The long term evolution of inequality of opportunity

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Motivation

Top incomes are rising in income share.
Middle classes are shrinking.
Income inequality is stable or rising.

Lack of better prospects undermines the social pact (willingness to contribute to public insurance and redistribution).
Increasing dissatisfaction opens the door to populistic solutions.

How are young generations reacting to such environment ?
Are they experiencing worsening prospects vis a vis older generations ?

This paper uses a parametric approach to measure inequality of opportunities in five European countries (Italy, Germany, France, Great Britain and Switzerland) over a long time span.

It builds a simple theoretical model offering predictions on the changes of inequality of opportunity, which is expected to decline with

$\rightarrow$ the decline in intergenerational persistence in education,

$\rightarrow$ the decline in the labour market return to education

$\rightarrow$ the decline in the networking activity associated to parental background.

Time trends show that the role of circumstances (parental background, gender age and place of birth) in shaping income distribution has declined over the last two decades in all countries considered.

Inequality of opportunity exhibits an inverted U-shaped pattern over the life cycle. Most recent age cohorts have experienced a lower inequality of opportunity.

Inequality of opportunity - basic notions

Main assumption: the outcome (income, education, etc) depends on circumstances (lack of responsibility) and effort (full responsibility).

Two principles:
⇨ compensation (differences in output due to circumstances should disappear)
⇨ reward (difference in output due to effort should not be discussed)

We follow the ex-ante compensation approach.

Problems with this literature:
⇨ additional dimensions matter in output production (ability, luck, …)
⇨ circumstances and effort must be additively separable

Prevailing static approach.

This paper instead is concerned with the evolution of inequality of opportunity.

There are three different ways one can analyse the evolution of inequality of opportunity, which correspond to three different concepts of inequality dynamics:
(i) inequality measured across repeated snapshots of the population (repeated cross-sectional analysis);
(ii) inequality measured along life courses (longitudinal analysis);
(iii) inequality measured across generations (cohort analysis).

Measuring IOp

Consider a distribution of income Y in a given population. Suppose that all determinants of Y including the different forms of luck, can be classified into either a set of circumstances C that lie beyond individual responsibility, belonging to a finite set Ω, or as responsibility characteristics, summarized by a variable e, denoting effort, belonging to the set Θ.

The outcome of interest is generated by a function $g: \Omega \times \Theta \rightarrow \mathbb{R}$ such that:

$$Y = g(C, e)$$

A parametric implementation of the model above, which has been extensively used in the literature (see Bourguignon et al. 2007) considers estimating by OLS the following equation

$$Y_i = a + bC_i + \epsilon_i$$

and computes inequality of opportunity as the value of a given inequality measure $I(\hat{Y}_i)$ where $\hat{Y}_i = \hat{a} + \hat{b}C_i$

Hence the value of absolute inequality of opportunity is given by $I(\hat{Y})$ while the value of relative inequality of opportunity is given by $I(\hat{Y})/I(Y)$.

If the number of cross-sections available for the same country is large enough, and their time span covers a sufficient number of years, one could interpret them as pseudo-panel. In such a case the relevant model becomes

$$Y_{i\tau t} = a_{t\tau} + b_{t\tau} C_{i\tau t} + \epsilon_{i\tau t}$$

where $Y_{i\tau t}$ is the income of individual i born in year τ and sampled in survey t. In such a case EOp can be repeatedly measured along three dimensions:

1) in a specific year of survey t, repeated observations refer to different birth cohorts τ's;
2) for a specific birth cohort τ,repeated observations refer to different dates of survey t's;
3) for a specific age cohort $(t - \tau)$ repeated observations refer to different point over a life cycle.

The model

In the sequel we aim to decompose measured inequality of opportunities into its constituting components, in the same vein of what Solon (2004) did for intergenerational mobility of incomes.

Let us consider circumstances as consisting of a single variable, parental education, indicated with $E_{\theta-1}$ where θ denote generations.

We assume that parental background affect the income opportunity of the child through two main channels: *educational investment* and *family networking*.

$$E_{i\theta} = \delta + \eta E_{i\theta-1} + \epsilon_{i\theta}$$

where E_{it} is the education of the child, E_{it-1} is the education of the parents, η is is a measure of intergenerational persistence and ϵ captures any unobservable component (like ability as well as effort).

This intergenerational correlation can be justified on various grounds:

* *cultural dependency*
* *financial resources*
* *teaching practices*

$$\log(Y_{i\theta}) = \alpha + \beta E_{i\theta} + \omega_{i\theta}$$

where Y_{it} is the income of the child, β is the standard return to education and ω is a random error (capturing unobservable components – ability, effort – but also unpredictable components – luck).

If we consider that parents may possess other channels of influencing children outcomes, we may consider an *extended mincerian equation* like the following

$$\log(Y_{i\theta}) = \alpha + \beta E_{i\theta} + \gamma E_{i\theta-1} + \omega_{i\theta}$$

The inclusion of parental education can be justified as proxy for family networking in non-competitive labour markets, where connections referral matter to obtain good jobs.

$$\log(Y_{i\theta}) = y_{i\theta} = [\alpha + \delta\beta] + [\gamma + \eta\beta]E_{i\theta-1} + [\omega_{i\theta} + \beta\epsilon_{i\theta}]$$

If we now denote with $I(\cdot)$ any inequality measure, we get

$$I(y_\theta) = I([\alpha + \delta\beta] + [\gamma + \eta\beta]E_{\theta-1} + [\omega_\theta + \beta\epsilon_\theta])$$

where we can notice that income inequality will be function of the distribution of parental education (circumstances) and unobservable components (effort, ability and/or luck), as well as of the structural parameters of the income generating process.

For consistency with most of the literature on earnings inequality, we have chosen the *standard deviation of logs* as our inequality indicator. In such a case (assuming zero correlation between parental education and unobservable shocks in the current generation)

$$sd(y_\theta) = \sqrt{var(y_t) =}$$

$$= \sqrt{(\gamma + \eta\beta)^2 var(E_{\theta-1}) + var(\omega_\theta) + \beta^2 var(\epsilon_\theta) + 2\beta cov(\omega_\theta, \epsilon_\theta)}$$

In the present case, the income attributable to circumstances is given by the predicted values

$$\hat{y}_{i\theta} = (\hat{\alpha} + \hat{\delta}\hat{\beta}) + \left(\hat{\gamma} + \hat{\eta}\hat{\beta}\right) E_{i\theta-1}$$

The relative IOp is given by the following equation:

$$IOp = \frac{\sqrt{var(\hat{y})}}{\sqrt{var(y)}} = \frac{(\hat{\gamma}+\hat{\eta}\hat{\beta})\sqrt{var(E_{\theta-1})}}{\sqrt{(\hat{\gamma}+\hat{\eta}\hat{\beta})^2 var(E_{\theta-1})+\hat{\sigma}^2_{\omega_\theta}+\hat{\beta}^2\hat{\sigma}^2_{\epsilon_\theta}+2\hat{\beta}cov(\hat{\omega}_\theta,\hat{\epsilon}_\theta)}} =$$

$$= \frac{(\hat{\gamma}+\hat{\eta}\hat{\beta})}{\sqrt{(\hat{\gamma}+\hat{\eta}\hat{\beta})^2 + \frac{\hat{\sigma}^2_{\omega_\theta}+\hat{\beta}^2\hat{\sigma}^2_{\epsilon_\theta}+2\hat{\beta}cov(\hat{\omega}_\theta,\hat{\epsilon}_\theta)}{var(E_{\theta-1})}}}$$

Other things constant IOp declines when:

① there is a reduction in the intergenerational persistence of education $\hat{\eta}$

② there is a reduction in the (private) return to education $\hat{\beta}$

③ there is a reduction in the effect of family network in the labour market $\hat{\gamma}$

④ there is an increase in the variance and covariance of the non-observable components $\hat{\omega}$ e $\hat{\epsilon}$ for the current generations

⑤ there is a reduction in the variance of the educational attainment of the previous generation $var(E_{\theta-1})$.

