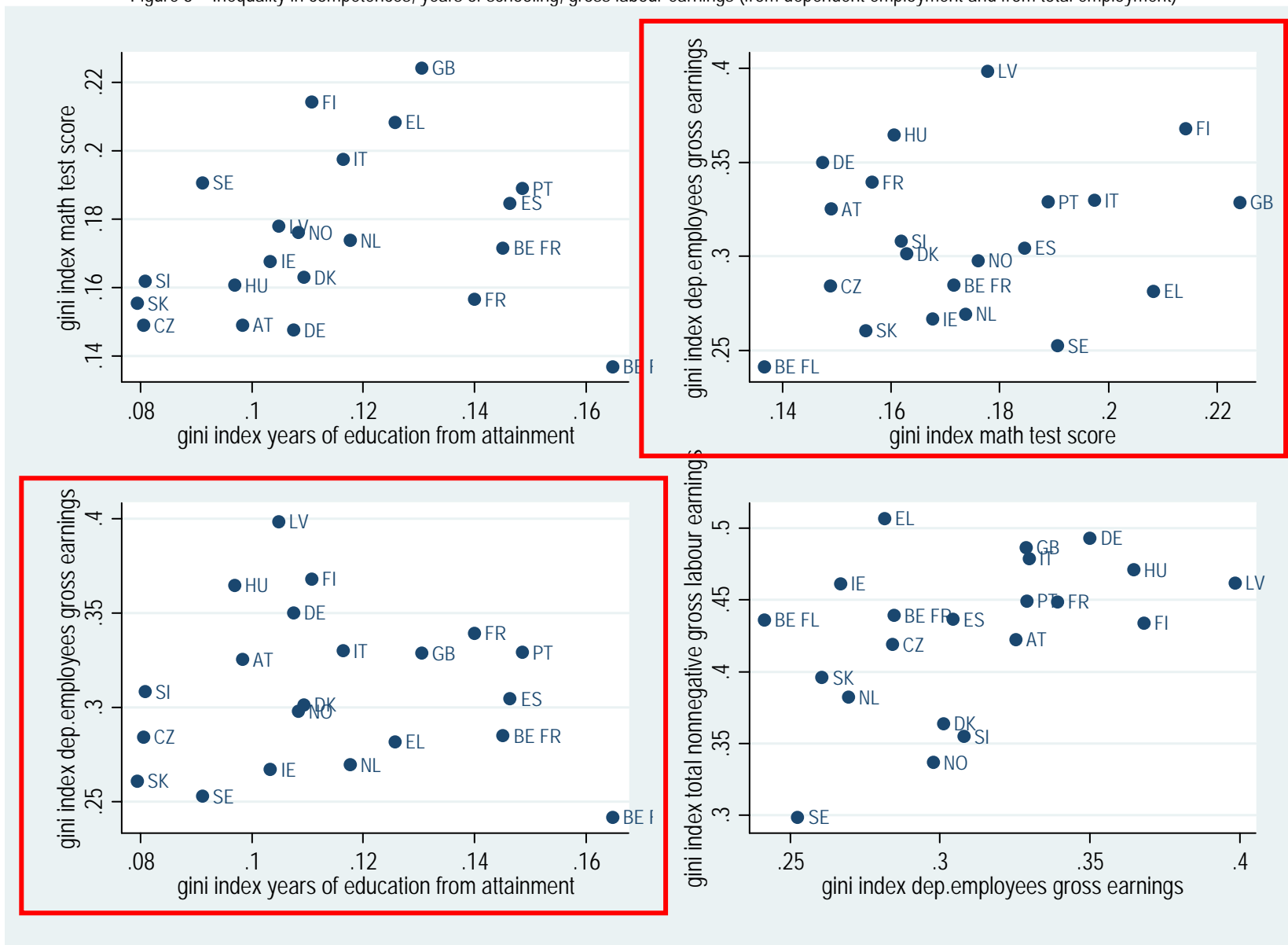
- positive correlation between inequality in quantity and inequality in quality of education for the country/gender/cohort cell available
- both dimensions are also positively correlated with earnings inequality.
- the relationship between earnings inequality for dependent employees and for total employment is altered by the extent of self-employment, labour market participation (which is significantly varying across countries in accordance with gender), unemployment and early retirement (which are both computed at zero incomes).

Figure 2 – Inequality in competences, years of schooling, gross labour earnings (from dependent employment and from total employment)



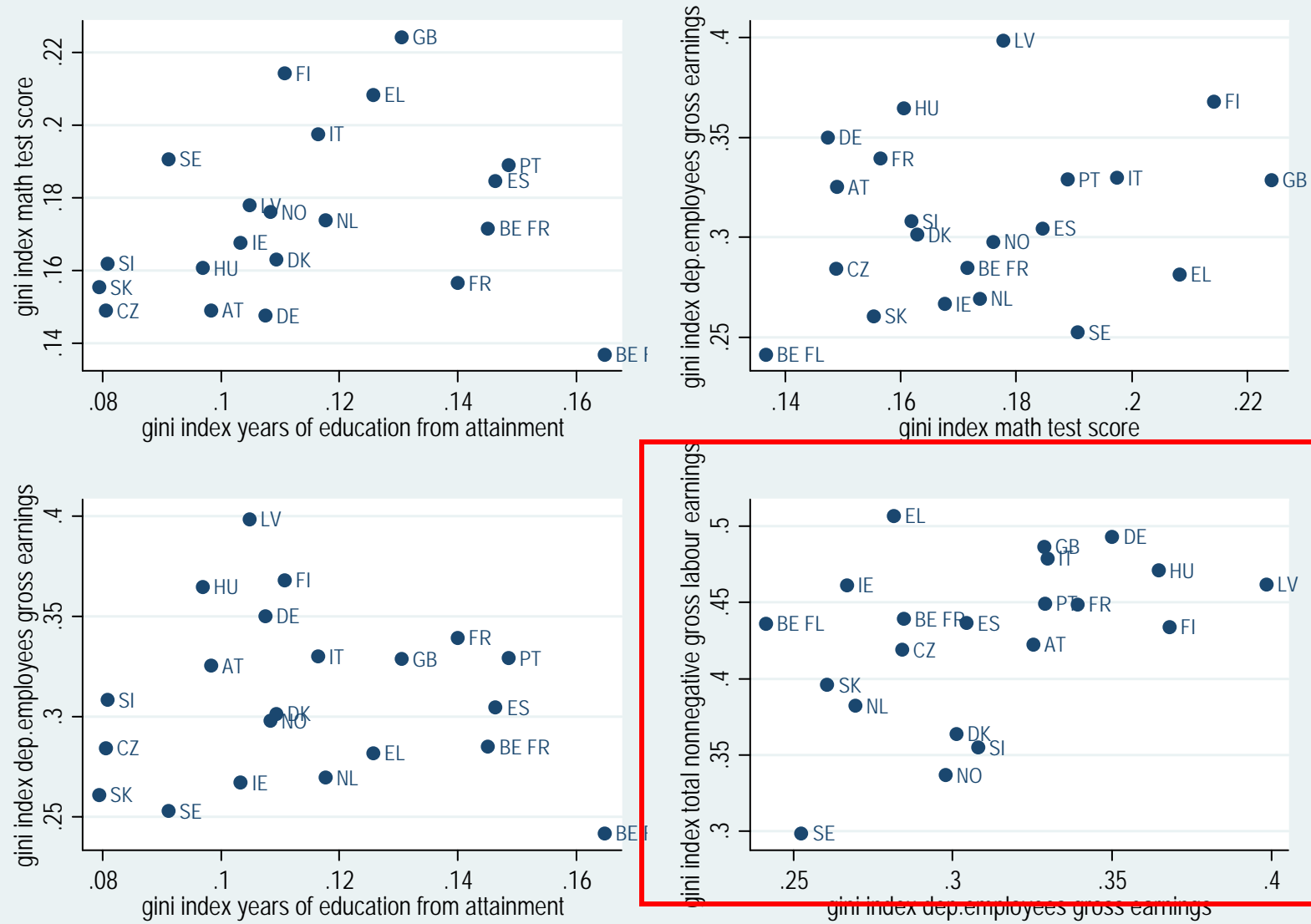
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Figure 3 – Inequality in competences, years of schooling, gross labour earnings (from dependent employment and from total employment)



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Figure 4 – Inequality in competences, years of schooling, gross labour earnings (from dependent employment and from total employment)



Our general strategy is to regress earnings inequality measures onto corresponding inequality measures for years of schooling (proxy for quantity measured over the same population on which non negative/positive earnings are available) and for math test scores when the same cohort was 14-year-old (proxy for quality measure). All other potentially confounding factors are controlled by means of corresponding dummies (gender, birth year, age, country and survey).

In principle we do not have *a priori* about which is the most appropriate inequality measure to be used in the analysis, since each index captures different dimensions of the underlying distributions.

