Institutional Reforms and Educational Attainment in Europe: A long run perspective

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❑   Education is beneficial at individual level (pecuniary and non pecuniary returns – Oreopulos and Salvanes 2011)

❑   Education is relevant for economic growth (Hanushek and Kimko, 2000; Krueger and Lindhal, 2001)

– Education yields social benefits (on social cohesion, citizenship, political participation, crime reduction - Dee 2004, Lochner and Moretti 2001)

❑   Positive externalities associated with schooling justifies governmental involvement in education

Human capital theory (Card 1999) predicts educational choices based on
⇨ prospective income
⇨ current costs (including endowments)

We know that the educational career occurs through
⇨ different stages of different length
⇨ different level of selectivity
⇨ various qualities of teachers
⇨ different quality of institutions.
These dimensions constitute what we call EDUCATIONAL INSTITUTIONS.

They can be modified by policy.

They may cause educational attainment in the population.

This paper is concerned on describing the effects of the continuous reforming activity of institutional design (from pre-primary to tertiary education) of European countries over almost a century (from 1930 to 2000).

① We exploit cross-country and over-time variations (over almost a century) to isolate the effects of changes in the institutional design on individual school attainment (years of education).

② We identification of heterogeneous effects of the reforms and predict the aggregate effects on educational inequality.

③ We propose a possible taxonomy of the institutional reforms according to their likely impact.

④ Last (but not least) we have created a dataset of potential instruments for cross-country causal analysis

1. Previous literature and theoretical expectations

Existing papers focus on **specific school features** or on **specific country experiences**. They deal with

⇨ single institutional dimension (provision of pre-primary education, duration of compulsory school, school tracking, school choice and competition, the extent of school accountability and autonomy, academic selection)

⇨ asking a related question: whether different characteristics of education systems may help reducing (reinforcing) to various extents the advantage of pupils from high socio-economic background, thus decreasing (increasing) educational inequality.

One maintained assumption: beneficial effects of education to individuals and societies.

1.1 Pre-primary education

Positive effects of pre-school education on both efficiency and equity of the education system (Cunha et al., 2006; Cunha and Heckman, 2007, 2008 and 2009) ⇨ the formation of skills as a life cycle process that exhibits both recursive productivity and dynamic complementarity.

The rates of return to investment in early education tend to be higher for children from disadvantaged families, while at older ages they tend to be higher for children from well-off families.

However it is not well ascertained whether the effect derives from earlier and longer time spent out of the family, or from school-like activities offered before formal schooling.

1.2 Expansion of compulsory education

Good reasons to introduce compulsory education: positive externalities (crime, voting); insurance against bad parents; redistributive device.

Increase by lowering the entry age or by raising exit age ?

Compliance rates changes over time, but the timing of the reforms seems effective in modifying educational attainment in a causal sense (Brunello, Fort and Weber 2009 – 12 European countries – pre-post framework).

Many case studies: Angrist and Krueger (1991) for US; Aakvik et al. (2010) for Norway; Harmon and Walker (1995) for UK; Meghir and Palme (1999) for Sweden; Pischke and von Wachter (2008) for Germany.

1.3 School tracking

Tracking when children are allocated – at some stages of their career – to different tracks, characterised by different curricula offered (generally academic or vocational) and different average abilities of the enrolled students.

National school systems differ in the age at which the selection takes place (typically secondary school level) and in the degree of differentiation (number of tracks).

The empirical evidence has generally confirmed the inequality enhancing effect of early school tracking, while the evidence on efficiency is more mixed (Hanushek and Woessmann 2006, Ammermuller 2005, Schuetz, Ursprung and Woessmann 2008, Brunello and Checchi, 2007).

1.4 School accountability

International evidence suggests that institutional features that introduce accountability by externally testing and making public students' and schools' exam results create the proper incentives to improve educational performance (Bishop 1997, 2006; Jürges et al. 2005; Woessmann, 2003, 2005 and 2008).

Unintended consequences of accountability (Hanushek and Raymond 2003):
* focus on academic achievement and ignore other aspects of development.
* focus on better students
* teaching to the test
* increase in selectivity

1.5 School autonomy

The evidence on the effects of competition on school performance and efficiency is mixed, the gains from competition are modest and difficult to identify. It may lead to increasing social stratification of schools.

Most of the empirical papers in the area are based on country-specific analysis and mainly focused on US and UK.

Woessmann et al. (2009) also find that the effect of school autonomy depends on the extent of accountability that affects the incentive for opportunistic behaviours.

1.6 Teacher qualification

Teacher quality matters, and is unrelated to observable (Rivkin et al 2005). What characteristics make a successful teacher not very clear

Attracting better applicants into the profession, combined with stimulating their effort through appropriate wage policies, explains the observed correlation between teachers' pay and student performance (Dolton and Marcenaro-Gutierrez, 2011)

Most of the recent policy recommendations to improve educational systems point to attracting, motivating and retaining good teachers.

1.7 Student financing

Liquidity constraints prevent the children of poorer households from proceeding in their educational career up to secondary and tertiary levels (Carneiro and Heckman 2002; Lochner and Monge-Naranjo 2011)

No clear understanding of how financial constraints work in limiting the choice set.

Chapman (2006) reviews the main arguments in support of public interventions (grant-loan schemes) to reduce financial constraints and/or the risk associated to the educational investment.

1.8 University autonomy

Jacobs and van der Ploeg (2006): "*European universities seem more comfortable providing a decent education for all with not much selection based on national exams and/or interviews or exams set by the universities themselves.*"

Better universities attract best students and best teachers. They perform better if they are made accountable of their choices (Aghion et al. 2009)

1.9 Summary

area of reform	affecting investment in education	expected impact
pre-primary education	enhances productivity of later school stages (education begets education)	student stay in school longer – more in the case of poor backgrounds
expansion of compulsory education	avoids early drop-out (for compliers)	student stay in school longer – more in the case of poor backgrounds
school tracking	better matching of abilities and/or backgrounds enhances peer effects	disequalising effects (academic stay longer, vocational stay shorter)
school accountability	more efficient use of resources may raise quality of education	disequalising effects (possible student screening and/or sorting)
school autonomy and competition	adapting teaching to the social environment may lower the effort cost	ambiguous effect
teacher qualification	increases quality of education and raises the expected return of human capital in the labour market	ambiguous average effects on staying – richer backgrounds take advantage (better access to information)
student financing	lower cost of attendance and/or reduces the risk associated to higher education	positive average impact since more students in higher education (mostly from poor background)
university autonomy and selectivity	raises the signalling value of tertiary education, and the associated expected earnings	disequalising effects (stronger competition to access better universities may translate in discouragement in the bottom tail)

Other institutional dimensions which we have been unable to collect information about (with same country/time coverage):
* instructional time
* class size
* school segregation
* teaching practices

Most of the existing cross-country literature investigates the impact of schools' institutional features on pupils' *competences*, using data from international testing surveys (PIRLS, TIMSS, PISA).

We instead measure educational attainment in terms of <u>completed years of school</u> by age cohorts and country, conditioning on gender and family background. With respect to this literature, the set on institutions is larger, country coverage is wider (24 countries), time coverage is longer (1930-2000).

2. Data and Descriptive Statistics

Our analysis combines microdata drawn from four international surveys (ESS-European Social Survey, EUSILC-European Union Statistics on Income and Living Conditions, IALS-International Adult Literacy Survey, and ISSP-International Social Survey Programme) with a newly created dataset collecting information on several institutional reforms of school systems over the last 70 years.

Our sample includes 24 European countries (Austria, Belgium (Flanders), Belgium (French), Czech Republic, Germany, Denmark, Estonia, Great Britain, Greece, Finland, France, Hungary, Ireland, Italy, Latvia, Northern Ireland, Norway, Netherlands, Poland, Portugal, Slovak Republic, Slovenia, Spain, Sweden) observed in the 1930-2000 period.

2.1 A dataset on educational reforms

A well-established methodology consists of identifying the salient features of an institutional practice, assigning a subjective score to each feature and aggregating them into a single index (examples: STE or EPL both from OECD).

Figure 3.1. The structure of the Supply of Tertiary Education indicator
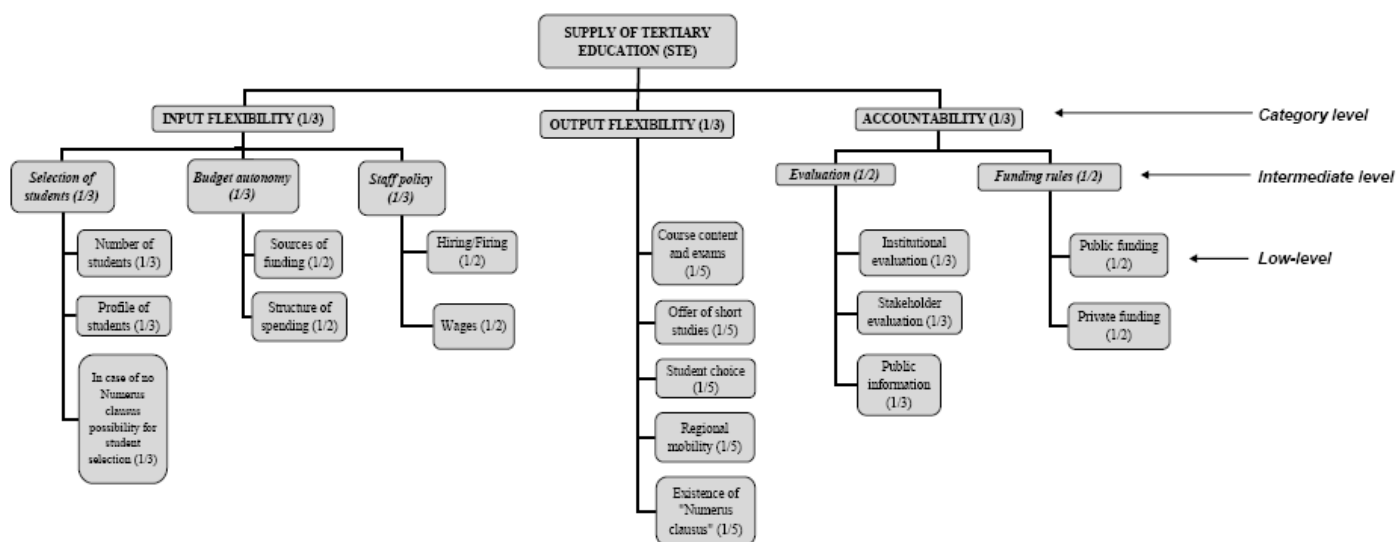
Note: The weights of each sub-level indicator are in parentheses. For the composition of the low-level indicators see Annex B.