The same approach can be used to study other attributes that may be responsible for inequality of opportunities. As a final example, consider the impact of gender: women are better achievers in schooling, but they are discriminated against in the labour market.

$$E_{i\theta} = \delta\phi_i + \eta E_{i\theta-1} + \epsilon_{i\theta}$$
$$\log(Y_{i\theta}) = \alpha\phi_i + \beta E_{i\theta} + \gamma E_{i\theta-1} + \omega_{i\theta}$$

where now ϕ_i is a dummy variable for women, δ is the mean school gap achieved by women and α is the gender wage gap.

Since $var(\phi) = \lambda(1-\lambda)$, where λ is the fraction of women in the working population, then we get that relative inequality of opportunity now reads

$$IOp = \frac{\sqrt{var(\hat{y})}}{\sqrt{var(y)}}$$

$$= \frac{\left(\hat{\alpha} + \hat{\delta}\hat{\beta}\right)\sqrt{\left(\lambda(1-\lambda)\right)} + \left(\hat{\gamma} + \hat{\eta}\hat{\beta}\right)\sqrt{var(E_{\theta-1})}}{\sqrt{\left(\hat{\alpha} + \hat{\delta}\hat{\beta}\right)^2\left(\lambda(1-\lambda)\right) + \left(\hat{\gamma} + \hat{\eta}\hat{\beta}\right)^2 var(E_{\theta-1}) + \hat{\sigma}^2_{\omega_\theta} + \hat{\beta}^2\hat{\sigma}^2_{\epsilon_\theta} + 2\hat{\beta}cov(\hat{\omega}_\theta, \hat{\epsilon}_\theta)}}$$

Now inequality of opportunity will also depends on whether the schooling advantage $\delta\beta$ for women exceeds (or falls short of) the labour market disadvantage α, as well as from the gender composition of the labour force.

The data

Data requirements are rather demanding:
a) adequate information on circumstances (in addition to gender and age, some information on parental background and country of origin).
b) a measure of disposable income that is comparable across surveys and across countries.
c) a sufficiently extended time coverage in order to capture meaningful dynamics and/or to apply birth/age cohort decomposition,

The surveys we have used are the following:

Italy: Survey on Household Incomes and Wealth (SHIW), collected by the Bank of Italy – 11 surveys, covering the period 1993-2014 (information on parental background is not available before the starting date – originally consisting of 112690 individuals, which reduces to 107846 when considering non-missing information.

Germany: German Socio-economic Panel (SOEP) – 11 surveys, covering the period 1984-2013 – originally including 156338 individuals, then reduced to 133467 in case of non-missing one.

France: Household Budget Survey (HBS), conducted by the Banque de France) – 6 surveys, covering the period 1978-2005 – originally consisting of 97306 individuals, declining to 89119 when missing information is excluded

Switzerland: Swiss Household Panel (SHP) – 6 surveys, covering the period 1999-2014 – originally consisting of 43102 individuals, which then decline to 31273 valid observations

United Kingdom: starts as British Household Panel (BHPS), replaced after 2009 by the Understanding Society-Household Longitudinal Survey (UKHLS) – considers 24 waves over the period 1991-2014 – originally consisting of 434253 individuals, which then decline to 308625 valid observations.

Our selection rules include individuals aged 25-80 with a positive disposable income, harmonized according to the LIS procedure (variable DPI). Incomes are converted to constant prices using the national consumer price index.

Parental education is typically a categorical variable recording the highest educational attainment in the parental couple. In order to estimate a unique coefficient associated to the intergenerational transmission of education, we have converted them into years of education. Descriptive statistics in the Appendix.

Using these data, we have estimated total inequality, absolute inequality of opportunity (namely inequality computed over incomes predicted according to circumstances) and relative inequality of opportunity.

One can notice that country samples are rather consistent, according to the impact exerted by the regressors.

Estimation of relevant equations, by country full sample

	Italy			Germany			France			Great Britain			Switzerland		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
dep.variable	years of education	log personal disposable income	log personal disposable income	years of education	log personal disposable income	log personal disposable income	years of education	log personal disposable income	log personal disposable income	years of education	log personal disposable income	log personal disposable income	years of education	log personal disposable income	log personal disposable income
female	-0.664***	-0.785***	-0.834***	-0.860***	-0.928***	-0.989***	-0.509***	-0.779***	-0.807***	-0.042***	-0.537***	-0.542***	-0.930***	-0.650***	-0.738***
	[0.027]	[0.008]	[0.008]	[0.022]	[0.007]	[0.008]	[0.033]	[0.007]	[0.007]	[0.005]	[0.004]	[0.004]	[0.028]	[0.015]	[0.015]
age	-0.089***	0.029***	0.034***	-0.019***	0.012***	0.015***	-0.103***	0.023***	0.020***	-0.022***	0.021***	0.027***	-0.020***	0.024***	0.026***
	[0.001]	[0.002]	[0.002]	[0.001]	[0.002]	[0.002]	[0.001]	[0.002]	[0.002]	[0.000]	[0.001]	[0.001]	[0.001]	[0.004]	[0.004]
age²		-0.000***	-0.000***		-0.000***	-0.000***		-0.000***	-0.000***		-0.000***	-0.000***		-0.000***	-0.000***
		[0.000]	[0.000]		[0.000]	[0.000]		[0.000]	[0.000]		[0.000]	[0.000]		[0.000]	[0.000]
years of education		0.078***			0.072***			0.054***			0.132***			0.095***	
		[0.001]			[0.001]			[0.001]			[0.002]			[0.004]	
parental education (yrs)	0.460***	0.022***	0.058***	0.667***	0.005**	0.054***	3.953***	0.113***	0.328***	0.114***	0.018***	0.033***	0.325***	0.023***	0.054***
	[0.003]	[0.001]	[0.001]	[0.008]	[0.002]	[0.002]	[0.042]	[0.009]	[0.009]	[0.001]	[0.001]	[0.001]	[0.007]	[0.004]	[0.004]
born in a specific regions	-0.602***	-0.378***	-0.426***	0.666***	-0.184***	-0.136***				-0.026***	0.005	0.001			
	[0.028]	[0.009]	[0.009]	[0.029]	[0.007]	[0.008]				[0.006]	[0.004]	[0.005]			
born abroad	-0.685***	-0.475***	-0.524***	0.375***	-0.253***	-0.227***	-2.199***	-0.105***	-0.225***	0.376***	-0.130***	-0.080***	-0.013	-0.147***	-0.149***
	[0.100]	[0.032]	[0.031]	[0.043]	[0.015]	[0.015]	[0.073]	[0.013]	[0.013]	[0.013]	[0.008]	[0.008]	[0.051]	[0.026]	[0.027]
constant	10.901***	8.052***	8.591***	6.063***	8.574***	8.897***	11.077***	8.922***	9.458***	10.678***	7.157***	8.352***	10.380***	8.874***	9.759***
	[0.075]	[0.067]	[0.068]	[0.092]	[0.055]	[0.056]	[0.070]	[0.039]	[0.040]	[0.023]	[0.033]	[0.029]	[0.103]	[0.110]	[0.103]
Observations	107846	107846	107846	133253	133253	133253	89119	89119	89119	259608	259608	259608	30984	30984	30984
R^2	0.439	0.285	0.239	0.162	0.277	0.244	0.241	0.229	0.175	0.209	0.222	0.199	0.211	0.144	0.119