In table 4 we propose three inequality measures, which are simply meant as descriptive correlation coefficients. We see that Gini concentration index and coefficient of variation exhibit statistically significant correlations, confirming that inequality in quantity and inequality in quality of human capital are positively associated with the observed earnings inequality (irrespective of whether we consider dependent employment incomes or total employment incomes).

Table 3 - Gross earnings and educational inequality - alternative inequality measures - OLS

	1	2	3	4	5	6
	Gini index		coefficient of variation		standard deviation of logs	
	dep.empl. earnings (gross)	total earnings (gross)	dep.empl. earnings (gross)	total earnings (gross)	dep.empl. earnings (gross)	total earnings (gross)
inequality in math test scores	0.899 [0.241]***	0.683 [0.210]***	1.282 [0.388]***	1.1 [0.351]***	0.464 [0.506]	0.325 [0.409]
inequality in years of education (from isced attainments)	0.833 [0.258]***	0.881 [0.231]***	1.227 [0.366]***	1.278 [0.361]***	-0.263 [0.835]	0.197 [0.747]
male component	-0.078 [0.017]***	-0.107 [0.015]***	-0.161 [0.046]***	-0.213 [0.042]***	-0.115 [0.049]**	-0.105 [0.043]**
Observations	82	82	82	82	82	82
Countries	20	20	20	20	20	20
R-squared	0.58	0.64	0.51	0.56	0.18	0.21

Robust standard errors in brackets – constant, age, birth year and survey controls included

* significant at 10%; ** significant at 5%; *** significant at 1%

We have decided to focus on the Gini index as our relevant measure of inequality, since a linear relationship seems to fit the data better. In addition, the Gini index is a better measure for inequality when compared to the coefficient of variation, since it satisfies a preference for redistribution (Galton-Pigou principle).

Our main results is provided under alternative specifications for incomes

Table 4 - Gross earnings and educational inequality – Gini indices – OLS country FE

	1 dep.empl. earnings robust se	2 total earnings robust se	3 dep.empl. earnings clustered se	4 total earnings clustered se	5 dep.empl. earnings >0 clustered se	6 total earnings >0 clustered se
inequality in math test scores	1.631 [0.555]***	1.716 [0.546]***	1.631 [0.815]*	1.716 [0.817]**	1.084 [0.508]**	1.079 [0.560]*
inequality in years of education (from ISCED attainments)	0.849 [0.371]**	0.825 [0.354]**	0.849 [0.370]**	0.825 [0.377]**	0.57 [0.153]***	0.519 [0.194]**
male component	-0.076 [0.012]***	-0.103 [0.012]***	-0.076 [0.013]***	-0.103 [0.012]***	-0.037 [0.009]***	-0.033 [0.010]***
Observations	82	82	82	82	82	82
R-squared	0.84	0.85	0.84	0.85	0.77	0.74

constant, country and year controls included – * significant at 10%; ** significant at 5%; *** significant at 1%

Overall, the magnitude of the coefficient on inequality in test scores oscillates between 1 and 1.8, while the coefficient on inequality in years of education remains in the range of half of it, between 0.5 and 0.8. In terms of elasticities, earnings inequality would exhibit an elasticity of **0.61-0.69** with respect to inequality in test scores and **0.21-0.22** with respect to inequality in years of education.

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Why should we care about inequality in education ?

- quantity of education
- quality of education

Can we affect inequality in education ?