Figure 3.3. Composite supply indicator of tertiary education (STE), 2005-2006
(Increasing in input and supply flexibility and accountability)
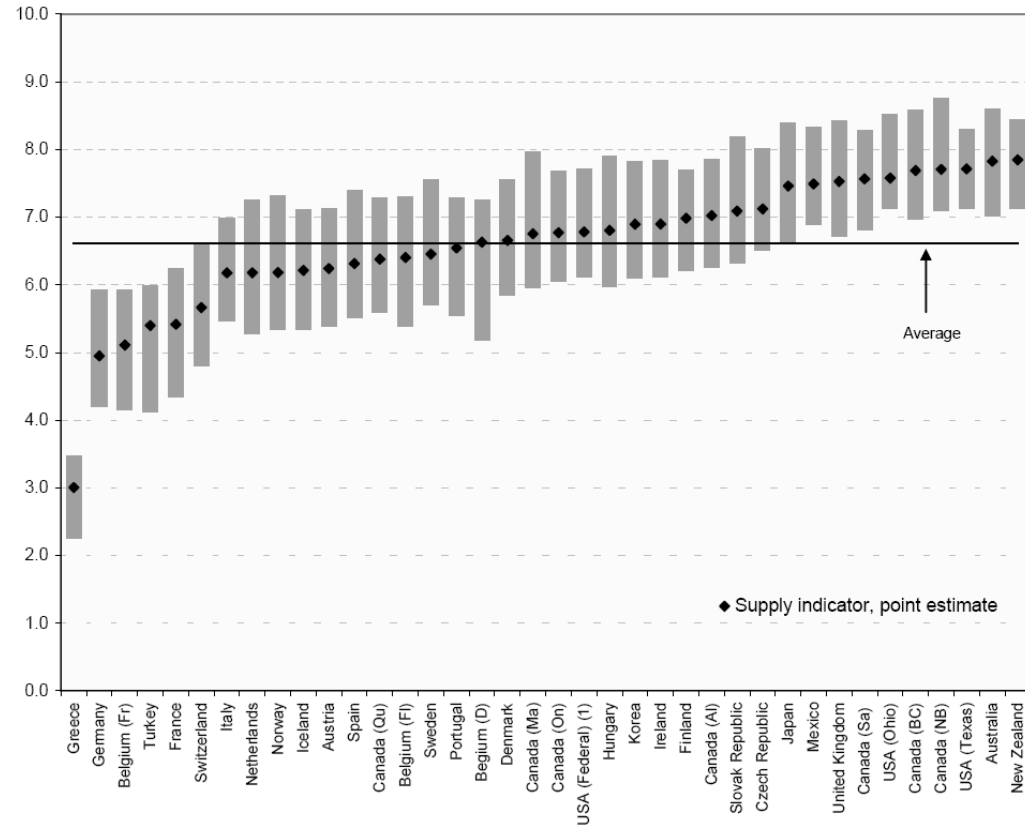
Note : Canadian provinces are : Al: Alberta, BC: British Columbia, Ma: Manitoba, NB: New Brunswick,
On: Ontario, Qu: Québec and Sa: Saskatchewan. Belgian regions are : Fr: French Community, Fl: Flemish
Community and D: German-speaking Community.
The bars correspond to the 95% confidence intervals obtained through the random weight technique.
1. In interpreting this value for Federal provisions concerning supply flexibility and accountability it should be taken into
account that federal funds only account for a small share of total funding of US tertiary education institutions.
Source : Authors' calculations based on questionnaire answers received from OECD Member countries.

Given the impossibility and the arbitrariness to recollect detailed information on all these institutional dimensions, we have chosen an alternative route:

we abandon the idea of being able to *fully* characterise a (national) educational system by means of level indicators: while everyone may be convinced that 10 years of compulsory education is better than 8 years, it is not as clearer whether one country is requiring more teacher qualification than another.

Conversely everyone agrees on the fact that introducing (or raising) teacher required qualification improves the quality of the education provision. Thus we combine level measures (age and duration of compulsory education, tracking age) with temporal variations associated to the occurrence of school reforms in a specific country/year.

The level dimension is anyhow absorbed by country fixed effect, while cohort effects and time trends are also absorbed by birth year fixed effect and country specific time trend. The remaining variations (along a longitudinal dimension) should identify the impact of each institutional dimension of the educational system, from kindergarten to university (a sort of diff-in-diff where each country deviates from the other and from its own trend.

REFORM	DESCRIPTION	TARGET POPULATION	REFORM ASPIRATION
Pre-primary expansion	Fees reduction; construction of new pre-primary schools; laws obliging to make pre-primary school available to all citizens; incorporation of pre-school into schooling systems	age 3	universalism
Duration compulsory education	Number of years of compulsory school	age 6	universalism
Beginning age of compulsory education	Entry age into compulsory formal education	age 6	universalism
Leaving age of compulsory education	Leaving age from compulsory formal education	age 6	universalism
Tracking age	Age at first tracking	age 10	universalism/ selectivity
Pre-primary teacher qualification	Increase educational requirement to be employed as a pre-primary school teacher	age 3	quality assurance
Primary teacher qualification	Increase educational requirement to be employed as a primary school teacher	age 6	quality assurance
Secondary teacher qualification	Increase educational requirement to be employed as a secondary school teacher	age 10	quality assurance
School evaluation	Creation of structures for the steering and evaluation of its education system; carrying out of independent external inspections and evaluations; legislations strengthening the importance of school evaluation; measurement of school	age 10	accountability

	performance through the testing of samples of students		
Standardised test (for career advancement)	Presence of national standardised tests for taking decisions about the school career of pupils	age 10	accountability/ selectivity
Standardised test (for other purposes)	Presence of national standardised test for other purposes(e.g. measure performance of schools)	age 10	accountability
School autonomy	Reforms increasing autonomy in school management and decision-making process	age 10	autonomy
Teacher autonomy	Increase degree of autonomy for teacher in primary and secondary education	age 10	autonomy
Expansion of university access	Open access from vocational high schools; geographical expansion of universities; creation of polytechnic institutions providing non-university vocational higher education	age 15	universalism
Increase grant size	Increase financial support at tertiary level through grant	age 15	universalism
Loan component to grant component	Dimension of the loan component to the grant component for financial support at tertiary level	age 15	universalism
Interest rate	Interest rate charged to loans for tertiary education	age 15	universalism
Selectivity in university access	Introduction of admission tests; introduction of national exam for entry to higher education; entrance to higher education based on candidates' grades at secondary school	age 15	selectivity
Index of university autonomy	Autonomy at tertiary level in the following dimensions: budget, recruitment, organization, logistic, courses organization, self - evaluation and development plans	age 15	selectivity / accountability

Table 1: Descriptive Statistics of the variables describing national school systems.

	Mean	Std. Dev. (overall)	Std. Dev. (between)	Std. Dev. (within)	Min	Max	Obs.	N. of countries
Pre-primary expansion	0.410	0.446	0.232	0.383	0	1	1728	24
Duration compulsory school	8.168	1.834	1.066	1.508	3	13	1728	24
Beginning age of compulsory education	6.336	0.754	0.699	0.317	4	9	1728	24
Leaving age of compulsory education	14.488	1.659	0.855	1.432	10	18	1728	24
Tracking age	13.097	2.259	1.669	1.559	6	16	1728	24
Pre-primary teacher qualification	0.272	0.400	0.215	0.341	0	1	1728	24
Primary teacher qualification	0.349	0.416	0.201	0.366	0	1	1728	24
Secondary teacher qualification	0.412	0.448	0.238	0.382	0	1	1728	24
School evaluation	0.121	0.323	0.100	0.307	0	1	1728	24
Standardised tests (for career advancement)	0.120	0.316	0.203	0.246	0	1	1728	24
Standardised tests (for other purposes)	0.104	0.305	0.157	0.263	0	1	1728	24
School autonomy	0.181	0.383	0.167	0.347	0	1	1728	24
Teacher autonomy	0.211	0.408	0.245	0.330	0	1	1728	24
Expansion of university access	0.325	0.420	0.171	0.385	0	1	1728	24
Increase grant size	0.539	0.165	0.065	0.152	0	1	1224	17
Loan component to grant component	0.275	0.280	0.270	0.097	0	1	1224	17
Interest rate	0.275	0.275	0.270	0.083	0	1	1224	17
Selectivity in university access	0.393	0.478	0.370	0.316	0	1	1224	17
Index of university autonomy	0.157	0.274	0.090	0.259	0	0.857	1296	18

Table 2: Pairwise correlation between reform measures

	Pre-primary expansion	Pre-primary teacher qualification	Duration compulsory school	Beginning age of comp. education	Leaving age of comp. education	Primary teacher qualification	Secondary teacher qualification	Tracking age	Standardised tests (for career adv.)	Standardised tests (for other purp.)	School evaluation	School autonomy	Teacher autonomy	Selectivity in university access†	Expansion of university access	Increase grant size†	Loan to grant component ††	Interest rate†	Index of university autonomy‡
Pre-primary expansion	1																		
Pre-primary teacher qualification	0.4627*	1																	
Duration compulsory school	0.3996*	0.3533*	1																
Beginning age of comp. education	0.1088*	0.0630*	-0.4678*	1															
Leaving age of comp. education	0.5010*	0.4277*	0.9139*	-0.0687*	1														
Primary teacher qualification	0.5433*	0.5627*	0.4965*	-0.0963*	0.5162*	1													
Secondary teacher qualification	0.5816*	0.3954*	0.5453*	-0.2070*	0.5205*	0.7157*	1												
Tracking age	0.3555*	0.3914*	0.2019*	0.3184*	0.3741*	0.2722*	0.1969*	1											
Standardised tests (for career adv.)	-0.0031	0.1210*	0.2416*	-0.1060*	0.2240*	0.0395	0.1404*	0.0107	1										
Standardised tests (for other purp.)	0.1238*	0.2271*	0.3308*	-0.1827*	0.2894*	0.3514*	0.1664*	0.1580*	0.2848*	1									
School evaluation	0.3582*	0.2816*	0.4103*	-0.2384*	0.3536*	0.3986*	0.4209*	0.0249	0.3361*	0.3520*	1								
School autonomy	0.3288*	0.3317*	0.4282*	-0.2246*	0.3802*	0.4199*	0.4483*	0.1777*	0.2551*	0.2884*	0.5884*	1							
Teacher autonomy	0.1173*	0.1364*	0.2915*	-0.2628*	0.2083*	0.2294*	0.2443*	0.0091	0.2602*	0.1637*	0.3768*	0.5998*	1						
Selectivity in university access†	0.1663*	0.3169*	0.3691*	-0.0811*	0.3936*	0.2023*	0.1388*	0.2753*	0.3627*	0.2712*	0.2035*	0.0574*	0.0579*	1					
Expansion of university access	0.4646*	0.4040*	0.5096*	-0.1788*	0.4931*	0.5864*	0.5549*	0.3161*	0.2030*	0.2583*	0.4435*	0.5164*	0.2653*	0.3376*	1				
Increase grant size†	0.3097*	0.1430*	0.0934*	-0.0047	0.1056*	0.2463*	0.2555*	0.1130*	0.1125*	0.2380*	0.3136*	0.2419*	0.0595*	0.1812*	0.2145*	1			
Loan to grant component †	0.0328	0.0448	0.1516*	0.1630*	0.2361*	0.1703*	-0.0351	0.3214*	0.1924*	0.0154	-0.036	0.1095*	0.1490*	0.3761*	0.1457*	0.0700*	1		
Interest rate†	0.1293*	0.0015	-0.0379	0.3020*	0.0710*	0.1528*	-0.0512	0.3125*	-0.1969*	0.0115	-0.1138*	0.0913*	-0.0615*	-0.0646*	0.1309*	0.0849*	0.5824*	1	
Index of university autonomy‡	0.4435*	0.4489*	0.5323*	-0.1969*	0.5378*	0.5582*	0.5003*	0.2807*	0.3581*	0.6385*	0.4971*	0.4353*	0.1491*	0.5328*	0.6311*	0.3462*	0.1750*	0.0217	1

Note: * indicates statistically significant at 5%

2.2 Microdata on educational attainment

Data on individual school attainment and background characteristics comes from four international surveys: ESS (30 countries, four waves from 2002/2003 to 2008/2009), EUSILC (27 EU+Norway&Iceland, 2005 wave), IALS (some OECD countries, implemented in different years: 1994, 1996, 1998) ISSP (varying country participation, annual since 1985).

In order to create our final dataset, we pool all the surveys' waves together and create a pseudo panel where the time dimension is given by birth cohorts. The oldest cohort of individuals included in our sample is born in 1926, while the youngest one includes individuals born in 1985

We match to every individual the institutional characteristics that her cohort faced when attending each school grade.

Sample restricted to individuals **older than 25** (education attainment does not change) and n**on-foreign born** (minimize the risk of assigning to individuals the wrong education system).

All surveys contain information on individuals' education, demographics (gender, age) and on background characteristics, such as parents' education and occupation.