Robust standard errors in brackets - sample weights - survey dummies included - statistical significance *** p<0.01, ** p<0.05, * p<0.1

Specific regions include South for Italy, East for Germany, England for Great Britain.- parental education for France correspond to high occupations

Education is adequately rewarded in all countries, with an estimated yearly return rate ranging between 5.4% in France and 13.2% in Great Britain.

The intergenerational persistence in education is highest in Italy and Germany and lowest in Great Britain.

There is also general evidence that parental education exerts an impact beyond favouring educational attainment of the next negation.

In all countries women are on average penalized in terms of both schooling and incomes.

Being born in less developed regions (South of Italy, East Germany) or holding a foreign citizenship is associated to lower incomes (but not necessarily lower schooling).

The estimation of the models can be replicated at survey level. However the sample sizes are large enough to allow the estimation at a more disaggregated level. We have partitioned birth years and ages in 5-year intervals and we have retained only cells gathering at least 400 individuals. In each population subgroup we have estimated inequality, inequality of opportunities and other structural parameters.

Estimation by age-cohort subgroups – Italy

number of observations

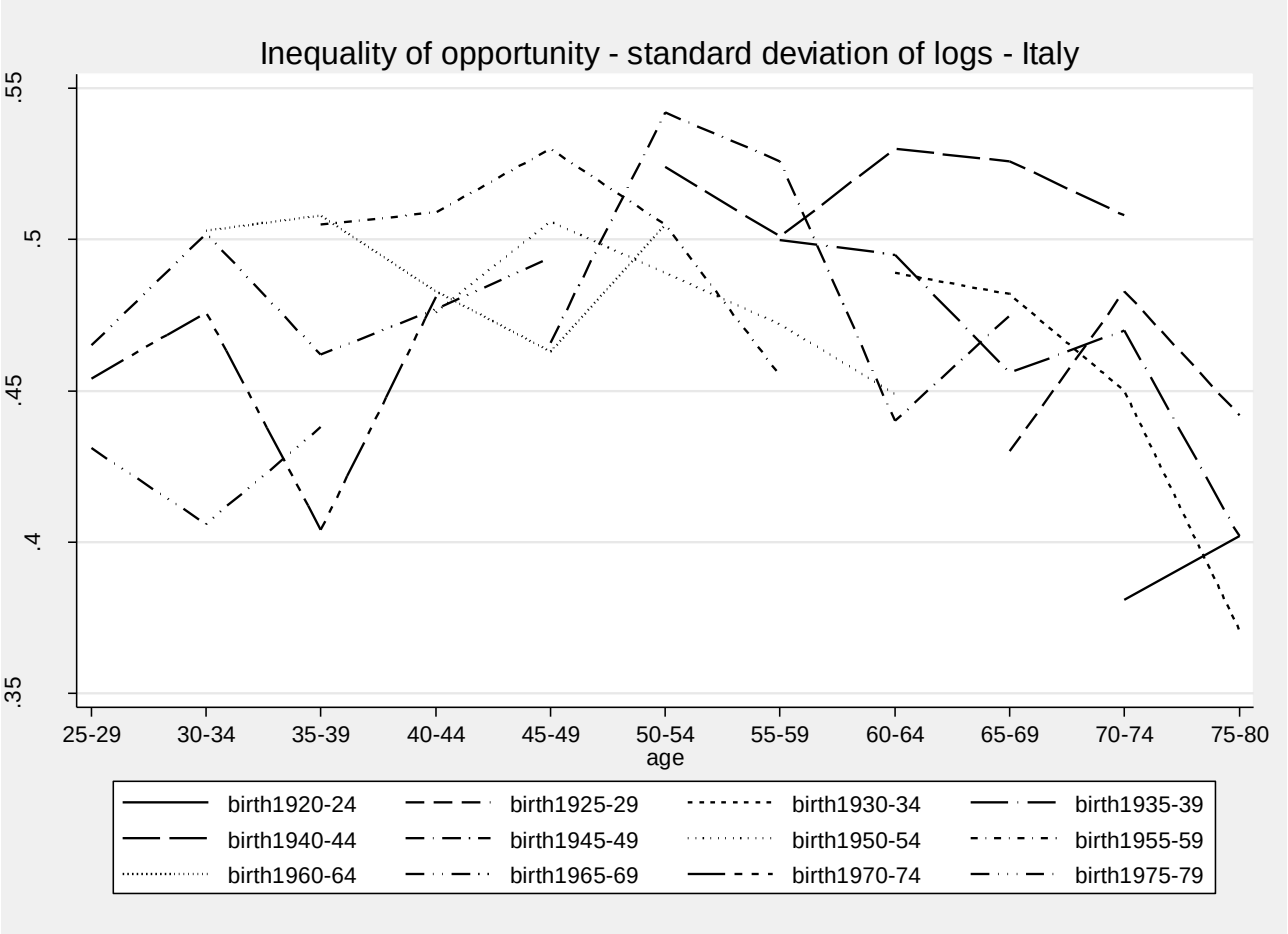
	age groups											
birth cohorts	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-80	Total
(1910-1914)	0	0	0	0	0	0	0	0	0	0	199	199
(1915-1919)	0	0	0	0	0	0	0	0	0	126	772	898
(1920-1924)	0	0	0	0	0	0	0	0	205	1638	1433	3276
(1925-1929)	0	0	0	0	0	0	0	240	2076	1708	1724	5748
(1930-1934)	0	0	0	0	0	0	266	2267	2165	2026	1607	8331
(1935-1939)	0	0	0	0	0	322	2512	2535	2656	1676	1568	11269
(1940-1944)	0	0	0	0	285	2616	2677	2643	1643	1705	0	11569
(1945-1949)	0	0	0	286	2896	3047	3017	1947	1956	0	0	13149
(1950-1954)	0	0	270	2482	3052	3112	1866	2018	0	0	0	12800
(1955-1959)	0	259	2395	2830	2914	1855	1847	0	0	0	0	12100
(1960-1964)	194	2068	2663	2921	1895	2028	0	0	0	0	0	11769
(1965-1969)	1047	1868	2386	1732	1730	0	0	0	0	0	0	8763
(1970-1974)	787	1479	1157	1351	0	0	0	0	0	0	0	4774
(1975-1979)	593	681	872	0	0	0	0	0	0	0	0	2146
(1980-1984)	343	508	0	0	0	0	0	0	0	0	0	851
(1985-1989)	204	0	0	0	0	0	0	0	0	0	0	204
Total	3168	6863	9743	11602	12772	12980	12185	11650	10701	8879	7303	107846