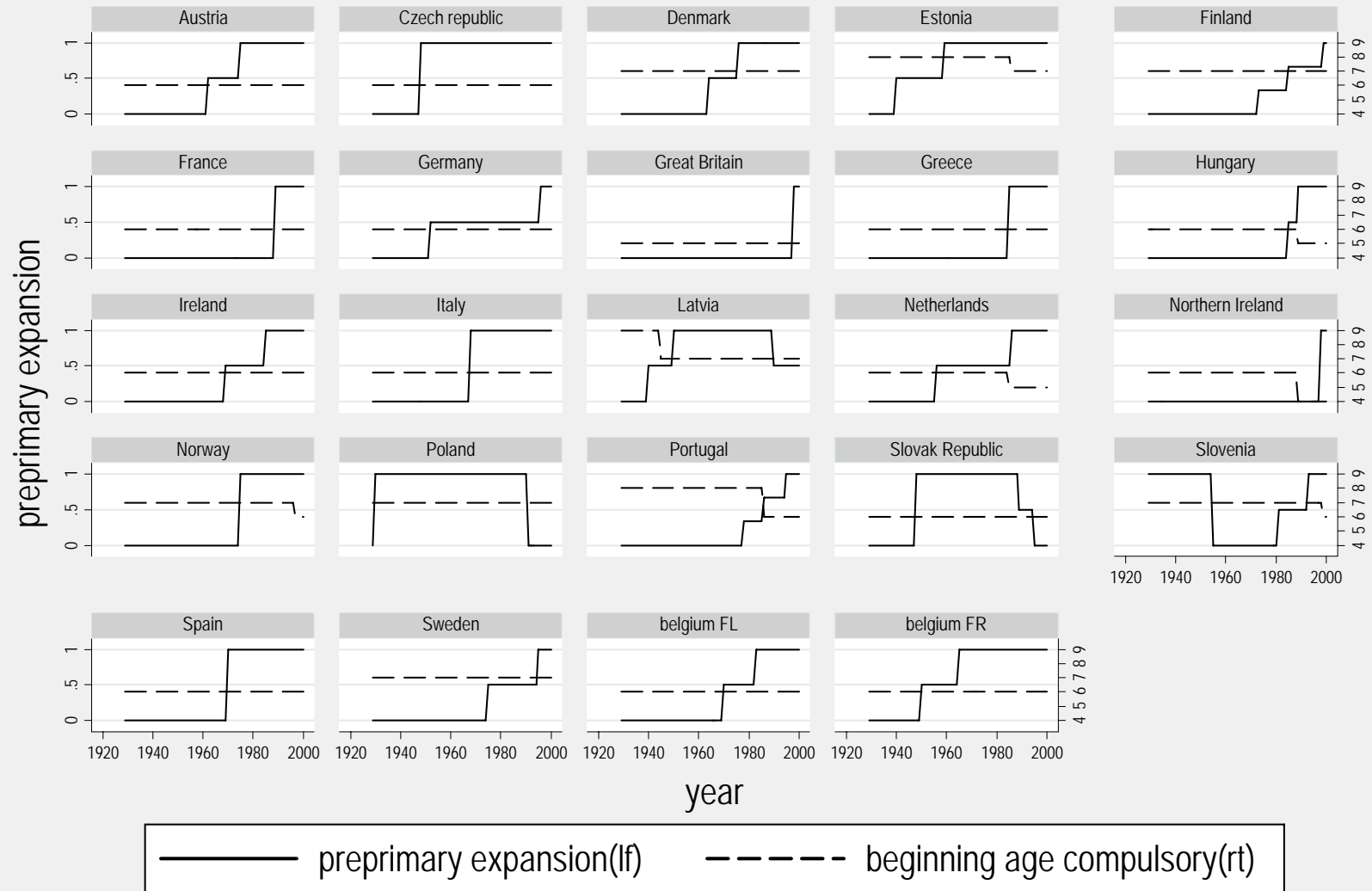
Two policy approaches

People preferences should matter

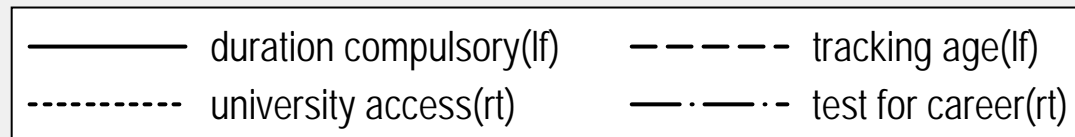
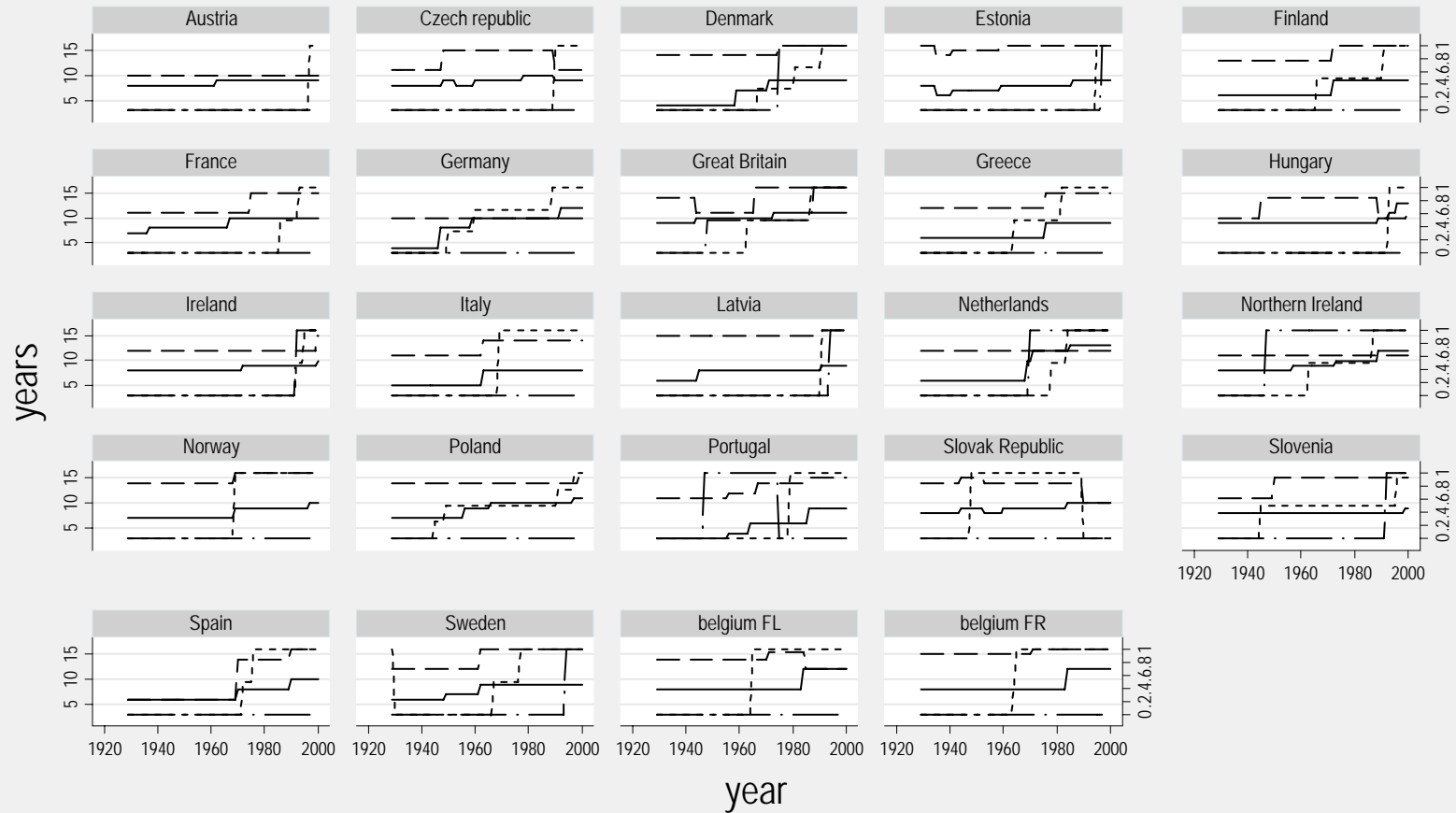
Educational reforms provide evidence that schooling inequality may be affected by institutional design (Braga, Checchi and Meschi 2013).

area of reform	expected impact on schooling inequality
pre-primary education	reduction (through increased educational attainment of students from disadvantaged background)
expansion of compulsory education	reduction (through increased educational attainment of students from disadvantaged background)
school tracking	ambiguous (vocational tracks have shorter duration, prevent academic enrolment but have lower drop-out rates)
school autonomy	ambiguous (adaptability to social environment, increased competition in presence of centralised control)
school accountability	increase (school differentiation, screening and sorting of students)
teacher qualification	ambiguous (better quality benefits students from poorer backgrounds but allows for greater differentiation)
student financial support	reduction (increased enrolment of students from poorer backgrounds)
university autonomy and selectivity	increase (increased signalling value of tertiary education requires a more intensive selectivity in university admissions)