Table 3: Descriptive statistics – ESS, EUSILC, IALS, ISSP

	Obs	Mean	Std. Dev.	Min	Max	Obs	Mean	Std. Dev.	Min	Max
			ESS					**EUSILC**		
Birth year	109415	1955	14.83	1926	1985	159895	1960	11.14	1939	1980
Age	109415	50	15	25	84	159895	45	11.14	25	66
Female	109415	0.53	0.50	0	1	159895	0.52	0.50	0	1
Years of education	109415	12	4	0	25	159895	12.51	4.46	0	25
			Highest qualification achieved							
Primary education or below	109097	0.15	0.36	0	1	159786	0.15	0.36	0	1
Lower secondary education	109097	0.19	0.39	0	1	159786	0.14	0.35	0	1
Upper secondary education	109097	0.38	0.49	0	1	159786	0.45	0.50	0	1
Tertiary education	109097	0.28	0.45	0	1	159786	0.25	0.44	0	1
			Parental highest qualification achieved							
Primary education or below	109415	0.35	0.48	0	1	159895	0.48	0.50	0	1
Lower secondary education	109415	0.22	0.41	0	1	159895	0.17	0.38	0	1
Upper secondary education	109415	0.28	0.45	0	1	159895	0.24	0.43	0	1
Tertiary education	109415	0.15	0.36	0	1	159895	0.11	0.31	0	1
			IALS					**ISSP**		
Birth year	31592	1953	11	1926	1973	28200	1949	13	1926	1974
Age	31592	43	11	25	68	28200	45	13	25	73
Female	31592	0.54	0.50	0	1	28200	0.52	0.50	0	1
Years of education	31592	12.04	3.49	0	25	28200	11.28	3.91	0	25
			Highest qualification achieved							
Primary education or below	31308	0.11	0.31	0	1	21543	0.06	0.24	0	1
Lower secondary education	31308	0.29	0.46	0	1	21543	0.48	0.50	0	1
Upper secondary education	31308	0.35	0.48	0	1	21543	0.32	0.47	0	1
Tertiary education	31308	0.25	0.43	0	1	21543	0.14	0.34	0	1
			Parental highest qualification achieved							
Primary education or below	31592	0.33	0.47	0	1	28200	0.20	0.40	0	1
Lower secondary education	31592	0.35	0.48	0	1	28200	0.59	0.49	0	1
Upper secondary education	31592	0.22	0.41	0	1	28200	0.15	0.35	0	1
Tertiary education	31592	0.11	0.32	0	1	28200	0.07	0.25	0	1

Country	ESS	EUSILC	IALS	ISSP	Total
Austria	4 888	5 548	n.a.	1 358	11 794
Belgium FL	3 456	3 387	1 373	n.a.	8 216
Belgium FR	1 462	1 609	n.a.	n.a.	3 071
Czech Republic	5 015	4 868	2 536	3 094	15 513
Denmark	4 760	2 524	2 420	n.a.	9 704
Estonia	3 129	3 611	n.a.	n.a.	6 740
Finland	6 339	5 204	2 269	n.a.	13 812
France	5 278	8 074	n.a.	1 422	14 774
Great Britain	5 807	4 360	2 673	n.a.	12 840
Germany	8 424	11 542	1 453	5 367	26 786
Greece	5 411	6 778	n.a.	n.a.	12 189
Hungary	4 970	7 909	1 949	3 439	18 267
Ireland	5 464	4 151	1 599	688	11 902
Italy	2 181	26 854	2 404	n.a.	31 439
Latvia	1 020	2 829	n.a.	894	4 743
Netherlands	6 018	4 105	2 346	n.a.	12 469
Northern Ireland	197	n.a.	2 032	n.a.	2 229
Norway	5 404	n.a.	2 391	902	8 697
Poland	5 217	21 696	2 238	4 290	33 441
Portugal	6 192	4 957	n.a.	979	12 128
Slovak Republic	3 819	7 626	n.a.	833	12 278
Slovenia	4 053	3 917	1 978	3 203	13 151
Spain	5 474	16 389	n.a.	855	22 718
Sweden	5 437	1 957	1 931	876	10 201
Total	109 415	159 895	31 592	28 200	329 102

Figure 1: Mean years of Education and GINI index, by country and 5-years cohorts

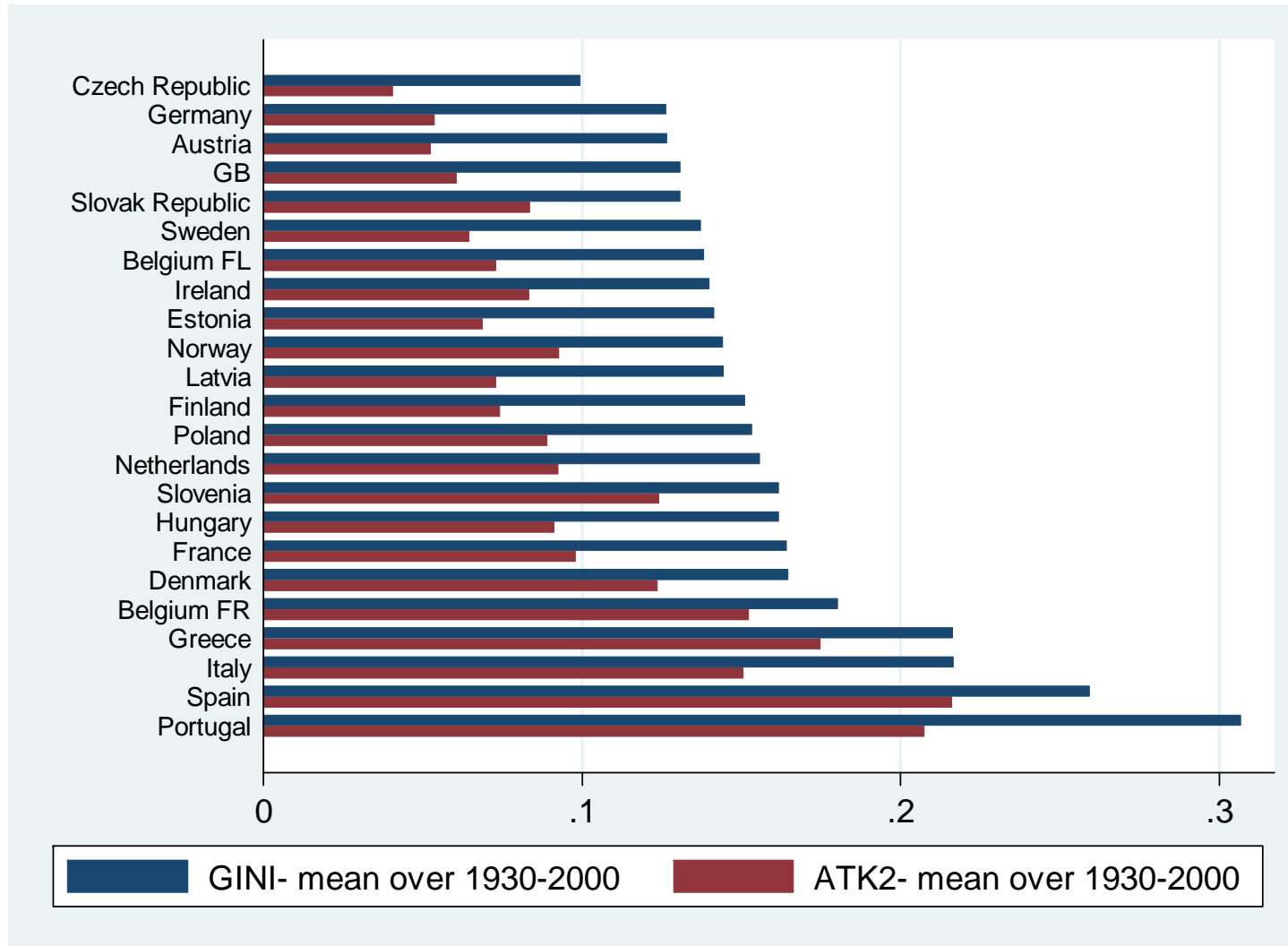Figure 2: Educational inequality measures by country

Figure 2 shows the average inequality in educational attainment (computed over the years of education) by country: Central Europe (Austria, Germany and Czech Republic) is the least unequal area (possibly a long run consequence of the early introduction of compulsory education in the Prussian empire), while the Mediterranean area (Portugal, Spain, Greece and Italy) is the most unequal one (a legacy of the Spanish domination?)

3. Empirical strategy

To study the effect of reforms on school attainment we use individual level data matched to our dataset on school reform to estimate the following equation:

$$h_{ict} = \alpha + \beta \cdot F_{ict} + \gamma \cdot R_{c,t+n} + \theta \cdot PB_{ict} + \delta_c + \delta_t + t \cdot \delta_c + \varepsilon_{ict} \qquad (1)$$

where i, c and t denote individual, country and birth cohort respectively. h_{ict} is our outcome of interest (years of schooling), F_{ict} is a gender indicator (1=female), $R_{c,t+n}$ is the institutional setting prevailing in country c at time country c at time $(t+n)$ where n captures the age at which the reform is supposed to affect individuals educational career[1]; PB_{ict} is a measure of family background (captured by a dichotomous variable that takes value one if at least one parent has tertiary education), δ_c and δ_t are country and birth year fixed effects, $t \cdot \delta_c$ is a country specific time trend, and finally ε_{ict} is the stochastic error term.

Our coefficient of interest (γ) provides the sample average effect of each reform.

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[1] In particular, n=3 for reforms regarding pre-primary school, n=6, n=10 and n=15 for those concerning primary, secondary and tertiary education respectively.

Causal effect of reforms identified exploiting the cross-country heterogeneity in the timing of their implementation. The intuition behind our strategy is the following. Suppose we had two countries *A* and *B* identical in every respect at time *t.* At time *t+1* an educational reform is exogenously introduced in country A. The effect of this reform can be then estimated comparing changes in mean educational attainment between year *t* and *t+1* in the two countries. In this setting country B provides a perfect counterfactual situation for country A in the absence of the reform.

Difference-in-difference intuition: compare *changes* in educational attainment over time across countries that introduced reforms in the school system in different periods. In this way, at every point in time, countries that are not affected by policy changes constitute a suitable counterfactual for the countries where a policy change occurs.

Unbiased estimates of the causal effect of the policy under the assumption of reforms' **exogeneity,** which correspond to two identifying assumptions:
a) the changes in individual outcomes of consecutive cohorts in different countries would have been the same in the absence of the reforms.
b) the treatment (i.e. having been exposed to a particular institutional school setting) is assigned to individuals exclusively based on the exogenously given date of birth.

If the reforms were implemented based on past levels of educational attainment, then the exogeneity hypothesis would be violated. We tested this assumption by regressing the alternative reform indicators on past levels of educational attainment (5 lags) controlling for country and cohort fixed effects. The results reassure us that almost all the reforms included in the analysis are not related to changes in countries' educational attainment.

	Exogeneity of reforms			
	Mean year of education (5 lags)		Observations	R-squared
	Coefficient	*Robust standard error*		
Duration compulsory school	0.009	[0.009]	3,476	0.706
Pre-primary expansion	-0.002	[0.002]	3,476	0.647
Pre-primary compulsory	-0.000	[0.000]	3,476	0.053
Pre-primary teacher qualification	0.002	[0.002]	3,476	0.556
Beginning age of compulsory education	0.001	[0.001]	3,476	0.973
Leaving age of compulsory education	0.005	[0.009]	3,476	0.695
Primary teacher qualification	0.001	[0.002]	3,476	0.707
Secondary teacher qualification	0.002	[0.002]	3,476	0.753
Tracking age	-0.011	[0.012]	3,476	0.712
Standardised tests (for career advancement)	0.002	[0.002]	3,476	0.524
Standardised tests (for other purposes)	-0.001	[0.001]	3,476	0.311
School evaluation	0.001	[0.001]	3,476	0.258
School autonomy	0.005***	[0.001]	3,476	0.571
Teacher autonomy	0.001	[0.002]	3,476	0.770
Selectivity in university access	0.001	[0.003]	2,366	0.726
Expansion of university access	-0.003	[0.002]	3,476	0.612
Index of university autonomy	0.001	[0.002]	2,546	0.646
Increase grant size	-0.001	[0.001]	2,366	0.278
Loan component to grant component	-0.000	[0.001]	2,366	0.938
Interest rate	0.001	[0.001]	2,366	0.962

Notes: robust standard errors in brackets - *** p<0.01, ** p<0.05, * p<0.1; Each row reports regressions with different reforms as dependent variable. All regressions control for the share of female and the share of people with graduate parent in each cell and include country, cohort, and survey fixed effects. The regressions are weighted by the number of observations in each country-cohort-survey cell.