(relative) inequality of opportunity

	age groups										
birth cohorts	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-80
(1915-1919)											0.401
(1920-1924)										0.381	0.402
(1925-1929)									0.43	0.483	0.442
(1930-1934)								0.489	0.482	0.450	0.371
(1935-1939)							0.500	0.495	0.456	0.470	0.402
(1940-1944)						0.524	0.501	0.530	0.526	0.508	
(1945-1949)					0.466	0.542	0.526	0.440	0.475		
(1950-1954)				0.476	0.506	0.489	0.472	0.449			
(1955-1959)			0.505	0.509	0.530	0.505	0.455				
(1960-1964)		0.503	0.508	0.483	0.463	0.505					
(1965-1969)	0.465	0.502	0.462	0.477	0.494						
(1970-1974)	0.454	0.476	0.404	0.481							
(1975-1979)	0.431	0.406	0.438								
(1980-1984)		0.417									

Once we have obtained these measures, if we ask ourselves what is the time pattern of IOp, we can plot these measures by birth cohort. Looking at the graph, one would be tempted to conclude that during the life course IOp exhibits an inverted U-shaped profile, at least in Italy. However we would be confusing two different dimensions, namely age and cohort.

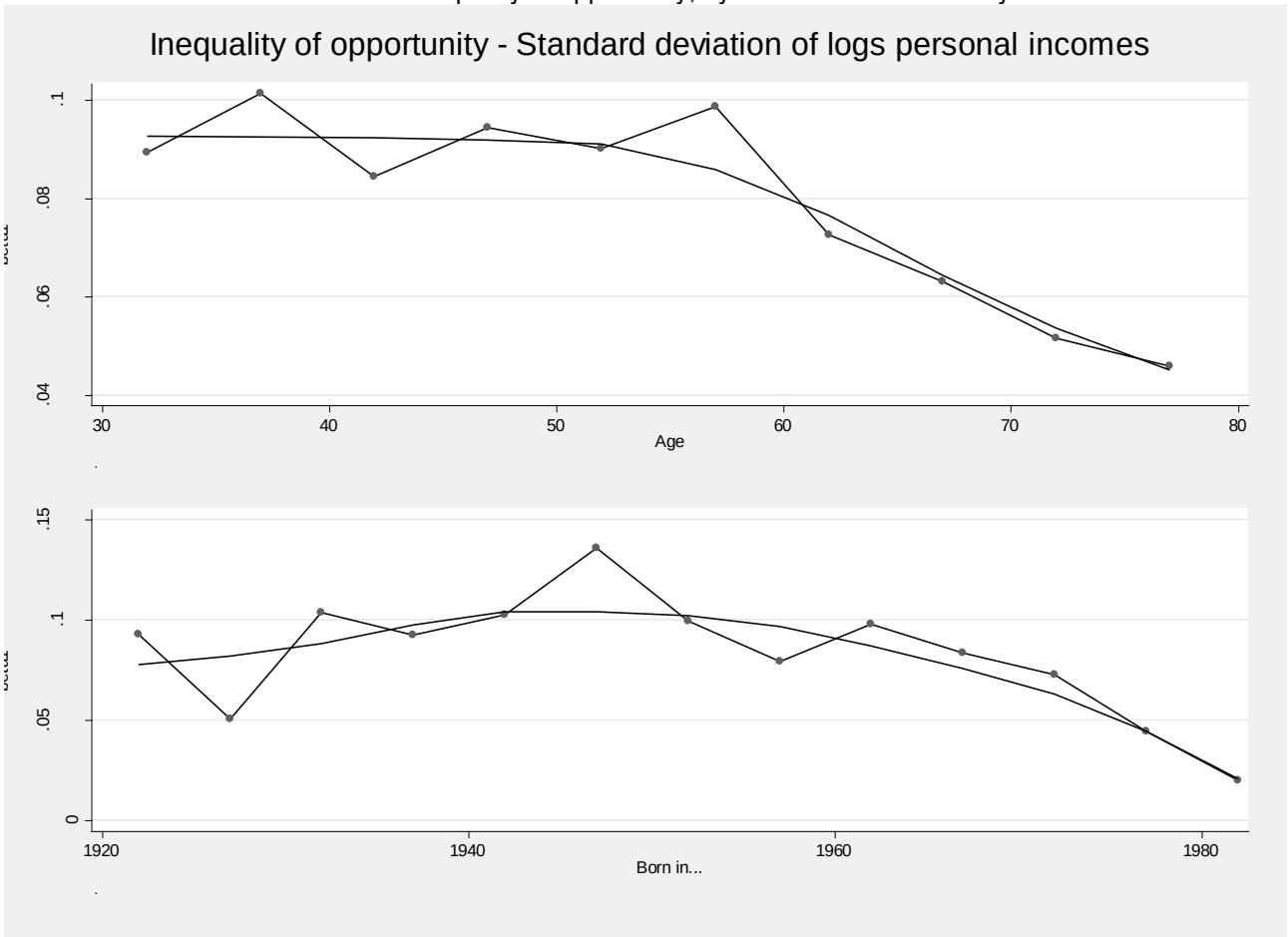
Age profiles for inequality of opportunity, by birth cohorts - Italy



We have then followed Deaton (1997) and we have regressed the obtained measures onto age, cohort and survey dummies, imposing restrictions on the

estimated coefficients for dummies. Results are plotted using a smoothing procedure (the LOWESS command in Stata).