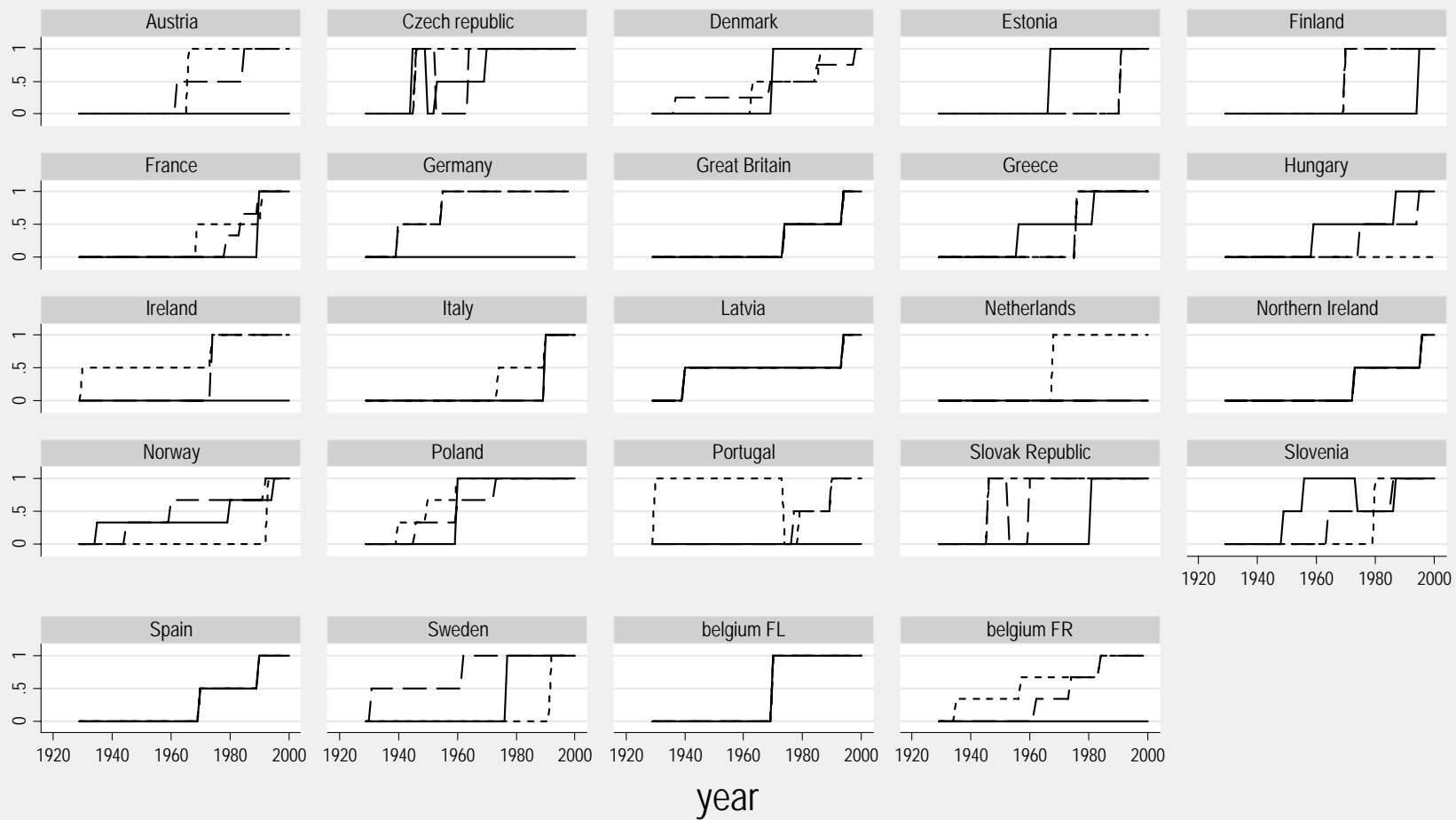
Preprimary education



Expansion



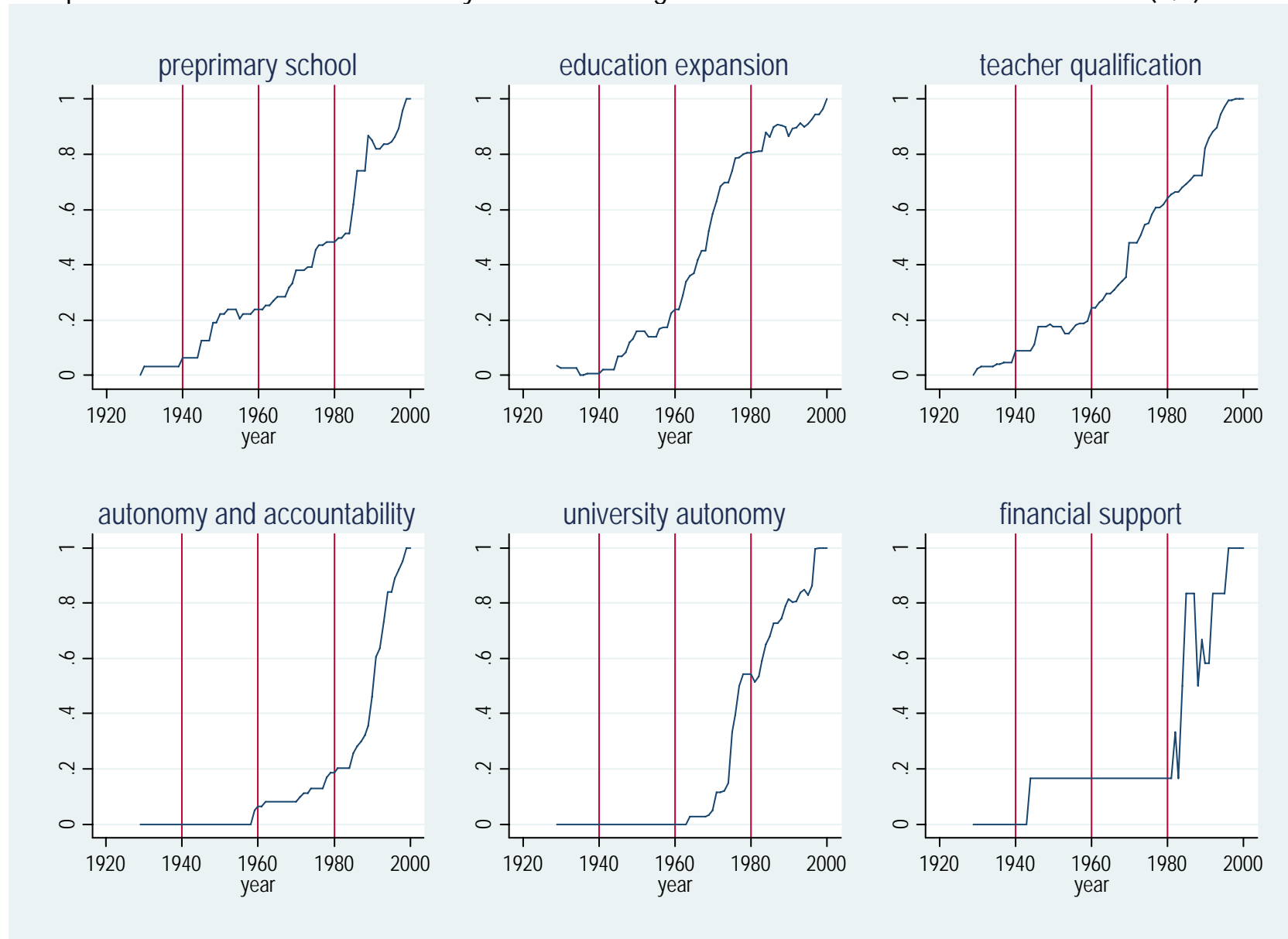
Teacher training



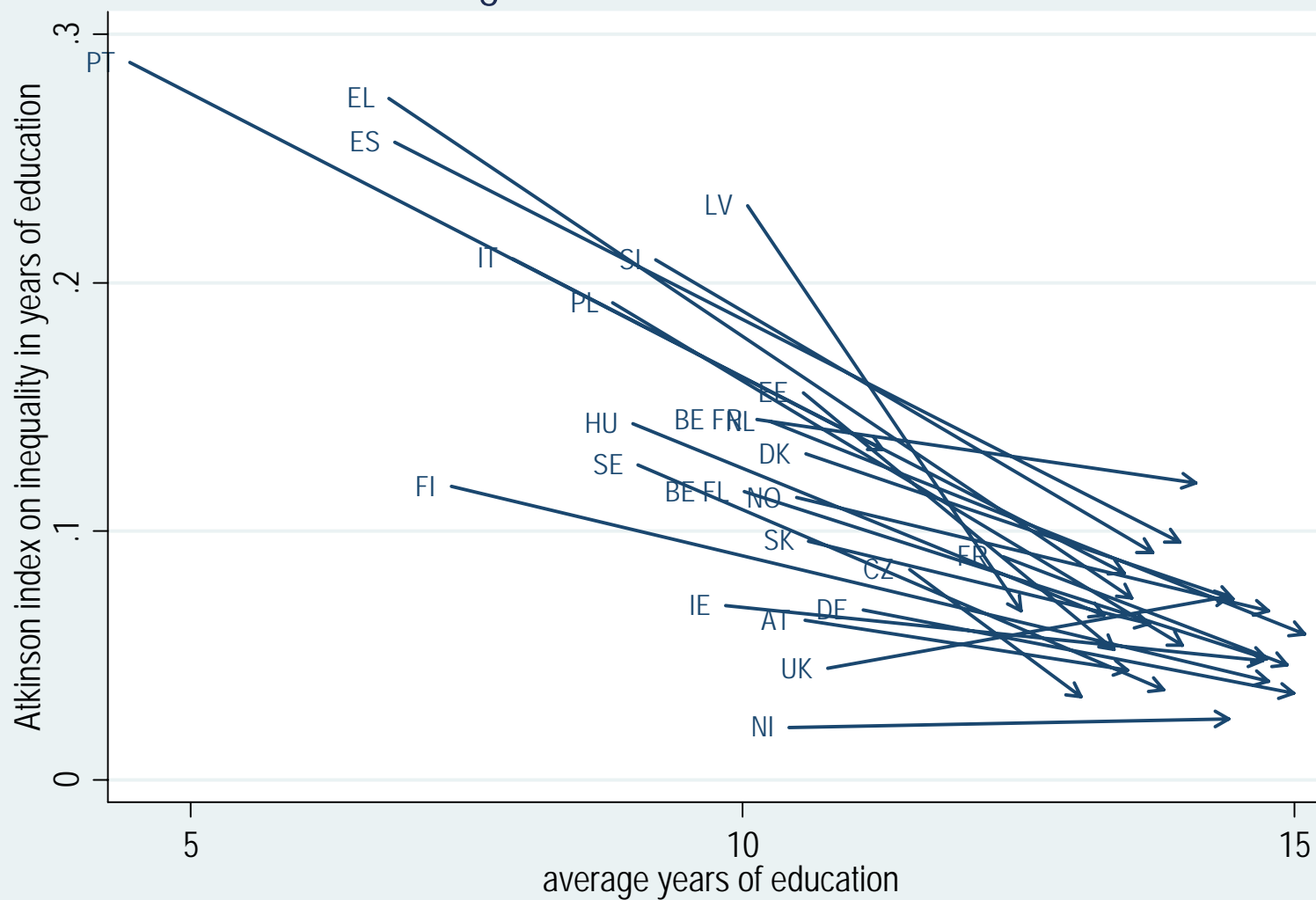
The historical evidence suggests that on average the countries of our sample have initially pursued inclusive policies, switching to selective policies at later stages.

- 1) the first waves of reforms among European countries in the aftermath of World War II involved pre-primary schooling, teacher qualification and expansion of access.
- 2) the latter intensified in the following decades, when many countries raised the leaving age for compulsory education and/or increased the comprehensiveness of their secondary school systems.
- 3) widening school access required recruiting more teachers, which led to reforms raising the qualification requirements to enter the profession during the same period.
- 4) At the beginning of the 80's the pressure for increasing the access to universities led many countries to widen admission rules and/or to introduce grant policies for financially constrained students.
- 5) Another common trend experienced by European countries is towards increased autonomy for universities, which took off at the end of the 70's and continued during the 80's and 90's.
- 6) Eventually, by the end of the 80's we also witness greater emphasis towards the accountability of the educational systems, which pushed many countries to establishing national assessment agencies.

Temporal evolution of reform summary indexes averaged across countries and rescaled in the (0,1) interval