We are concerned with <u>heterogeneity</u> in the effects.

In order to test whether the same reform had a differential effect between individuals raised in "culturally rich" families (where at least one parent was college graduate), we interact the reform variable with measures of parental background, thus estimating the following:

$$h_{ict} = \alpha + \beta \cdot F_{ict} + \gamma \cdot R_{c,t+n} + \theta \cdot PB_{ict} + \varphi(R_{c,t+n} \times PB_{ict}) + \delta_c + \delta_t + t \cdot \delta_c + \varepsilon_{ict} \qquad (2)$$

The differential effect of the reform in the culturally different subgroups is given by γ for culturally poor families and $(\gamma + \varphi)$ for culturally rich families.

We further investigate whether educational reforms have differential impacts along the distribution of educational attainment. It may well be that some reforms do not affect the mean educational level, but only impact educational attainment of people in any tails of distribution. In particular, we aggregate the individual-level data by country and cohort and compute for each cell (country and cohort) the value of different deciles of the dependent variable distribution.

If h_{pct} denotes the pth decile of the individual distribution of attainment in country c for cohort t then we estimate

$$h_{pct} = \alpha_p + \gamma_p \cdot R_{c,t+n} + \delta_t + \delta_c + \varepsilon_{pct} \qquad (3)$$

The vector γ_p provides the differential impact of each reform on the unconditional distribution of attainment, thus allowing to evaluate whether and to what extent the policy entailed some distributional effects.

Finally we study the effect of institutions on inequality. For each 5-year cohort t in country c and survey s we computed an inequality index (based on the distribution of the years of education in the cell) and run the following regression:

$$Ineq_{cts} = \alpha + \beta \cdot \overline{h}_{cts} + \gamma \cdot R_{c,t+n} + \theta \cdot PB_{cts} + \delta_t + \delta_c + \delta_s + \varepsilon_{gct}$$

where $Ineq_{cts}$ is the inequality outcome of interest (either the Gini index or the Atkinson index), $\overline{h}_{cts}$ is the average years of education of the cell age cohort×country×survey, $R_{c,t+n}$ is the reform measure associated to cohort t in country c, PB_{cts} is the fraction of individuals with at least on parent with tertiary education in a given cohort and country, δ_c, δ_t and δ_s are country, cohort and survey fixed effects.

In order to account for the different sample sizes underlying inequality indices in each country-cohort-survey, we weight the regressions using the number of observations used to compute inequality indices in cell.

4. Results
4.1 Institutions and school attainment

In principle all reforms inspired by principles of *universalism*, *quality assurance* and *accountability* should produce an increase in the average educational attainment, whereas reforms intended to increase *selectivity* may exhibit ambiguous effects: on one side, by creating fiercer competition to obtain better results and/or to enter better schools, heavier selection elicit more effort and raise potential achievement; on the other side, it may discourage marginal individuals, or even prevent them from achieving (as in the case of quotas), thus reducing attainment.

We introduce each reform separately, in order to reduce the risk of multicollinearity among them.

Table 4: Reforms and educational attainment

	Pre-primary expansion	Pre-primary teacher qualification	Duration compulsory school	Beginning age comp education	Leaving age comp education	Primary teacher qualification	Secondary teacher qualification	Tracking age	Standardised tests (for career adv.)	Standardised tests (for other purposes)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Graduate parent	3.011***	3.012***	3.010***	3.012***	3.011***	3.012***	3.011***	3.011***	3.013***	3.011***
	[0.042]	[0.042]	[0.042]	[0.042]	[0.042]	[0.042]	[0.042]	[0.042]	[0.042]	[0.042]
Reform	0.132***	-0.191***	0.061***	-0.607***	0.048***	-0.000	0.169***	0.012	-0.432***	0.429***
	[0.049]	[0.044]	[0.014]	[0.117]	[0.014]	[0.054]	[0.048]	[0.010]	[0.076]	[0.090]
Obs.	329 102	329 102	329 102	329 102	329 102	329 102	329 102	329 102	329 102	329 102
R²	0.258	0.258	0.258	0.258	0.258	0.258	0.258	0.258	0.258	0.258
Countries	24	24	24	24	24	24	24	24	24	24

	School evaluation	School autonomy	Teacher autonomy	Selectivity university access	Expansion university access	Increase grant size	Loan to grant component	Interest rate	Index of university autonomy
	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
Graduate parent	3.012***	3.012***	3.012***	3.019***	3.011***	3.019***	3.022***	3.020***	3.008***
	[0.042]	[0.042]	[0.042]	[0.055]	[0.042]	[0.055]	[0.055]	[0.055]	[0.051]
Reform	0.017	0.133	-0.021	-0.176**	0.171***	0.235	-0.830***	-1.010***	-0.209**
	[0.108]	[0.087]	[0.063]	[0.077]	[0.050]	[0.147]	[0.196]	[0.340]	[0.095]
Obs.	329 102	329 102	329 102	224 969	329 102	224 969	224 969	224 969	240 482
R²	0.258	0.258	0.258	0.287	0.258	0.287	0.287	0.287	0.283
Countries	24	24	24	17#	24	17#	17#	17#	18##

Note: standard errors clustered by country×age cohorts in brackets - *** p<0.01, ** p<0.05, * p<0.1 –
Constant, gender, birth year, country, survey controls and country specific time trend included
#: no Hungary, Latvia, Poland, Slovak Rp., Slovenia and Czech Rp.); ## : no Estonia, Hungary, Latvia, Poland, Slovak Rp. and Slovenia

Our results in previous table suggest the following findings:

i) Consistently with previous findings in the literature, reforms that expand the access to **pre-primary education** seem to be associated to an increase in average educational attainment. Similarly, from column 5, we see that the higher is the starting age of compulsory school the lower is the successive attainment, suggesting that lowering the beginning age of compulsory education is an effective tool to increase educational attainment

ii) **compulsory education** favours education achievement, mostly through retaining students in schools al later stages

iii) while we expected reforms affecting **teacher recruiting** being positively correlated with rising educational attainment, our results show a counterintuitive negative effect of teacher qualification requirements in pre-primary school and no impact in primary schools. In contrast, teacher qualifications in secondary schools seems to be effective in promoting higher educational attainment.

iv) **tracked secondary school** systems lower school performance through reduced competence acquisition; this is reflected in the positive association between the age at which students are sorted into different tracks and educational attainment.

v) the introduction of **standardised tests** does not have a univocal impact on educational choices. The introduction of standardised tests aimed at guiding career advancement are associated to a

reduction in average educational attainment, implying that students would be discouraged by lower test scores in proceeding further in education. On the other hand, standardised tests introduced for other reasons, such as school evaluation, seem to foster educational attainment. No significant effect of the reforms aimed at make school more accountable, introducing different forms of school evaluation.

vi) reforms that increased **school autonomy** and **teacher autonomy** turned out to be positively and significantly related to educational attainment In contrast, a composite measure for different dimension of **university autonomy** obtains a negative (and significant sign).

vii) finally policies to **foster tertiary education** show positive association with average educational attainment, as visible from sign and significance of variables related to the expansion of educational supply. In terms of cost reduction, the increase in the availability of grant financing for university students is not statistically significant, while higher interest rates and higher proportion of loan to grant component decrease average educational attainment.

We may summarise previous results by saying that *universalistic policies* (expansion of compulsory education, detracking, opening access to universities, subsidising university attendance) *raise the average educational attainment of the corresponding populations, while policies targeted to quality improvements* (either through increased autonomy and accountability of educational institutions, or through raising teachers' required qualifications) *tend to reduce it.*

Table 5: Reforms and educational attainment - interaction between reforms and parental background

	Pre-primary expansion	Pre-primary teacher qualification	Duration compulsory school	Beginning age comp education	Leaving age comp education	Primary teacher qualification	Secondary teacher qualification	Tracking age	Standardised tests (for career adv.)	Standardised tests (for other purposes)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Graduate parent	3.207***	3.125***	6.816***	2.737***	10.562***	3.478***	3.319***	5.129***	3.105***	3.073***
	[0.056]	[0.053]	[0.218]	[0.419]	[0.435]	[0.061]	[0.066]	[0.298]	[0.043]	[0.044]
Reform	0.195***	-0.123***	0.111***	-0.613***	0.104***	0.111**	0.224***	0.028***	-0.295***	-0.956***
	[0.050]	[0.047]	[0.014]	[0.117]	[0.014]	[0.056]	[0.050]	[0.010]	[0.084]	[0.099]
Reform×graduate parent	-0.573***	-0.515***	-0.436***	0.044	-0.503***	-1.156***	-0.588***	-0.160***	-1.089***	0.635***
	[0.104]	[0.107]	[0.024]	[0.065]	[0.029]	[0.090]	[0.089]	[0.021]	[0.152]	[0.096]
Observations	329 102	329 102	329 102	329 102	329 102	329 102	329 102	329 102	329 102	329 102
R²	0.258	0.258	0.260	0.258	0.261	0.259	0.258	0.259	0.258	0.258
Countries	24	24	24	24	24	24	24	24	24	24

	School evaluation	School autonomy	Teacher autonomy	Selectivity university access	Expansion university access	Increase grant size	Loan to grant component	Interest rate	Index of university autonomy
	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
Graduate parent	3.032***	3.062***	3.134***	3.598***	3.438***	3.618***	3.960***	3.371***	3.535***
	[0.042]	[0.045]	[0.047]	[0.078]	[0.058]	[0.165]	[0.077]	[0.091]	[0.063]
Reform	0.223**	0.206**	0.089	0.049	0.269***	0.501***	0.246	-0.643*	0.123
	[0.096]	[0.089]	[0.063]	[0.080]	[0.051]	[0.143]	[0.194]	[0.338]	[0.101]
Reform×graduate parent	-1.219***	-0.612***	-0.789***	-1.217***	-0.883***	-1.127***	-2.778***	-1.041***	-2.169***
	[0.204]	[0.096]	[0.088]	[0.101]	[0.104]	[0.274]	[0.148]	[0.191]	[0.142]
Observations	329 102	329 102	329 102	224 969	329 102	224 969	224 969	224 969	240 482
R²	0.258	0.258	0.258	0.289	0.258	0.287	0.290	0.288	0.285
Countries	24	24	24	24	17#	24	17#	17#	18##

Note: standard errors clustered by country×age cohorts in brackets - *** p<0.01, ** p<0.05, * p<0.1 – Constant, gender, birth year, country and , survey controls and country specific time trend included; #: no Hungary, Latvia, Poland, Slovak Rp., Slovenia and Czech Rp.); ## : no Estonia, Hungary, Latvia, Poland, Slovak Rp. and Slovenia

Results are substantially unchanged when considering a differential impact by family background. We see that

wiii) in most cases reforms tend to have an attenuated impact for children from culturally rich environments. This is the case for compulsory education, tracking age, open access to universities and financial support in college.

ix) when reforms represents an obstacle to education expansion (as in the cases of teacher qualification, teacher autonomy and standardised tests), this effect is weaker in the case of children from culturally poor environments (probably because their parents are less capable to choose, and therefore less reactive to perceived school quality). This is clearly visible in the cases of reforms introducing school evaluation and/or enhancing school or university autonomies: while the average effects are nil (or negative), they become significantly negative when we allow for differential impact in the culturally rich population.

There are therefore two types of reforms: *reforms that raise the bottom tail of the endowment distribution and reforms that increase the dispersion in the upper tail of the same distribution* (whatever the original asset can be: parental education, family wealth or even innate ability). We call *inclusive* the first family and *selective* the second family of reforms.