Profiles for inequality of opportunity, by birth and cohorts – Italy



Results

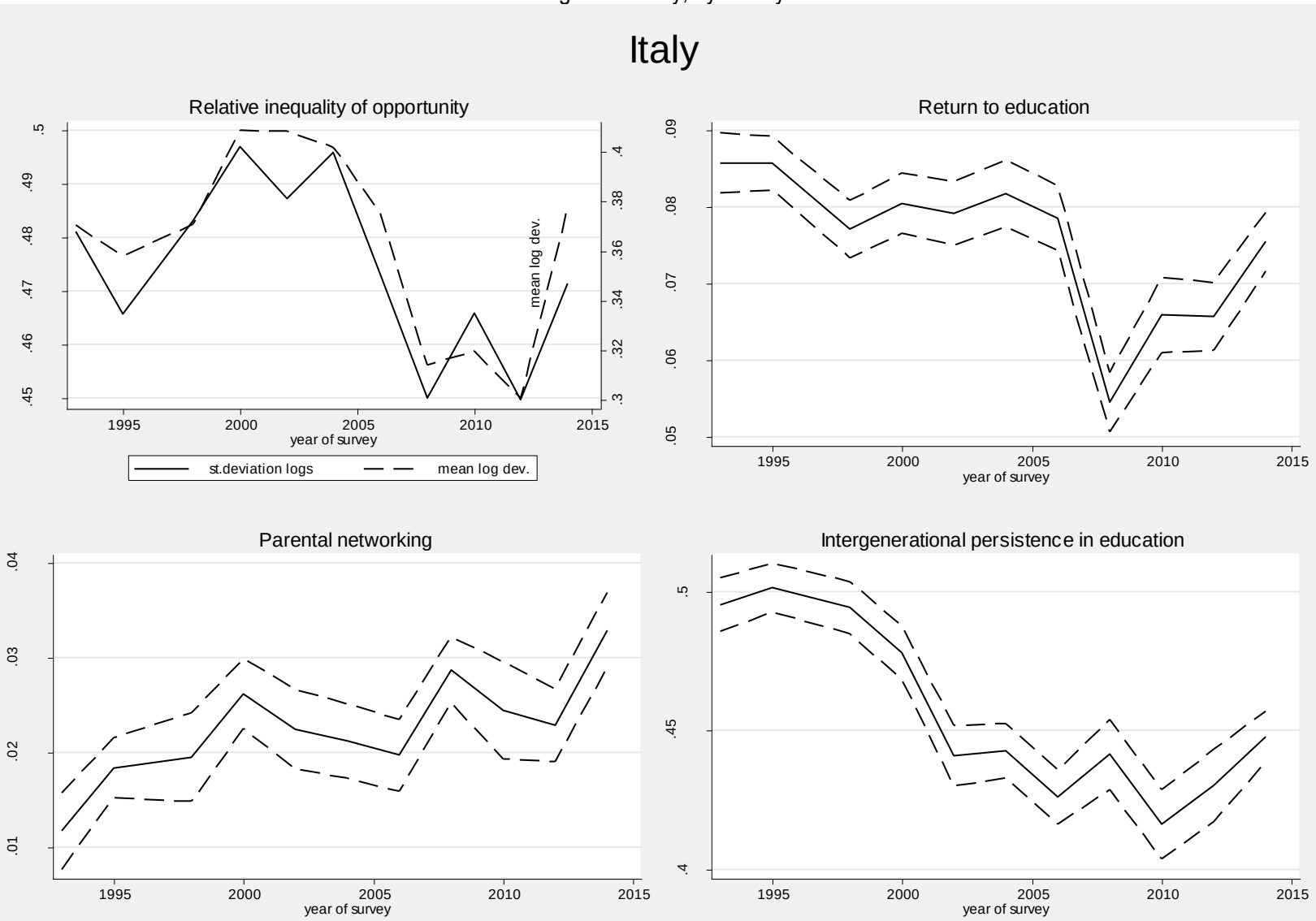
1 Italy

Starting with relative IOp, the analysis by survey shows a clear reduction in relative IOp at the beginning of the 2000's and then a reverse jump at the beginning of the 2010.

Surprisingly, the intergenerational persistence of education shows a clear declining trend.

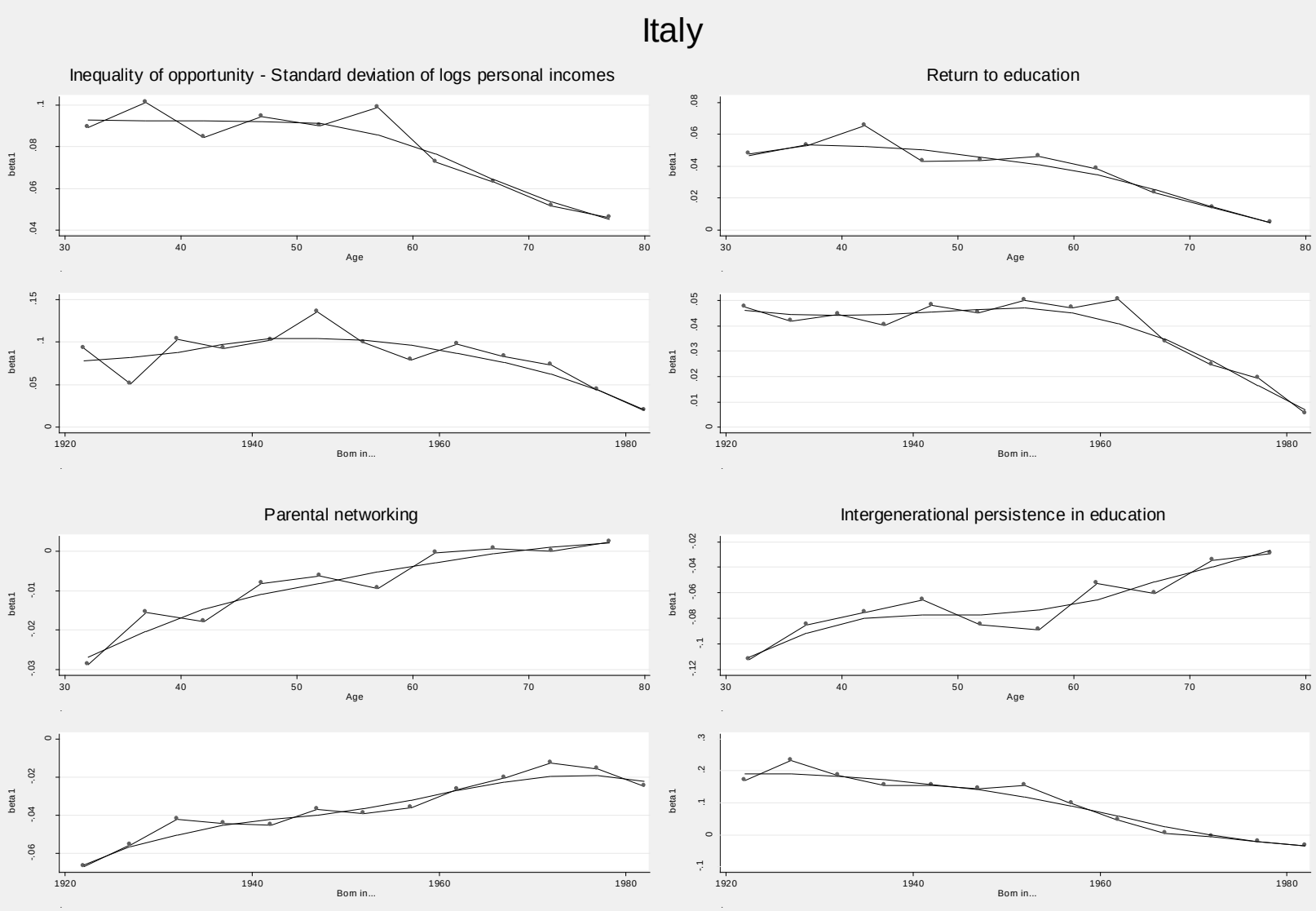
Our interpretation is that the increased equality of educational opportunities (associated to the decrease in intergenerational education persistence) has failed to translate into a decrease of opportunity inequality in income because of the increasing role of parental networking and the reduced "value" of education in the labour market.