Change from 1926-1935 to 1976-1985



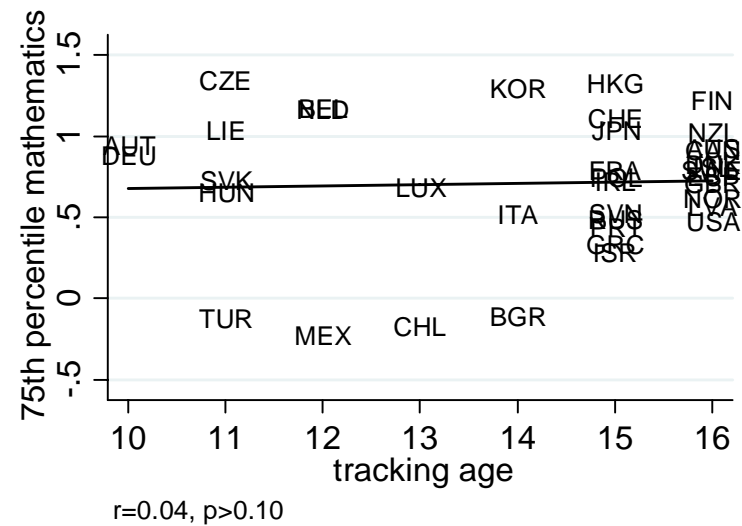
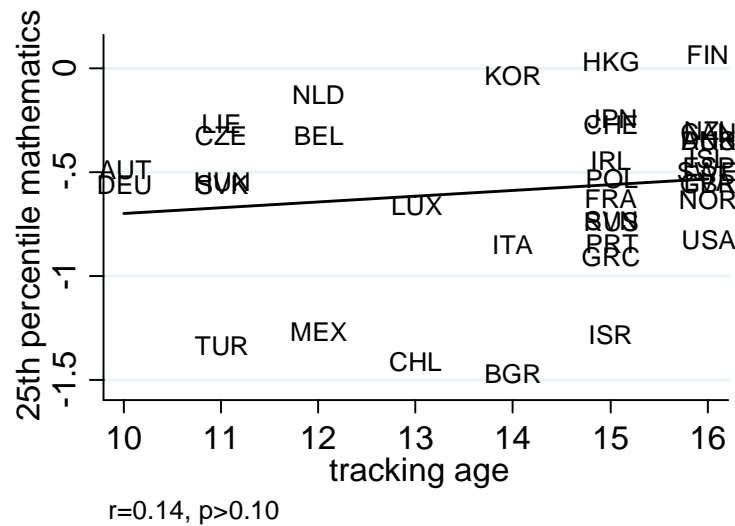
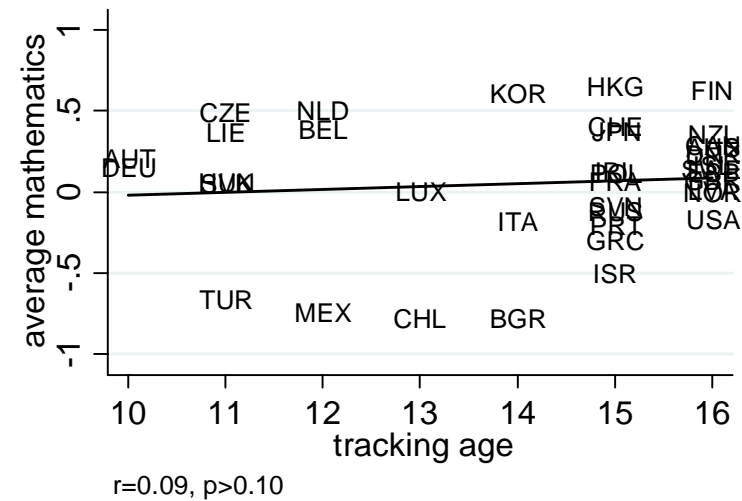
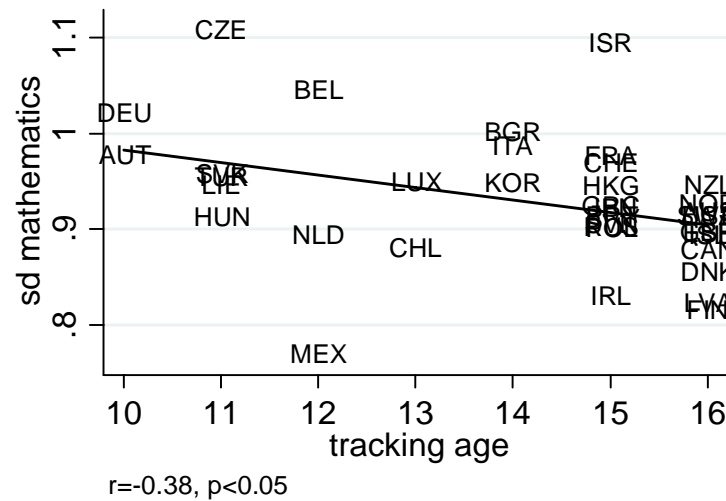
Also inequality in quality (competences) can be reduced by appropriate institutional design:

- ✓ raising tracking age
- ✓ vocational orientation
- ✓ central examination (standardisation)

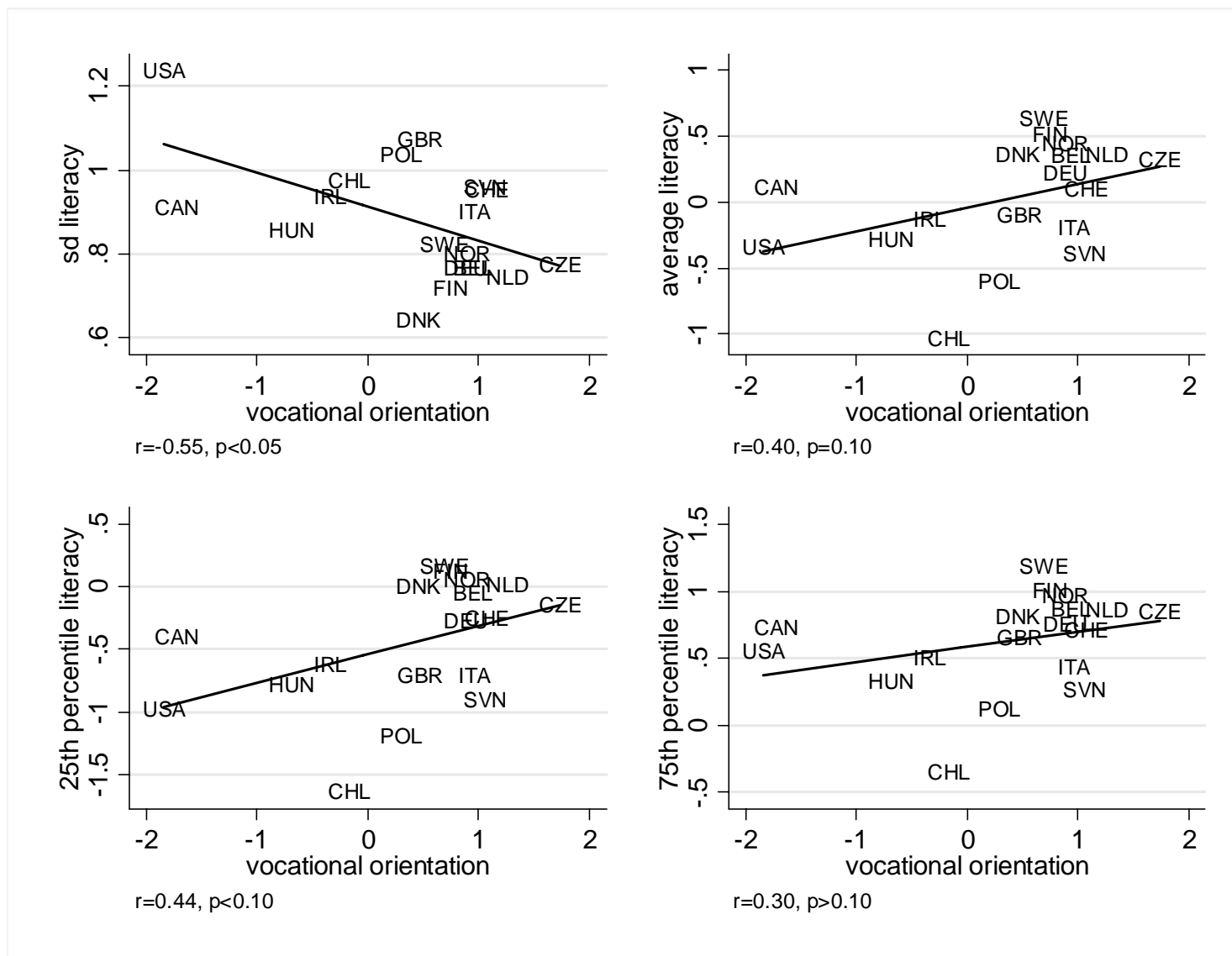
Having a early dual system has prons and cons:

- on one side it may prevent the full development of individual potential (including access to university)
- on the other side reduces the risk of dropping out of the system (as it happens in most comprehensive systems like US)

The distribution of mathematics achievement by age at which tracking starts



The distribution of young adult literacy by the vocational orientation of the educational system



Despite the fact that schooling presumably ended before entrance in the labour market, and test scores were collected in years when the sampled population was 14-year-old, still we cannot claim that inequalities in quantity and quality of human capital are causing inequalities in income.

$$I(y_{jt}) = \delta_j + \alpha I(h_{jt-n}) + \beta I(q_{jt-n}) + \omega_{jt}$$

We are tempted to a causal interpretation of statements like “a reduction in inequality in test scores is associated to a β -reduction in income inequality”.

However, unobservable components at country level (like competitiveness, solidarity, ethnic fractionalisation and so on) may drive both dimension of inequality, leading to biased estimates of the relevant coefficients.

Accounting for this possibility, we may resort to an instrumental variable strategy to estimate previous equation leading to

$$\begin{cases} I(h) = a_j + \mathbf{b}'_j \mathbf{Z}_j + e_j \\ I(q) = c_j + \mathbf{d}'_j \mathbf{Z}_j + g_j \\ I(y) = \delta_j + \alpha \hat{I}(h) + \beta \hat{I}(q) + \omega_j \end{cases}$$

where the educational inequality measures are replaced by their projections obtained from a vector of (supposedly) exogenous variables pertaining reforms in the educational sectors affecting the relevant age cohorts. We thus exploit both geographical and temporal variations in educational reforms by government to obtain unbiased estimates of the causal impact of educational inequality onto income inequality.

In order to strengthen the claim of causality, in table 5 we resort to instrumental variable estimation, which has the additional advantage of allowing us the study of the impact of educational reforms on income inequality via their impact on inequality in quantity and quality of human capital.