Table 6: Correlation between intergenerational elasticities and reform variables

	Pre-primary expansion	Pre-primary teacher qualification	Duration compulsory school	Beginning age comp education	Leaving age comp education	Primary teacher qualification	Secondary teacher qualification	Tracking age	Standardised tests (for career adv.)	Standardised tests (for other purposes)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Reform	-0.093	0.448***	-0.135***	0.437	-0.121***	0.214	-0.368**	-0.109***	0.560*	0.002
	[0.192]	[0.162]	[0.038]	[0.303]	[0.036]	[0.197]	[0.163]	[0.039]	[0.325]	[0.172]
Observations	1 362	1 362	1 362	1 362	1 362	1 362	1 362	1 362	1 362	1 362
R²	0.512	0.514	0.515	0.513	0.514	0.512	0.513	0.516	0.514	0.512

	School evaluation	School autonomy	Teacher autonomy	Selectivity university access	Expansion university access	Increase grant size	Loan to grant component	Interest rate	Index of university autonomy
	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
Reform	-0.584*	0.114	0.369**	0.098	-0.482***	-0.838***	-0.398	-0.398	-0.136
	[0.302]	[0.183]	[0.169]	[0.166]	[0.144]	[0.278]	[0.354]	[0.354]	[0.373]
Observations	1 362	1 362	1 362	961#	1 362	961#	961#	961#	1020##
R²	0.513	0.512	0.513	0.564	0.515	0.566	0.564	0.564	0.554

Note: robust standard errors in brackets – statistical significance: *** p<0.01, ** p<0.05, * p<0.1 – Constant, birth year, and country controls included
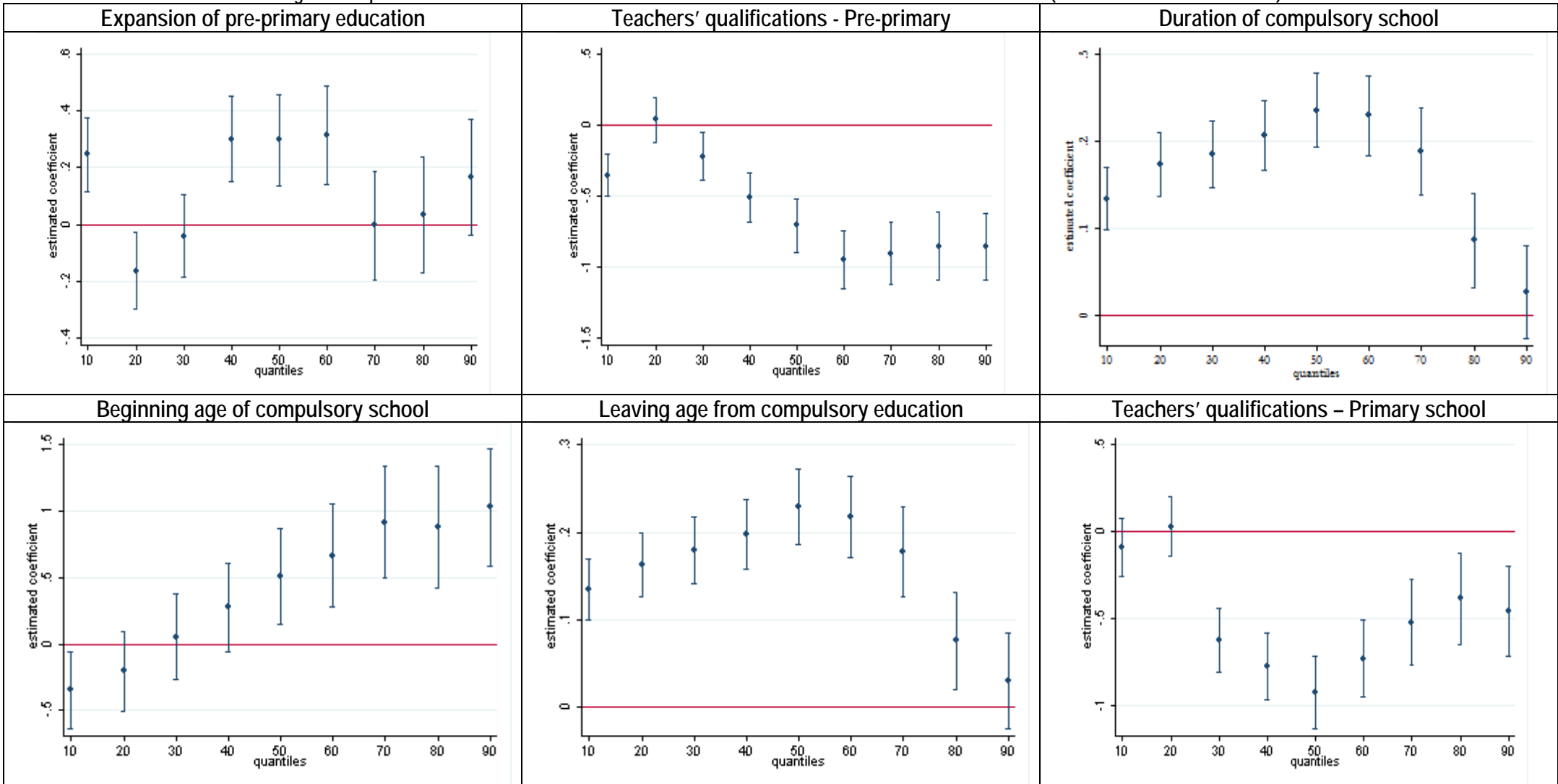- #: no reform data for Estonia, Hungary, Latvia, Poland, Slovak Rp., Slovenia and Czech Rp.;
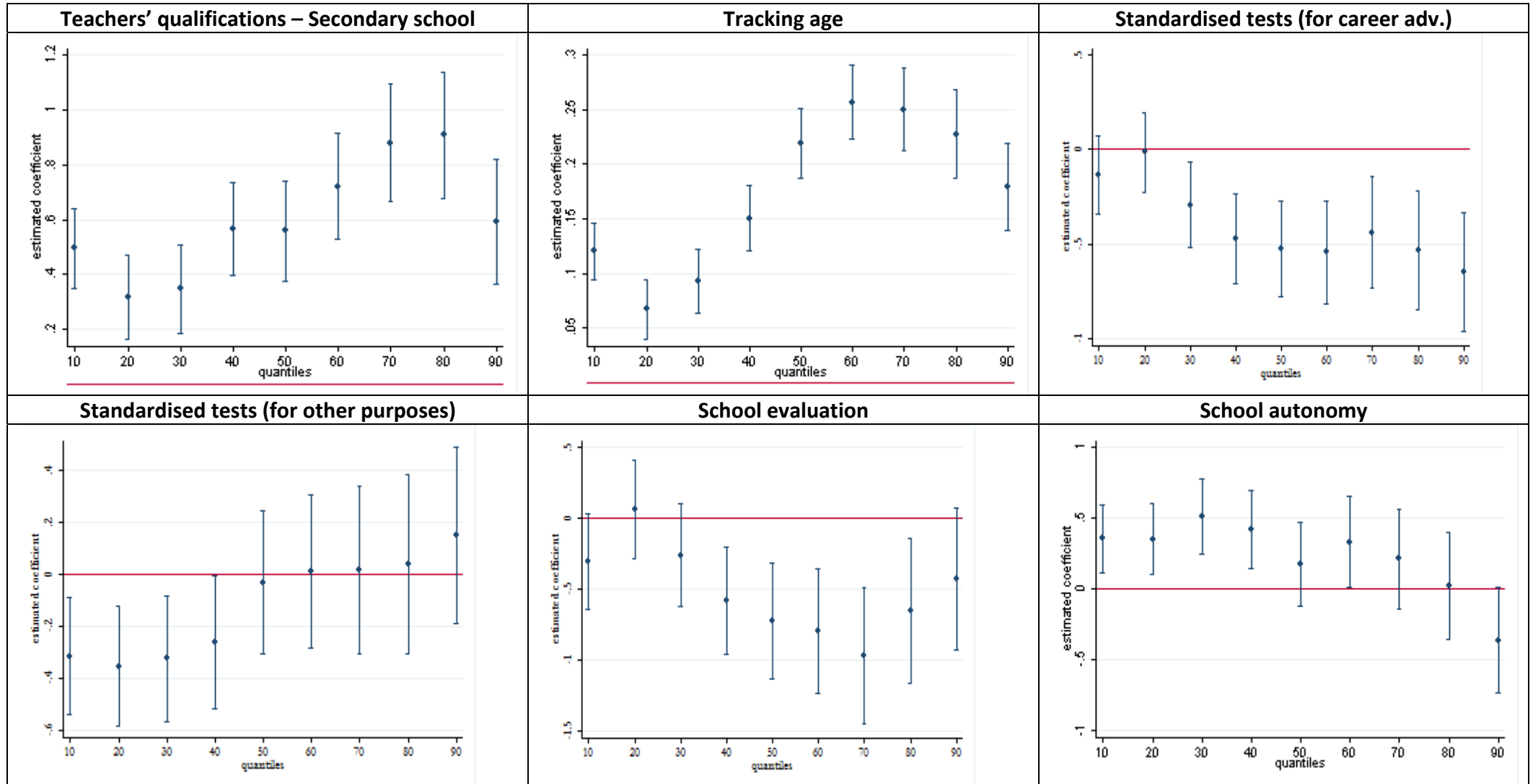## : no reform data for Estonia, Hungary, Latvia, Poland, Slovak Rp. and Slovenia
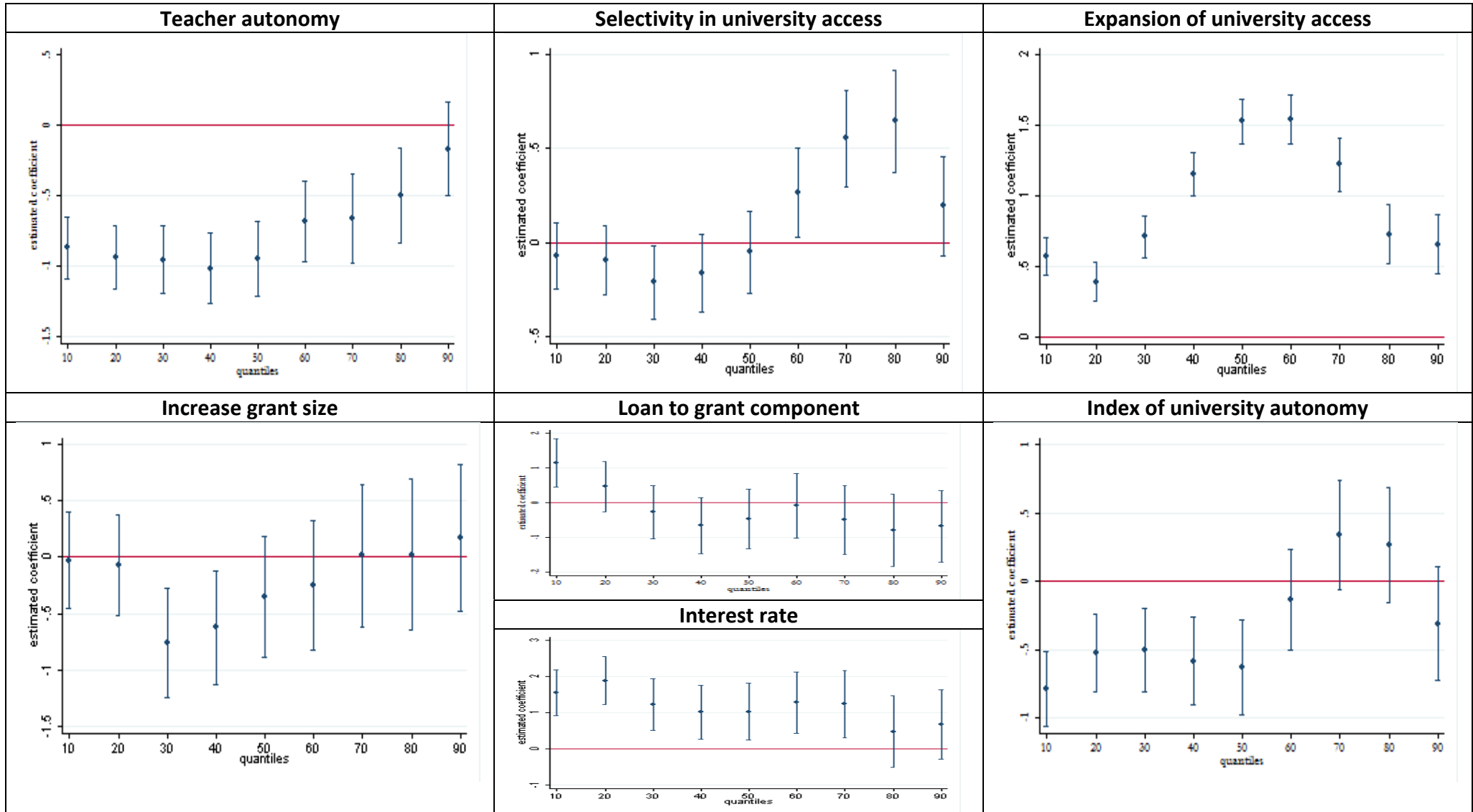
4.2 Distributional effects of the reforms

An alternative strategy to investigate the potential heterogeneity of educational reforms is resorting to regressions by decile (which are not quantile regressions!), which do identify the local effect associated to a specific decile of the years of education distribution.