Figure 1 – Italy, by survey



Regressors include gender, age, age², born in South Italy and foreign citizenship

Figure 2 – Italy, age-cohort decomposition



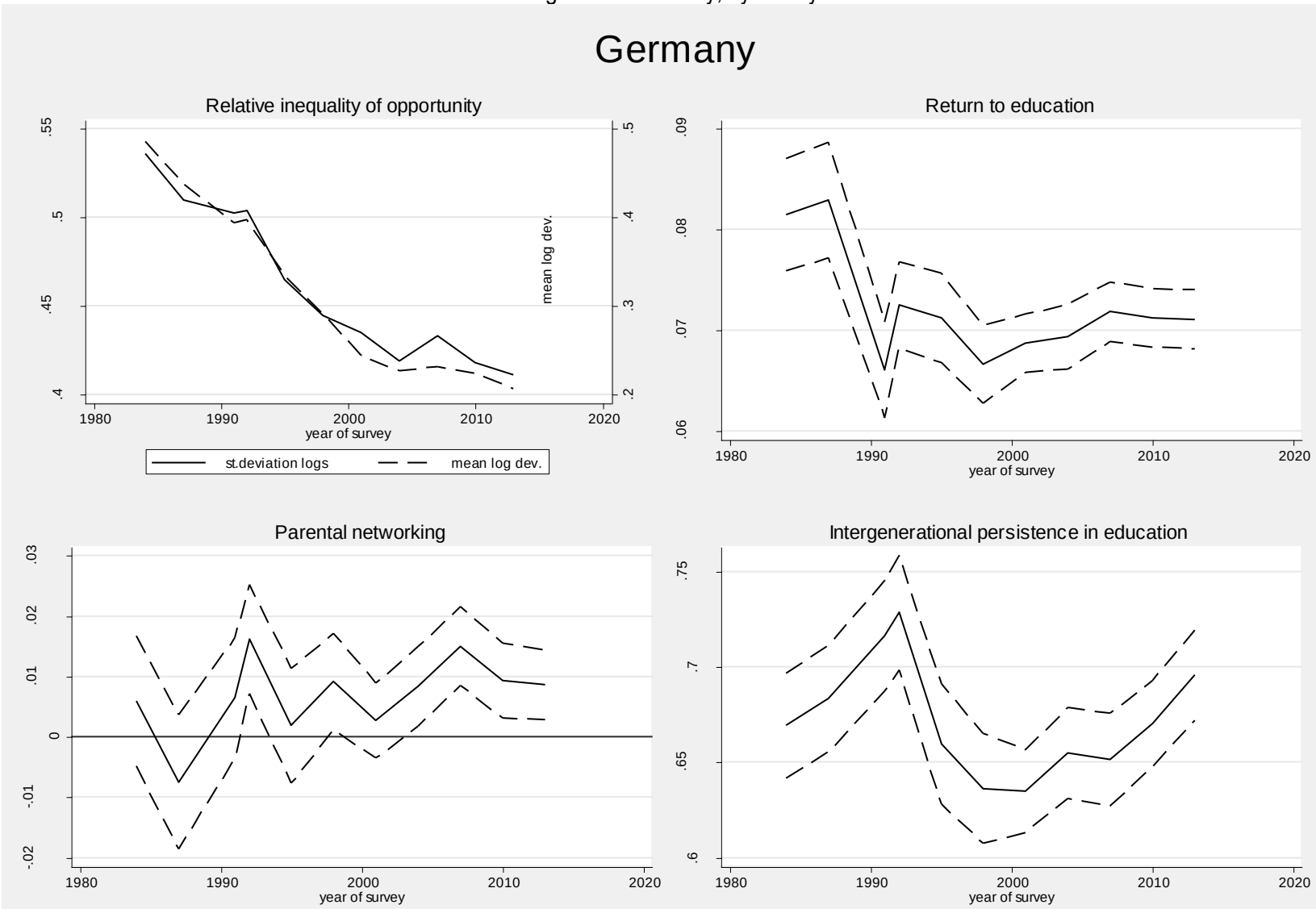
Regressors include gender, age, age², born in South Italy and foreign citizenship - Age and cohort effects obtained from Deaton's decomposition

2 Germany

The analysis by survey shows a clear declining pattern in relative IOp, which takes values between 40% and 55% in case of standard deviation of logs (between 20% and 50% in case of MLD). This is complemented by a fairly constant pattern of intergenerational education persistence and a weakly increasing trend of parental networking (which however is not statistically significant for most of the sample period), while the return to education shows a declining trend in the 80's and then a fairly stable pattern.

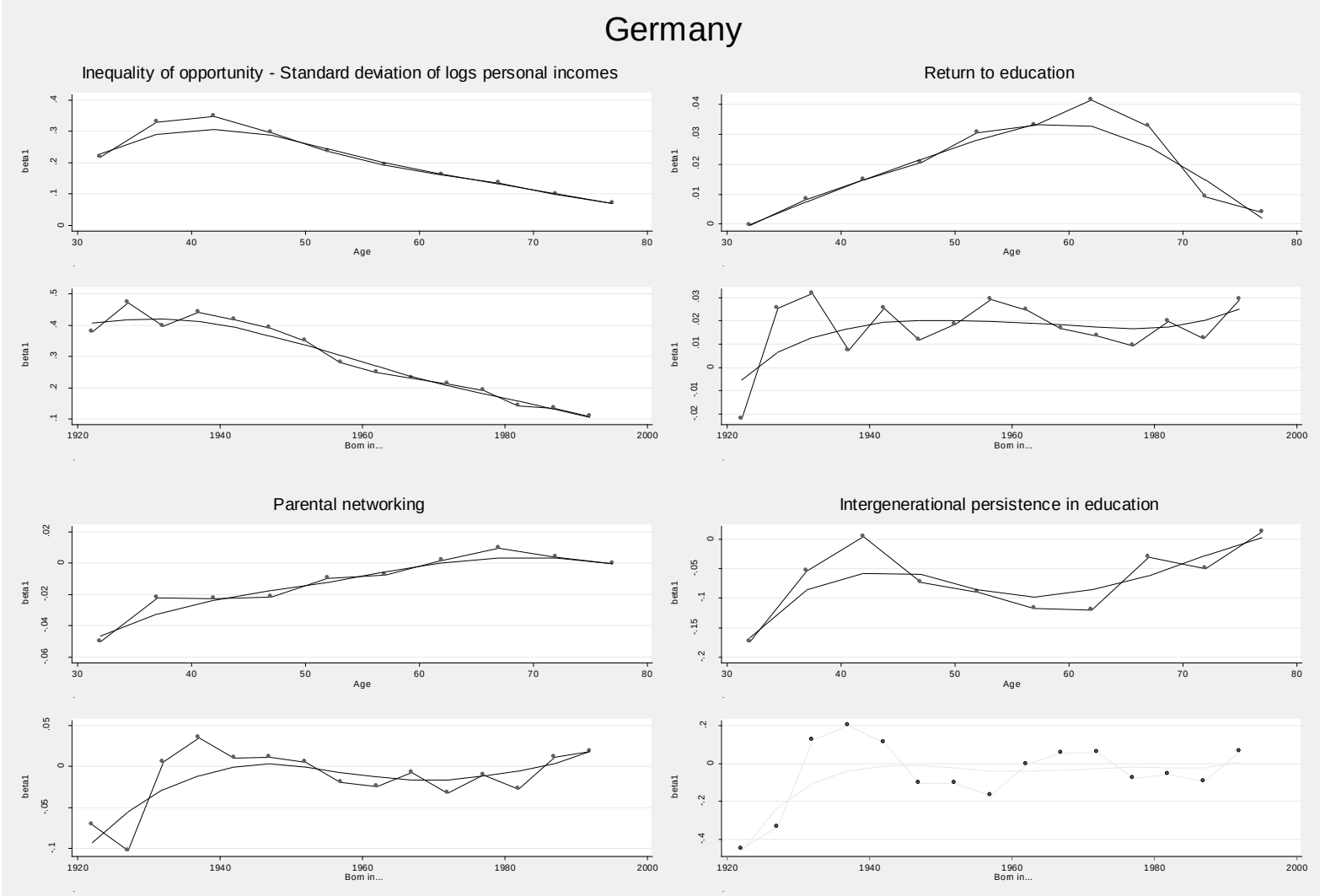
As for the age profiles, results shows a clear declining pattern in the value of relative inequality of opportunity, which is associated with an inverted U-shaped trend of the return to education and a flat pattern of both intergenerational persistence of education and parental networking.