Table 5 - Inequality and reforms - Gini indices – OLS and IV estimates with educational reforms as instruments

	OLS		IV 2SLS		IV GMM	
	dep.empl. earnings	total earnings	dep.empl. earnings	total earnings	dep.empl. earnings	total earnings
inequality in math test scores	1.631 [0.815]*	1.716 [0.817]**	1.133 [0.808]	1.249 [0.743]*	1.499 [0.559]***	1.225 [0.593]**
inequality in years of education (from isced attainments)	0.849 [0.370]**	0.825 [0.377]**	1.206 [1.116]	1.669 [1.046]	0.614 [0.818]	1.682 [0.858]*
Observations	82	82	82	82	82	82
R-squared	0.84	0.85	0.84	0.83	0.83	0.82
			1st stage:		1st stage:	
			Gini math test	Gini yrs education	Gini math test	Gini yrs education
reform on public pre-primary schooling			-0.093 [0.032]***	-0.086 [0.018]***	-0.093 [0.022]***	-0.086 [0.067]
compulsory education (start age)			-0.058 [0.020]***	-0.070 [0.012]***	-0.058 [0.015]***	-0.070 [0.037]*
compulsory education (end age)			0.010 [0.002]***	0.009 [0.002]***	0.010 [0.002]***	0.009 [0.006]
tracking age			0.007 [0.002]***	0.006 [0.002]***	0.007 [0.003]***	0.006 [0.005]
introduction of standardised test			-0.093 [0.020]***	-0.066 [0.016]***	-0.093 [0.016]***	-0.066 [0.051]
reform on school accountability			0.018 [0.035]	0.045 [0.024]*	0.018 [0.029]	0.045 [0.073]
reform on school teacher autonomy			0.027 [0.009]***	0.027 [0.008]***	0.027 [0.008]***	0.027 [0.017]
reform of university access			0.076 [0.015]***	0.029 [0.011]**	0.076 [0.013]***	0.029 [0.032]
R-squared			0.94	0.77	0.94	0.77
F test 1st stage [p-value]			4146 [0.00]	17033 [0.00]	28.88 [0.00]	1.13 [0.36]

Standard errors in brackets clustered by country [2sls] or robust against heteroscedasticity [gmm] –

* significant at 10%; ** significant at 5%; *** significant at 1% - constant, gender, age, country, survey and year controls included

Table 6 summarises our findings in two ways, either by computing the overall impact of educational reforms onto earnings inequality or by re-estimating a reduced form.

Table 6 – Reduced form multipliers computed from table 5: effects of policies on income inequality

	estimated from reduced form		computed from columns (5) and (6) of table 5	
	Gini index dependent employment earnings	Gini index on total labour earnings	Gini index dependent employment earnings	Gini index on total labour earnings
reform on public pre-primary schooling	-0.343 [0.051]***	-0.411 [0.070]***	-0.192	-0.259
compulsory education (start age)	-0.188 [0.038]***	-0.222 [0.049]***	-0.130	-0.189
compulsory education (end age)	0.001 [0.006]	0.009 [0.008]	0.020	0.027
tracking age	-0.01 [0.008]	-0.006 [0.008]	0.014	0.018
introduction of standardised test	-0.203 [0.061]***	-0.252 [0.079]***	-0.181	-0.226
reform on school accountability	0.202 [0.087]**	0.252 [0.094]**	0.054	0.098
reform on school teacher autonomy	0.093 [0.030]***	0.122 [0.032]***	0.057	0.079
reform of university access	0.084 [0.048]*	0.113 [0.052]**	0.132	0.143
Observations	82	82		
R-squared	0.83	0.85		

Most of these effects are consistent with previous literature:

① reinforcing early (pre)schooling, raising the beginning age for compulsory education, reinforcing educational standardisation by introducing standardised test scores, all reforms yield a reduction in income inequalities observed many years later in the labour market.

② On the contrary, increasing teachers' autonomy (in the selection of teaching contents), reinforcing school accountability and/or boosting university autonomy widen income differentials.

③ According to the reduced form estimation, two additional reforms (increasing the years of education and delaying the tracking) come out statistically insignificant with respect to earnings inequalities. While we are not aware of comparable results in the literature, we can say that these insignificant results are partly at odds with received knowledge, at least with respect to educational achievements.

Why should we care about inequality in general ?

Why should we care about inequality in incomes ?

Why should we care about inequality in education ?

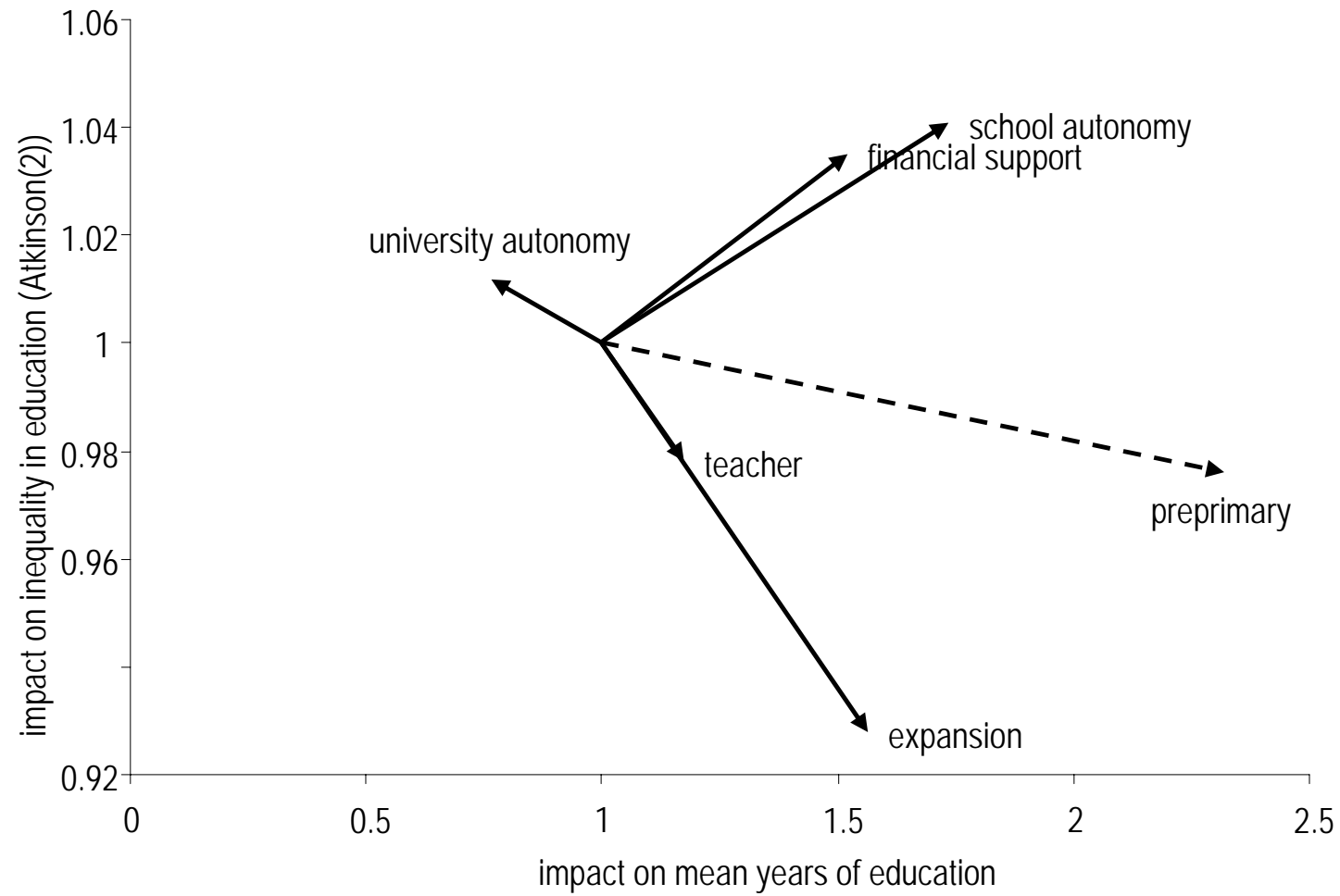
- quantity of education
- quality of education

Can we affect inequality in education ?