Some reforms seem especially targeted for low achievers: it is the case of pre-primary education and early start of compulsory education, as well as the financial support at tertiary level through grant. Some other reforms are more effective in pushing up the attainment of higher achievers: this is the case of raising tracking age (which by construction affect those who choose at least secondary school or more) and of selective access to college (trough admission tests)

Figure 3: impact of reforms and on different deciles of educational attainment – estimated coefficients (and 90% confidence intervals)

| Teachers' qualifications – Secondary school | Tracking age | Standardised tests (for career adv.) |
| Standardised tests (for other purposes) | School evaluation | School autonomy |

Teacher autonomy	Selectivity in university access	Expansion of university access

Increase grant size	Loan to grant component	Index of university autonomy
	Interest rate	

Some reforms seem especially targeted for low achievers: it is the case of pre-primary education and early start of compulsory education, as well as the financial support at tertiary level through grant. Some other reforms are more effective in pushing up the attainment of higher achievers: this is the case of raising tracking age (which by construction affect those who choose at least secondary school or more) and of selective access to college (trough admission tests).

Other reforms contributes to make the educational attainment distribution more unequal, by creating obstacles to low achiever and by boosting high achievers: this is the case of reforms enhancing school or teachers' autonomy and/or introducing school assessment. It is less clear the relative contribution of reforms that raise teacher qualifications (at least at pre-primary and primary level), as well as reforms that introduced standardised tests at the exit of secondary schools (here measure without distinction between "college admission" and "career development" purposes).

Since tend to have heterogeneous impacts in the population, the overall effect remain uncertain. We move to the direct estimation of equations (4) using Atkinson index ($\varepsilon=2$) as dependent variable. As a rule of thumb, we may say that whenever the decile profiles in figure 2 are decreasing, inequality should be reduced by the corresponding reform, whereas the opposite situation applies for increasing profiles.

Table 8: Impact of reforms on educational inequality: Dependent variable: Atkinson index ($\varepsilon=2$)

	Pre-primary expansion	Pre-primary teacher qualific.	Duration compulsory school	Beginning age comp education	Leaving age comp education	Primary teacher qualific.	Secondary teacher qualific.	Tracking age	Standardised tests (for career adv.)	Stand. tests (for other purposes)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Mean years of education	-0.010***	-0.010***	-0.009***	-0.010***	-0.009***	-0.010***	-0.009***	-0.009***	-0.009***	-0.010***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Share of people with graduate parent	0.061***	0.061***	0.064***	0.061***	0.064***	0.060***	0.058***	0.055***	0.053***	0.060***
	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)
Reform	-0.002	-0.005	-0.002***	0.031***	-0.002**	0.011***	-0.009***	-0.004***	0.022***	0.018***
	(0.003)	(0.003)	(0.001)	(0.007)	(0.001)	(0.003)	(0.003)	(0.001)	(0.005)	(0.004)
Observations	3,368	3,368	3,368	3,368	3,368	3,368	3,368	3,368	3,368	3,368
R²	0.687	0.687	0.688	0.688	0.688	0.688	0.688	0.692	0.690	0.688

	School evaluation	School autonomy	Teacher autonomy	Selectivity university access	Expansion university access	Increase grant size	Loan to grant component	Interest rate	Index of university autonomy
	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
Mean years of education	-0.010***	-0.010***	-0.009***	-0.011***	-0.009***	-0.011***	-0.011***	-0.011***	-0.011***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Share of people with graduate parent	0.062***	0.061***	0.058***	0.081***	0.061***	0.079***	0.089***	0.085***	0.080***
	(0.013)	(0.013)	(0.013)	(0.015)	(0.013)	(0.015)	(0.015)	(0.015)	(0.014)
Reform	0.012**	0.009**	0.027***	0.007**	-0.013***	0.012	-0.046***	-0.041***	0.009*
	(0.005)	(0.004)	(0.003)	(0.004)	(0.003)	(0.008)	(0.013)	(0.014)	(0.005)
Observations	3,368	3,368	3,368	2,271	3,368	2,271	2,271	2,271	2,461
R²	0.687	0.687	0.690	0.707	0.689	0.707	0.708	0.707	0.714

Notes: robust standard errors in brackets - *** p<0.01, ** p<0.05, * p<0.1; Regressions are weighted by the number of observations used to compute inequality indices in each country-cohort-survey cell. All regressions include controls for country, cohort, and survey fixed effects.

By looking at the impacts on mean and dispersion, we identify three types of reforms:

a) reforms that raise the mean educational attainment in the population while reducing its dispersion; given an implicit limit to the amount of schooling achievable, these reforms are effective by raising the attainment of the bottom tail. We call them *inclusive*.

b) reforms that raise the mean educational attainment while increasing its variation within the population. While the distribution of years of education is shifted to the right, at least one of the two tails has to become more elongated: either low achievers are not affected by the reform (and therefore loose terrain with respect to the mean) or high achievers are stimulated by it (and therefore grow beyond the mean). We call these reforms *selective*.

c) a third group of reforms obtain a reduction in the mean accompanied by an increase in dispersion. This may occur either because they were purposely intended to limit the expansionary trend in education, or because they revealed a failure ex-post. We call these reforms as *restrictive*.

Table 7: Impact of the reform on the distribution of years of schooling in the population –
24 European countries – 1929-2000

REFORM	impact on the mean	impact on equality (deciles)	impact on equality (Atkinson)	nature of the reform
Pre-primary expansion	+	±	±	inclusive (↑ mean ≈ dispersion)
Pre-primary school teacher qualification	−	+	±	restrictive ? (↓ mean↑ dispersion)
Duration compulsory education	+	+	+	inclusive (↑ mean ↓ dispersion)
Beginning age of compulsory education	−	−	−	inclusive (↑ mean ↓ dispersion)
Leaving age of compulsory education	+	+	+	inclusive (↑ mean ↓ dispersion)
Primary school teacher qualification	±	±	−	selective (≈ mean ↑ dispersion)
Secondary school teacher qualification	+	−	+	inclusive (↑ mean ≈ dispersion)
Tracking age	±	±	+	inclusive (≈ mean ↓ dispersion)
Standardised test (for career advancement)	−	+	−	restrictive (↓ mean ≈ dispersion)
Standardised test (for other purposes)	+	−	−	selective (↑ mean ↑ dispersion)
School evaluation	±	±	−	selective (≈ mean ↑ dispersion)
School autonomy	±	+	−	selective ? (≈ mean ≈ dispersion)
Teacher autonomy	±	−	−	selective (≈ mean ↑ dispersion)
Selectivity in university access	−	−	−	restrictive (↓ mean ↑ dispersion)
Expansion of university access	+	±	+	inclusive (↑ mean ↓ dispersion)
Increase grant size	±	−	±	selective (≈ mean ↑ dispersion)
Loan component to grant component	−	+	+	inclusive (↑ mean ↓ dispersion)
Interest rate	−	+	+	inclusive (↑ mean ↓ dispersion)
Index of university autonomy	−	−	−	restrictive (↓ mean ↑ dispersion)

4.3 Factor Analysis

The second step is to investigate the correlation between reforms and educational inequality.

In order to reduce the dimensionality of the problem, we have applied factor analysis to our reform series. Since the mere application of this statistical technique to the whole group of reform variables retains seven factors, which are then difficult to interpret (even after rotation), we have preferred to partition the entire list into subgroups, which in our opinion are sufficiently homogenous, then retaining the first factor only.

Table 8: Factor analysis – principle component method

		Factors	Eigenvalue	Cumulative variance explained	Name of original variable	Factor loading		countries available
inclusive reforms	*Compulsory*	**1**	**2.056**	**0.685**	Duration compulsory school	0.999		24
		2	0.944	1	Beginning age of comp. education	-0.501		
		3	0	1	Leaving age of comp. education	0.898		
	Comprehensive	**1**	**1.761**	**0.587**	Pre-primary expansion	0.807		24
		2	0.707	0.823	Tracking age	0.703		
		3	0.532	1	Expansion of university access	0.785		
	University support 1	**1**	**1.705**	**0.426**	Selectivity university access	0.49	0.70	17 (no Estonia, Hungary, Latvia, Poland, Slovak Rp., Slovenia and Czech Rp.)
	University support 2	**2**	**1.128**	**0.708**	Increase grant size	0.31	0.56	
		3	0.899	0.933	Loan to grant component	0.91	-0.13	
		4	0.268	1	Interest rate	0.74	-0.55	
selective/restrictive reforms	*Accountability*	**1**	**2.445**	**0.489**	Standardised tests (for career adv)	0.567		24
		2	0.941	0.677	Standardised tests (for other purp)	0.551		
		3	0.734	0.824	School evaluation	0.79		
		4	0.561	0.936	School autonomy	0.828		
		5	0.319	1	Teacher autonomy	0.714		
	Teacher qualification	**1**	**2.126**	**0.709**	Pre-primary teacher qualification	0.755		24
		2	0.622	0.916	Primary teacher qualification	0.916		
		3	0.252	1	Secondary teacher qualification	0.847		
	University autonomy	**1**	**5.448**	**0.778**	Budget autonomy	0.874		18 (no Estonia, Hungary, Latvia, Poland, Slovak Rp. and Slovenia)
		2	0.459	0.844	Recruitment autonomy	0.864		
		3	0.325	0.89	Organization autonomy	0.947		
		4	0.282	0.931	Logistic autonomy	0.912		
		5	0.238	0.965	Course autonomy	0.894		
		6	0.152	0.987	Self-evaluation	0.865		
		7	0.095	1	Development plan autonomy	0.814		

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No surprise that all measures are upward trended, since by construction each reform is summed (subtracted) to another if it has the same (opposite) orientation. The general message of the graph is that European educational systems underwent significant reforms during last century, and nevertheless they followed different orientations.

A possible history of educational reforms ?

If we take the zero value as a reference point, we observe that *at the European level* the first wave of reforms in the 60's involved the expansion of compulsory education, followed by a second wave of expansion of comprehensive schools at the beginning of the 70's. Widening school access required recruiting more teachers, which led to reforms raising the qualification requirements to enter the profession during the 70's. 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. 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. Eventually, by the end of the 90's we also witness greater emphasis towards the accountability of the educational systems, which pushed many countries to establishing national assessment agencies.