Figure 3 – Germany, by survey



Regressors include gender, age, age², born in East Germany and foreign citizenship

Figure 4 – Germany, age-cohort decomposition



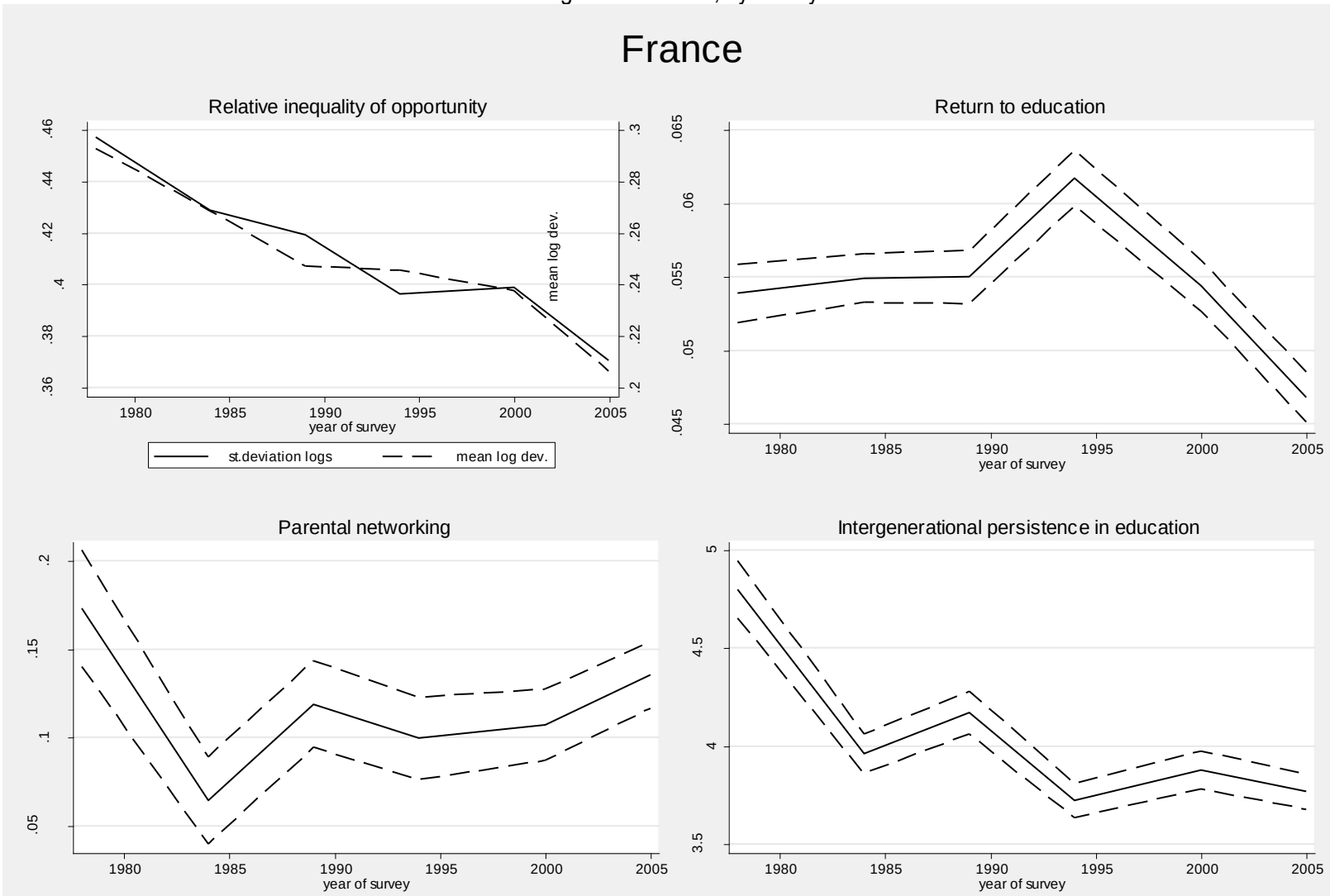
Regressors include gender, age, age², born in East Germany and foreign citizenship - Age and cohort effects obtained from Deaton's decomposition

3 France

The analysis by survey clearly shows a declining pattern in relative IOp, which takes values between 30% and 45% in case of standard deviation of logs (between 20% and 30% in case of MLD). This is complemented by a decreasing trend in the intergenerational education persistence. On the other hand, the parental networking shows a pretty flat picture and the return to education a constant pattern with a decline in the last period (the first half of 2000's). Hence the declining trend of IOp might be mainly driven by the reduction in intergenerational educational persistence.