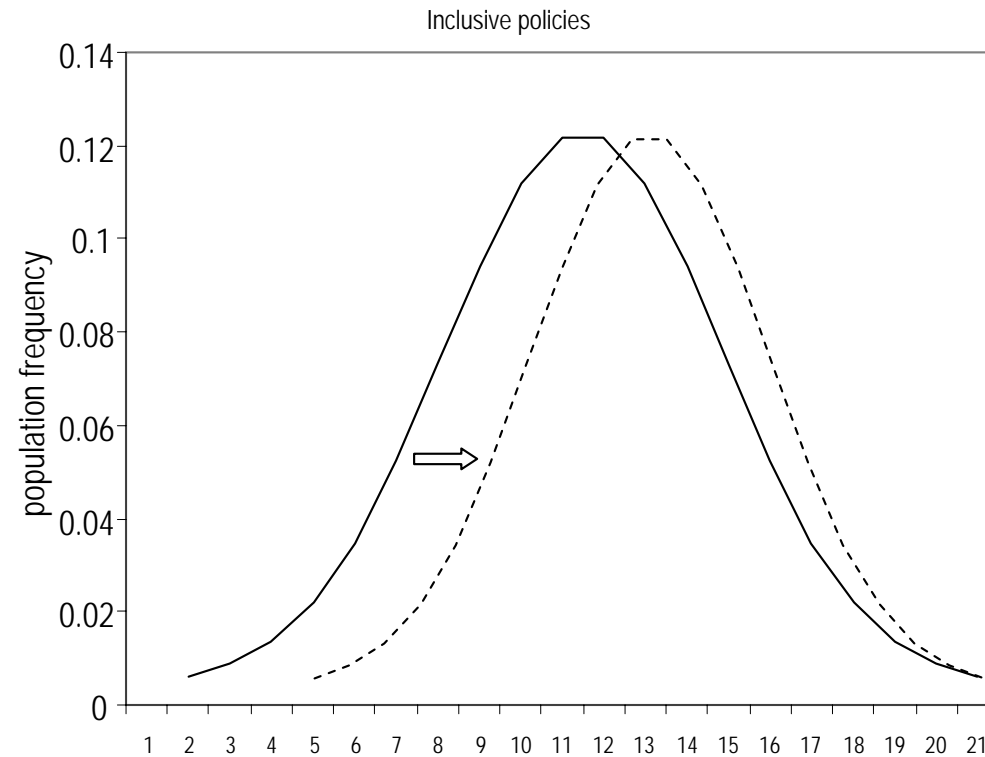
Two policy approaches

People preferences should matter

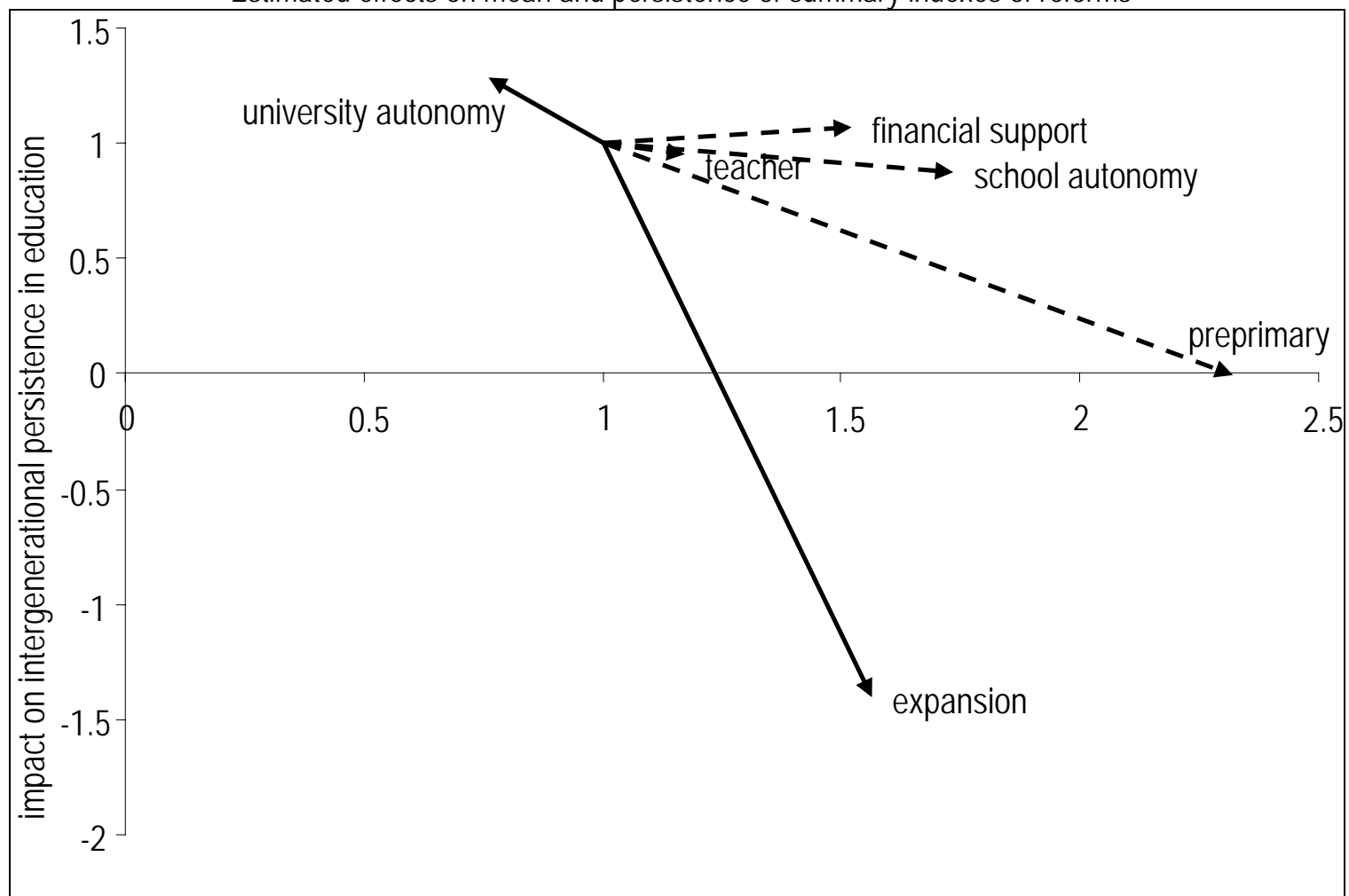
Estimated effects on mean and dispersion of summary indexes of reforms



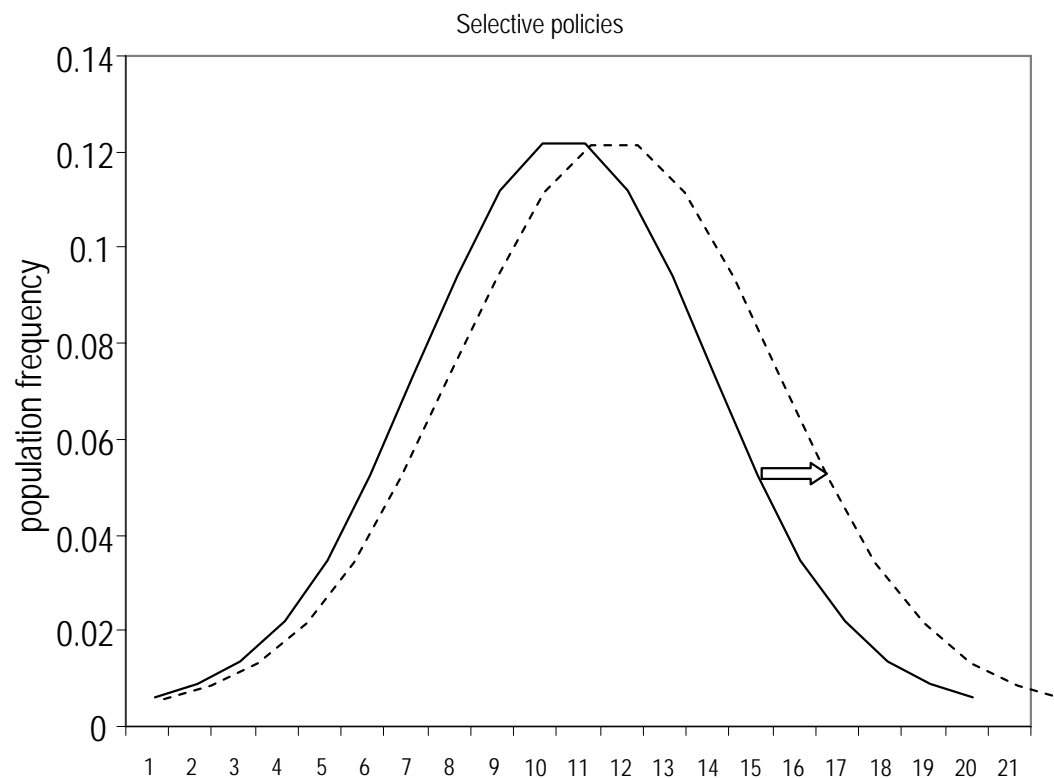
Reforms extending pre-primary schooling and/or expanding the access education (via raise in leaving age for compulsory education or in tracking age, removing barriers to university admissions) and/or increasing teacher qualifications exhibit positive correlation with average years of education in the population and negative one with inequality and intergenerational persistence. We label these reforms as *inclusive*.



Estimated effects on mean and persistence of summary indexes of reforms



Reforms increasing school autonomy and accountability as well as university autonomy are also positively correlated with mean educational attainment, but also with inequality and persistence. Similar properties are also associated to reforms related to financial support to university students. We identify these reforms as *selective*.



Why should we care about inequality in general ?

Why should we care about inequality in incomes ?

Why should we care about inequality in education ?