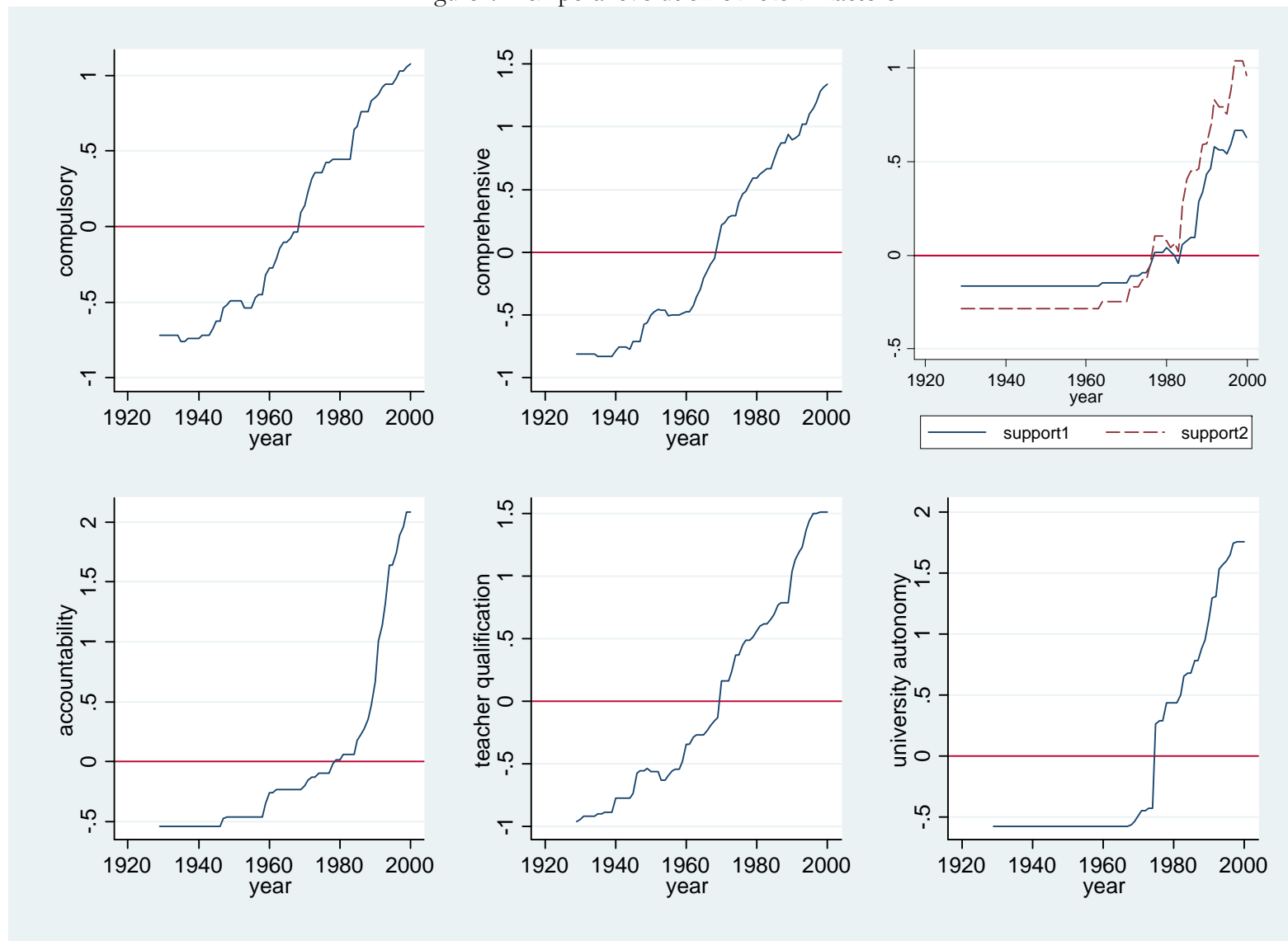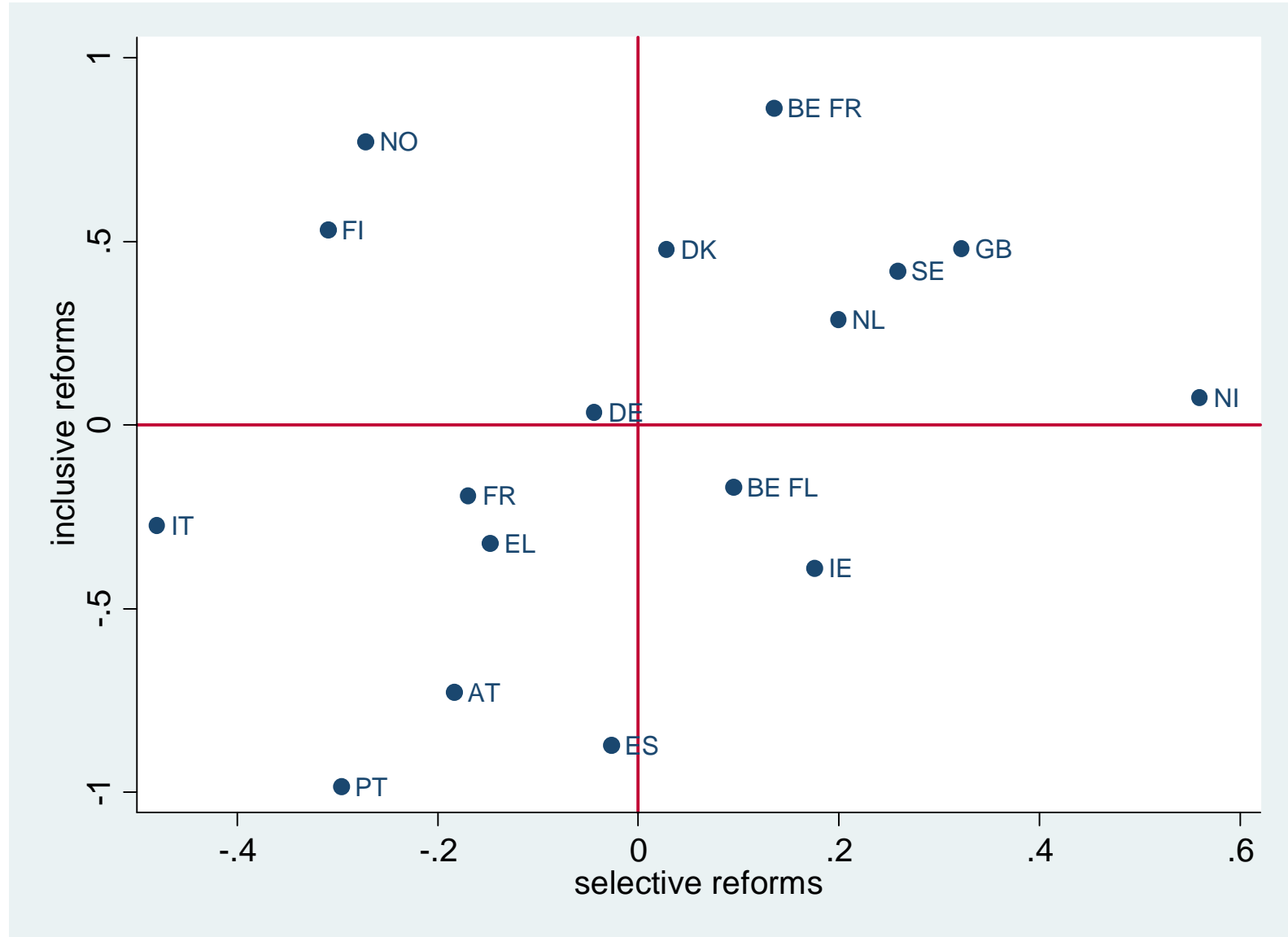Figure 4: Temporal evolution of reform factors

Figure 5: Country average location with respect to policy stances

Simply as a rhetorical device, we have replicated the factor analysis to the two groups of three factors, thus identifying a unique *inclusive policies factor* and a unique *selective policies* factor. We notice that Anglo-Saxon countries (Britain and Northern Ireland, but also Sweden) were the countries which score highest along the *selective policies* dimension, while Nordic countries (notably Norway and Finland, in company of French Belgium) exhibit higher scores along the *inclusive policies* axis. The Mediterranean countries (Greece, Italy, Portugal and Spain), together with Austria and Flemish Belgium, are all gathered in a low reforming area in the south-west quadrant. More specifically, Portugal and Spain are associated with negative scores along the *inclusive* axis, while Italy and at a lesser extent Greece attain negative scores along the *selective* axis.

We have shown that there is sufficient temporal and geographical variation in our extracted factors to claim that these reforms (and their summary indicators) have exerted a causal impact on individual educational choices of the population under analysis.

We observe that *inclusive reforms* raise the average educational attainment, with a stronger impact in culturally disadvantaged backgrounds. On the contrary, *selective reforms* tend to lower the average educational attainment, and this effect is stronger in culturally advantaged backgrounds.

These conclusions are confirmed when resorting to decile regressions. For *inclusive policies* the typical profile is declining with educational attainment (stronger impact of the policies for low achievers), while for selective policies we observe diversified patterns, depending on the variable considered.

|	inclusive reforms				selective reforms		
	compulsory	comprehensive	university support 1	university support 2	accountability	teacher qualification	university autonomy
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Graduate parent	3.260***	3.094***	3.232***	3.012***	2.916***	3.138***	3.172***
	[0.042]	[0.042]	[0.050]	[0.055]	[0.039]	[0.043]	[0.051]
Reform (factor)	0.210***	0.086***	0.036	-0.243***	0.185***	0.095***	0.027
	[0.027]	[0.025]	[0.071]	[0.050]	[0.038]	[0.025]	[0.027]
Observations	329,102	329,102	224,969	224,969	329,102	329,102	240,482
R²	0.260	0.259	0.290	0.288	0.259	0.259	0.284
Countries	24	24	17	17	24	24	18

Note: standard errors clustered by country×age cohorts in brackets - *** p<0.01, ** p<0.05, * p<0.1 –
Constant, gender, birth year, country and survey controls included

Table 11: Dependent variable: Atkinson index (ε=2)

	Inclusive reforms				Selective reforms		
	Compulsory	comprehensive	university support 1	university support 2	Accountability	teacher qualification	university autonomy
Mean years of education	-0.009***	-0.009***	-0.011***	-0.011***	-0.010***	-0.010***	-0.011***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Share of people wth graduate parent	0.064***	0.057***	0.082***	0.083***	0.059***	0.061***	0.081***
	(0.013)	(0.013)	(0.015)	(0.014)	(0.013)	(0.013)	(0.014)
Reform (factor)	-0.004***	-0.009***	-0.005	0.006***	0.012***	-0.005***	0.002
	(0.001)	(0.001)	(0.004)	(0.002)	(0.002)	(0.002)	(0.001)
Observations	3,368	3,368	2,271	2,271	3,368	3,368	2,461
R²	0.688	0.692	0.706	0.708	0.691	0.688	0.714

Note: standard errors clustered by country×age cohorts in brackets - *** p<0.01, ** p<0.05, * p<0.1 –
Constant, gender, birth year, country and survey controls included