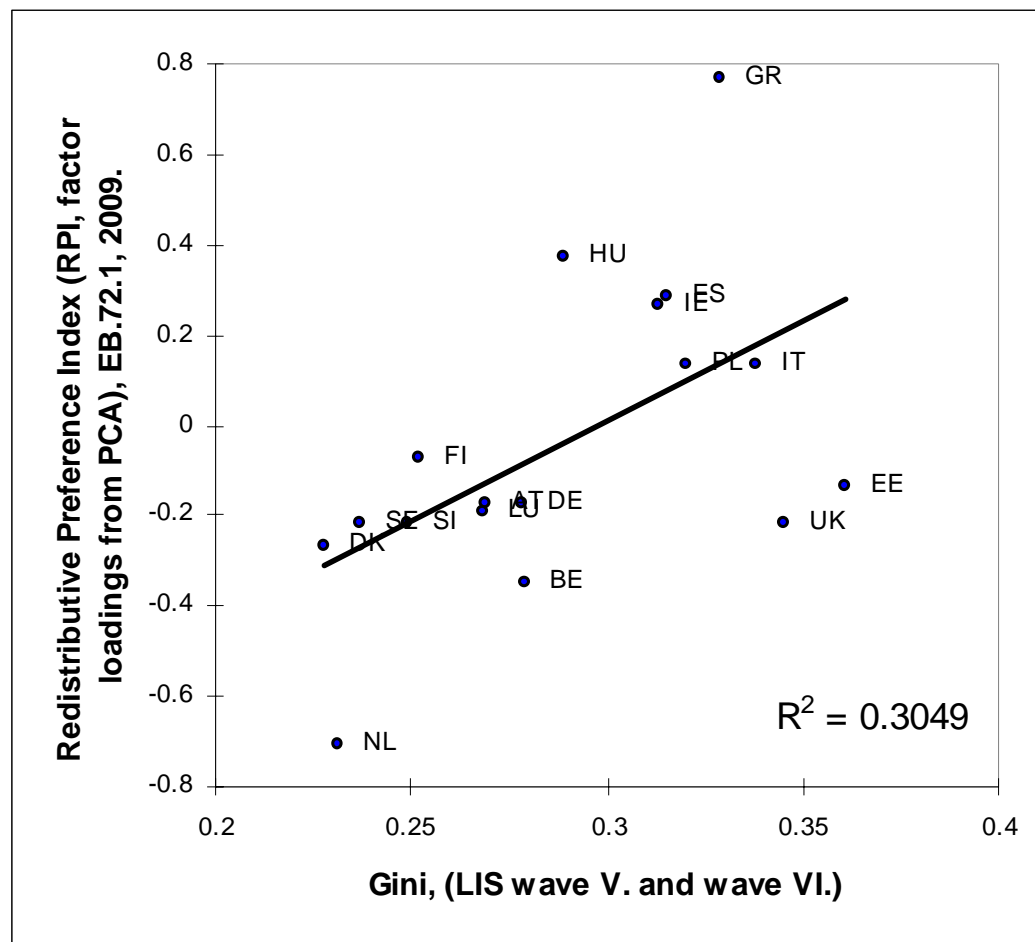
- quantity of education
- quality of education

Can we affect inequality in education ?

Two policy approaches

People preferences should matter

Why do different countries choose different policies ?
People may have different opinions about the need to reduce inequalities.



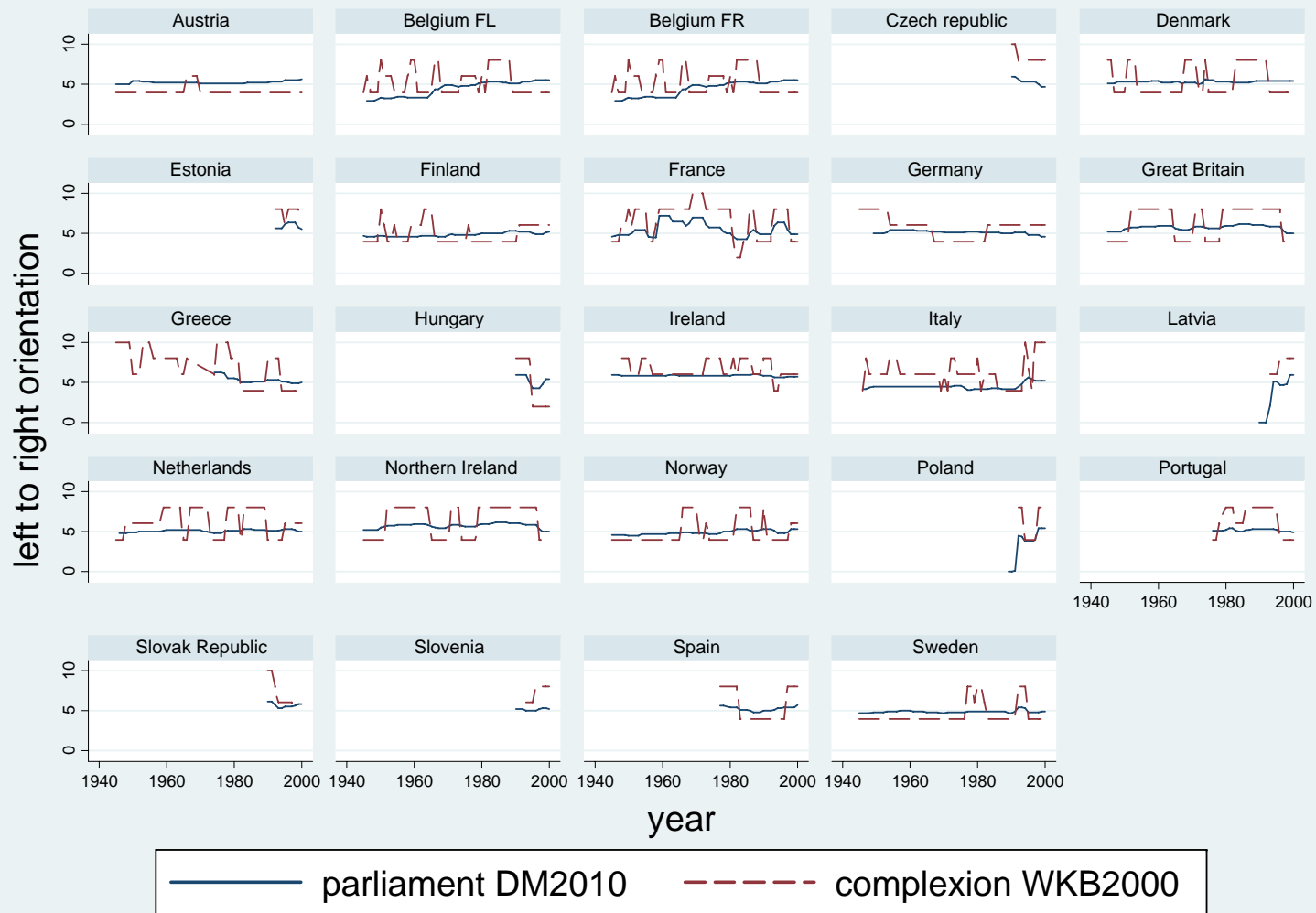
This is typically reflected in voting. Policy choice by government may reflect social preferences as interpreted by the ruling parties.

Educational reforms are structural reforms, which require some time to yield some result. For this reason, they cannot be undertaken frequently and, in general, they require a wide support, both in the parliament and in the public opinion.

In general parties with a left-wing orientation are more supportive of inclusive policies, because they benefit the lower tail of the educational attainment distribution, where their supporters are largely over-represented. In addition, they may expect a more intense political participation of low class people, which should translate in stronger electoral support.

Conversely, conservative parties are more reluctant towards any generalised expansion of schooling, for at least two reasons: on one side educational expansions require an expansion in public expenditure; on the other side, they raise people expectations in terms of future life-time incomes, which may translate in higher wage pressure and rigidities.

Ideological orientation of governments



Educational reform and political variables – OLS – 1950-2000

	1	2	3	4	5	6
	pre- primary	expansion	teachers	school autonomy	university autonomy	financial support
right-wing orientation of parliament	-0.006*	-0.026***	0.033**	0.016	0.029**	0.030**
	[0.004]	[0.004]	[0.015]	[0.015]	[0.012]	[0.013]
log GDP per capita	0.190***	0.189***	0.202*	-0.363***	-0.552***	0.467***
	[0.036]	[0.044]	[0.122]	[0.113]	[0.109]	[0.101]
government consumption share	1.131***	0.778***	2.340***	0.117	4.528***	4.942***
	[0.181]	[0.239]	[0.868]	[0.776]	[0.831]	[0.770]
Observations	843	843	843	843	770	770
R ²	0.901	0.899	0.871	0.864	0.893	0.828
Countries	24	24	24	24	17	17

Robust standard errors in brackets - * significant at 10%; ** significant at 5%; *** significant at 1%
constant, country and year fixed effects, country-specific time trend included

Concluding:

- ① inequality in education should be decomposed into inequality in quantity and inequality in quality
- ② inequality in quantity can be reduced by retaining people in schools (inclusive vs selective policies)
- ③ inequality in quality can be reduced by allowing for more standardisation of teaching contents
- ④ governments are not always concerned about inequality in education because their constituencies have different degree of risk aversion and/or inequality tolerance.