Figure 5:
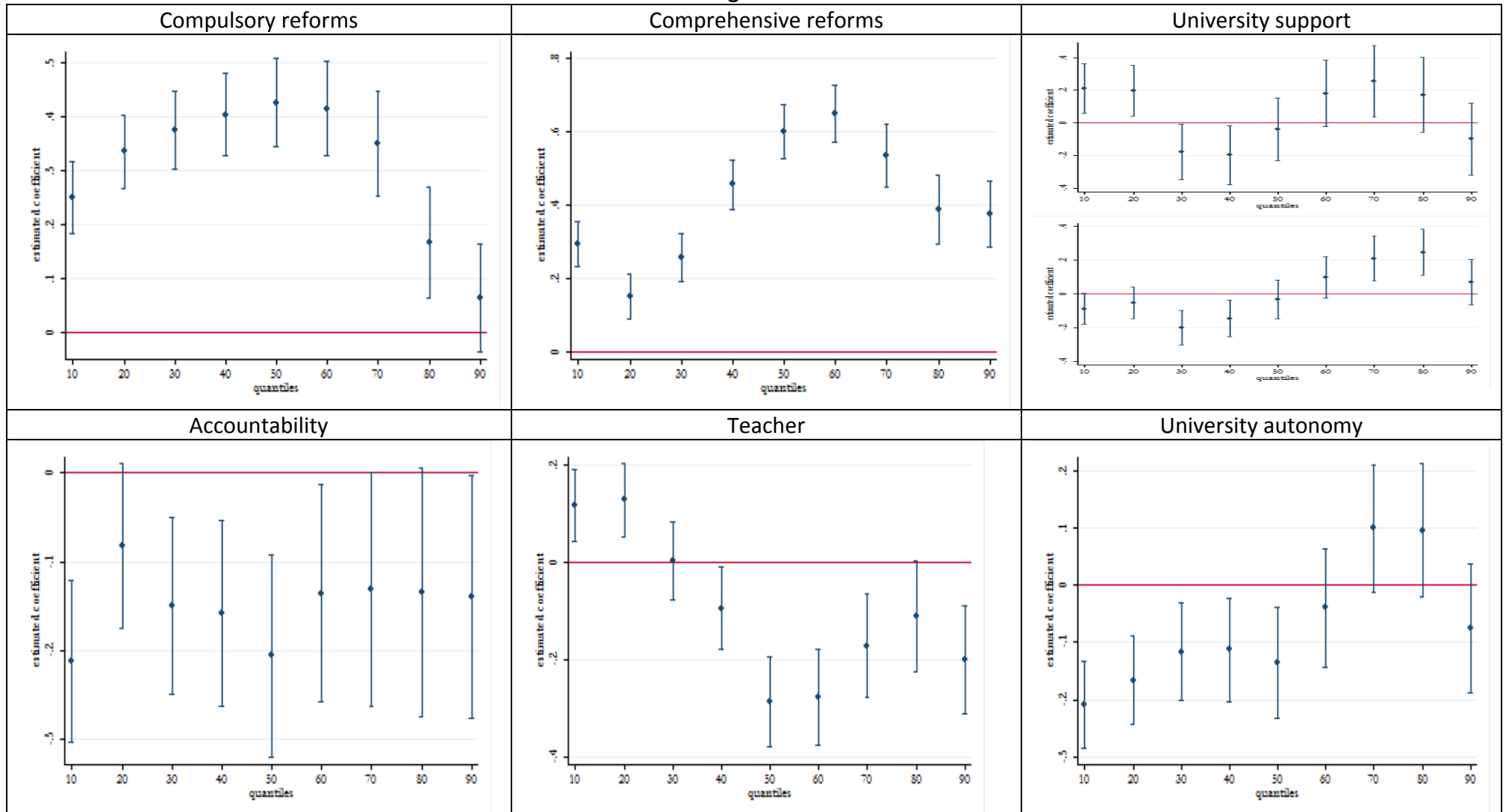
4.4 Educational reforms and political orientation

Educational reforms can be considered as structural reforms, which require a sufficiently long period 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. However, political parties have different opinions with respect to what is the appropriate skill composition in the domestic labour force, as well as about the desirable degree of social differentiation.

We deem plausible to assume that parties with a left-wing orientation are strongly supportive 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 tend to oppose any generalised expansion of schooling, for at least two reasons: on one side educational activities are highly labour-intensive, and therefore they induce expansion in public expenditure; on the other side, they raise people expectations in terms of future life-time income, which may translate in higher wage pressure and rigidities.

Following this line of argument, we have then analysed the correlation between our measures of reforms and political orientation of (democratically elected) governments in the countries we have considered so far.

Data on policy orientation of political parties elected in parliament and selected cabinets are taken from ParlGov database (Döring and Manow 2010). A less detailed source of data is from Woldendorp, Keman and Budge (2000).

Table 9: Political variables – descriptive statistics

	Mean	Std. Dev. (overall)	Std. Dev. (between)	Std. Dev. (within)	Min	Max	Obs.	N. of countries
right-wing orientation of the government (Döring and Manow 2010)	5.119	1.506	0.775	1.308	0	8.154	928	24
right-wing orientation of the parliament (Döring and Manow 2010)	5.095	0.756	0.648	0.558	0	7.194	928	24
cabinet support in the parliament (Döring and Manow 2010)	0.562	0.124	0.07	0.097	0.123	1	928	24
political complexion of parliament and government (Woldendorp, Keman and Budge 2000 – rank-reversed for comparability)	5.8	1.895	1.069	1.666	2	10	940	24
Log of PPP Converted GDP Per Capita at 2005 constant prices (Penn World Tables v.7.00)	9.604	0.5	0.33	0.411	7.869	10.71	963	24
Government Consumption Share of PPP Converted GDP Per Capita at 2005 constant prices (Penn World Tables v.7.00)	0.103	0.028	0.028	0.011	0.027	0.21	963	24

Table 10: Political variables – correlations

	right-wing government	right-wing parliament	cabinet support	political complexion	log gdp per capita	government share
right-wing orientation of the government	1					
right-wing orientation of the parliament	0.6440*	1				
cabinet support in the parliament	-0.0322	-0.0755*	1			
political complexion of parliament and government	0.7255*	0.3973*	-0.1316*	1		
log gdp per capita	-0.0225	0.1669*	-0.1020*	-0.1587*	1	
government share	0.0845*	-0.0275	0.2454*	0.0627	0.2346*	1

Note: * indicates statistically significant at 5%

Figure 6: Ideological orientation of governments

Our dependent variables are the factors extracted from single reform variables in the previous section. By construction, these variables have zero mean and unitary standard deviation over the entire sample, but country means may be different from zero

$$R_{ct} = \eta + \varphi \cdot W_{ct} + \zeta \cdot Z_{ct} + \delta_c + \delta_t + \tau \cdot \delta_c + \varepsilon_{ct} \qquad (4)$$

where c and t denote country and year respectively, R_{ct} is our outcome of interest (the factor extracted from the reform variables), W_{ct} is the political orientation of either the cabinet or the parliament in office, Z_{ct} are potentially confounding factors controlling against the risk of spurious correlation (GDP per capita at PPP US 2005 dollars, share of public expenditure on GDP), δ_c and δ_t are country and year fixed effects and $\tau \cdot \delta_c$ is a country specific time trend. Finally ε_{ct} is the stochastic error term. Equation (4) is estimated using OLS and robust correction for heteroscedasticity.

From this table we observe that educational reforms that we classified as *inclusive* (since they increase the mean educational attainment and reduce its dispersion, thus raising the bottom tail of the years of education distribution) are negatively correlated with a right wing attitude of parliaments. This is mostly true for the *compulsory* factor and, at a lesser extent for the *comprehensive* factor, while the association with the factors correlated to financing college attendance is positive.

On the contrary, *selective/restrictive* policies exhibit positive correlation with right-wing parliaments (all but the *accountability* factor). This is mostly clearly visible once we consider the partition of reform variables in two groups, where two latent factors are extracted (columns 5 and 9). In this case it is clear that political orientation of the parliament matters for the type of educational policies introduced. The other regressors suggest that inclusive educational are more likely in richer countries/periods, given the

positive association per-capita income, while public expenditure in value added seems to favour reforms.

The parliament ideological orientation displays the strongest correlation with reform activity in the educational field. When we consider the cabinet orientation, we do find much weaker correlations.

Policy orientation of the cabinet and policy complexion behave in similar ways, despite the former being slightly more statistically correlated with reform factors.

Finally, we do not find a stable pattern of government strength in parliament, especially when we control for confounding factors.

Table 11: Educational reform and political variables – OLS – 1950-2000

	1 compulsory	2 comprehensive	3 support 1	4 support 2	5 Inclusive	6 accountability	7 teacher	8 uniautonomy	9 selective
right-wing orientation of parliament	-0.186	-0.05	0.057	0.11	-0.091	0.066	0.074	0.125	0.105
	[5.39]***	[1.15]	[2.08]**	[2.17]**	[3.10]***	[1.20]	[1.76]*	[2.79]***	[3.00]***
log gdp per capita	0.771	1.818	-2.209	-1.222	0.526	-0.616	0.784	-1.843	-1.135
	[2.74]***	[6.74]***	[9.90]***	[3.21]***	[2.73]***	[1.44]	[2.58]**	[4.34]***	[3.50]***
government share	-10.392	22.31	-6.225	18.591	5.905	0.568	6.496	5.51	5.299
	[3.78]***	[10.53]***	[4.51]***	[7.43]***	[4.06]***	[0.18]	[2.72]***	[2.24]**	[2.85]***
Observations	843	843	770	770	770	843	843	781	781
R²	0.858	0.909	0.941	0.888	0.933	0.871	0.879	0.86	0.913
Countries	24	24	17	17	17	24	24	18	18

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

5. Conclusions

In the present paper we have shown that reforming the educational systems induces variation in the educational investment on the corresponding populations.

By collecting detailed information on different dimensions of the institutional design (from compulsoriness to tracking, from accountability to selectivity, from financial support to autonomy) we have exploited cross-country and temporal variations to assess their causal impact on the (average) educational attainment of the populations affected.

We have paid attention to the distributional aspects of the reforms, since each reform is affecting costs and/or benefits which are heterogeneous in the population, given unobservable ability and difference in parental background.

Combining the results obtained about the reforms' impacts on mean achievement as well as on educational inequality, we have proposed a classification of the reforms along two dimensions, identifying two main groups: *inclusive* and *selective reforms* (the *restrictive* being a subgroup of the latter).

The robustness and usefulness of this classification is then checked by aggregating single reforms in synthetic indices and studying their impact on mean and dispersion of educational attainment.

These reforms were introduced as output of parliamentary activity. We find that *inclusive policies* were favoured by left-wing parliament, while *selective policies* were promoted in more conservative parliaments.

With all possible caveats about conducting this exercise, we believe that our result bring in a clear message: despite market incentives (which we do not explicitly model in this paper, leaving to fixed effects to take care of) in educational investments, schooling can be affected by policy makers, who may alter both the level and the distribution. This fall-back both on the economy, via the impact of human capital accumulation on growth, and on the society, via the impact on political participation and social cohesion. This is our program for future research.

REFORM	SOURCES
Pre - primary expansion	- Eurydice: National Education System Descriptions (Section 3) - Garrouste (2010)
Duration compulsory education	- Eurydice: National Education System Descriptions (Section 2,4,5) - Garrouste (2010) - Brunello, Fort and Weber (2009)
Entry age	- Eurydice: National Education System Descriptions (Section 2,3,4) - Garrouste (2010) - Brunello, Fort and Weber (2009)
Leaving age	- Eurydice: National Education System Descriptions (Section 2,4,5) - Garrouste (2010) - Brunello, Fort and Weber (2009)
Tracking age	- Eurydice: National Education System Descriptions (Section 2,4,5) - Garrouste (2010)
Increase grant size, Interest rate	- Eurydice (2000) "Two Decades of Reform in Higher Education in Europe: 1980 Onwards"
Teacher qualification (primary and secondary school)	- Eurydice: National Education System Descriptions (Section 8)
School evaluation	- Eurydice: National Education System Descriptions (Section 9) - Eurydice (2004): "Evaluation of Schools Providing Compulsory Education In Europe" thematic study
Standardised test	- Eurydice (2009): "National Testing of Pupils in Europe: Objectives, Organisation and Use of Results"
Expansion of university access	- Eurydice: National Education System Descriptions (Section 6) -Garrouste (2010) - Eurydice (1999): "Key Topics in Education, Volume 1, Financial Support for Students in Higher Education in Europe" - Eurydice (2000) "Two Decades of Reform in Higher Education in Europe: 1980 Onwards"
Selectivity in university access	- Eurydice (1999): "Key Topics in Education, Volume 1, Financial Support for Students in Higher Education in Europe"
School autonomy	- Eurydice (2008) "School Autonomy in Europe Policies and Measures"
Teacher autonomy	- Eurydice (2008) "Levels of Autonomy and Responsibilities of Teachers in Europe"
Index of university autonomy	- Eurydice (2000) "Two Decades of Reform in Higher Education in Europe: 1980 Onwards" (p. 91)