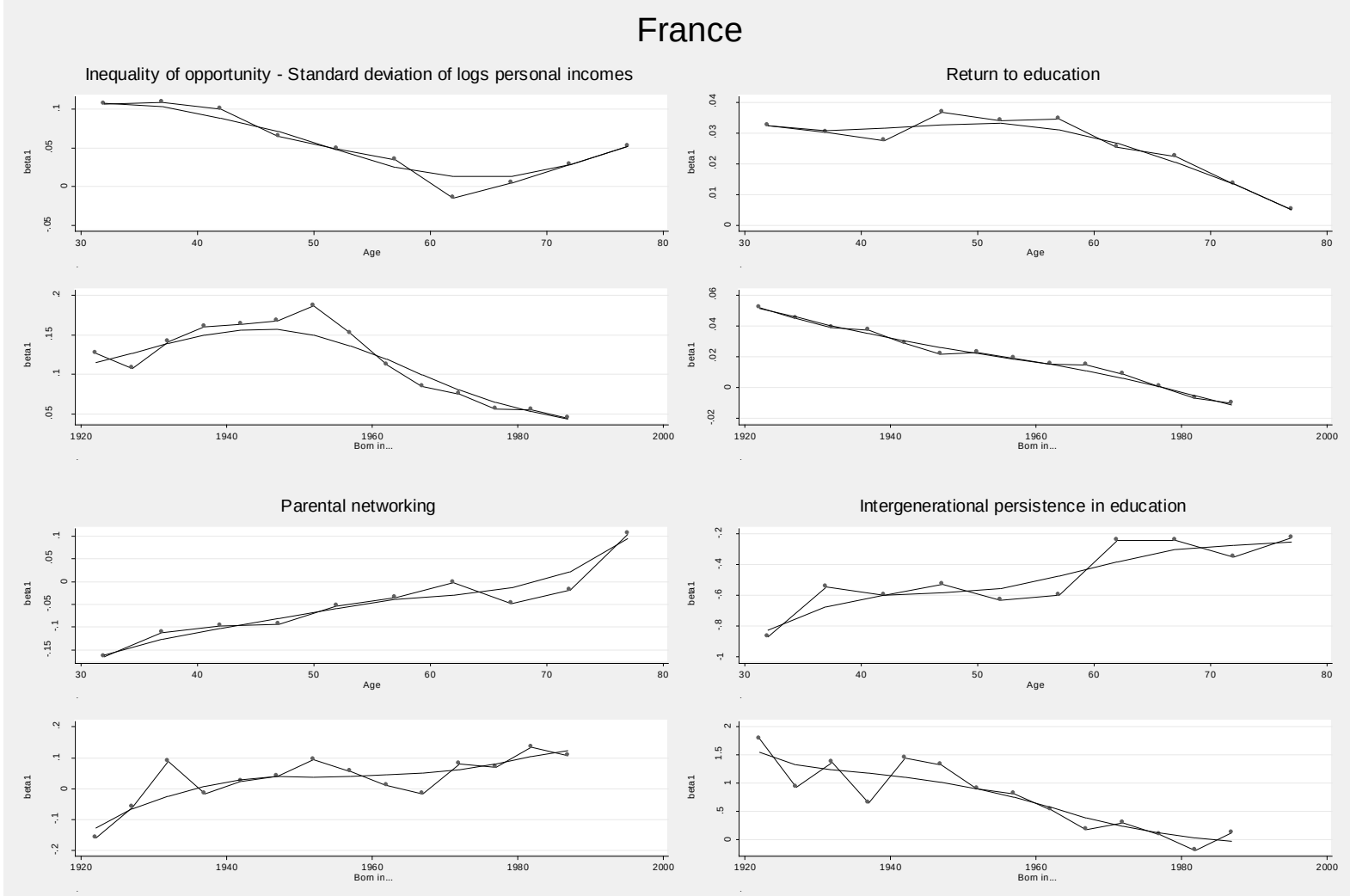
As for the age profiles, our results show a clear declining pattern in the value of relative inequality of opportunity, which is associated with a consistent declining trend in the return to education and a clear increasing trend in both intergenerational persistence and parental networking.

Figure 5 – France, by survey



Regressors include gender, age, age² and foreign citizenship
Parental education is absent and is replaced by dummy indicating middle-high parental occupations

Figure 6 – France, age-cohort decomposition



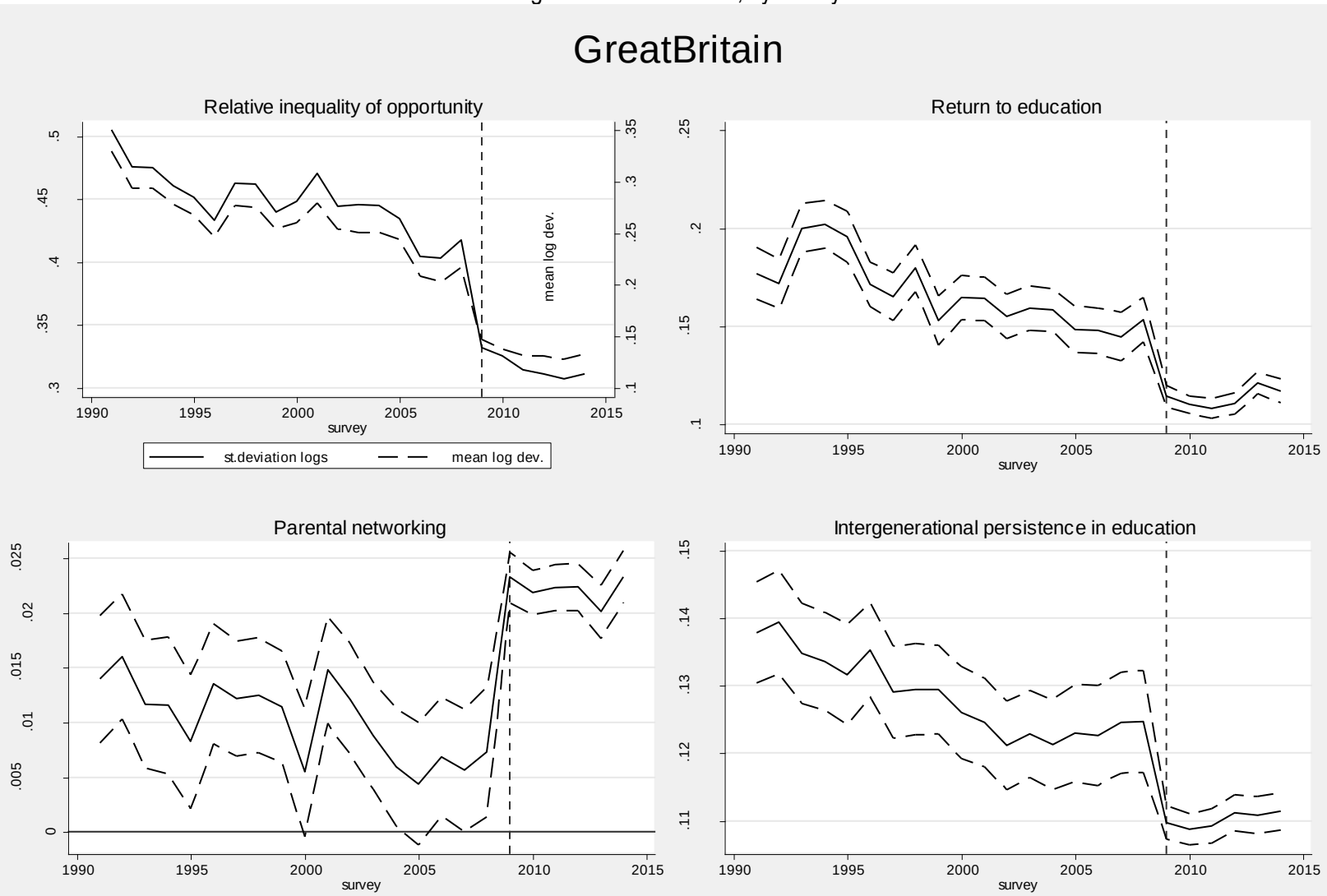
Regressors include gender, age, age² and foreign citizenship - Age and cohort effects obtained from Deaton's decomposition
Parental education is absent and is replaced by dummy indicating middle-high parental occupations

4 United Kingdom.

The analysis by survey shows a declining pattern in relative IOp, which takes values between 30% and 50% in case of standard deviation of log incomes (between 10% and 35% in case of MLD). On the other hand it is observed a stable pattern in parental networking and a weakly declining trend in both intergenerational education persistence and return to education. Hence the declining trend of IOp might be mainly driven by the reduction in intergenerational educational persistence.

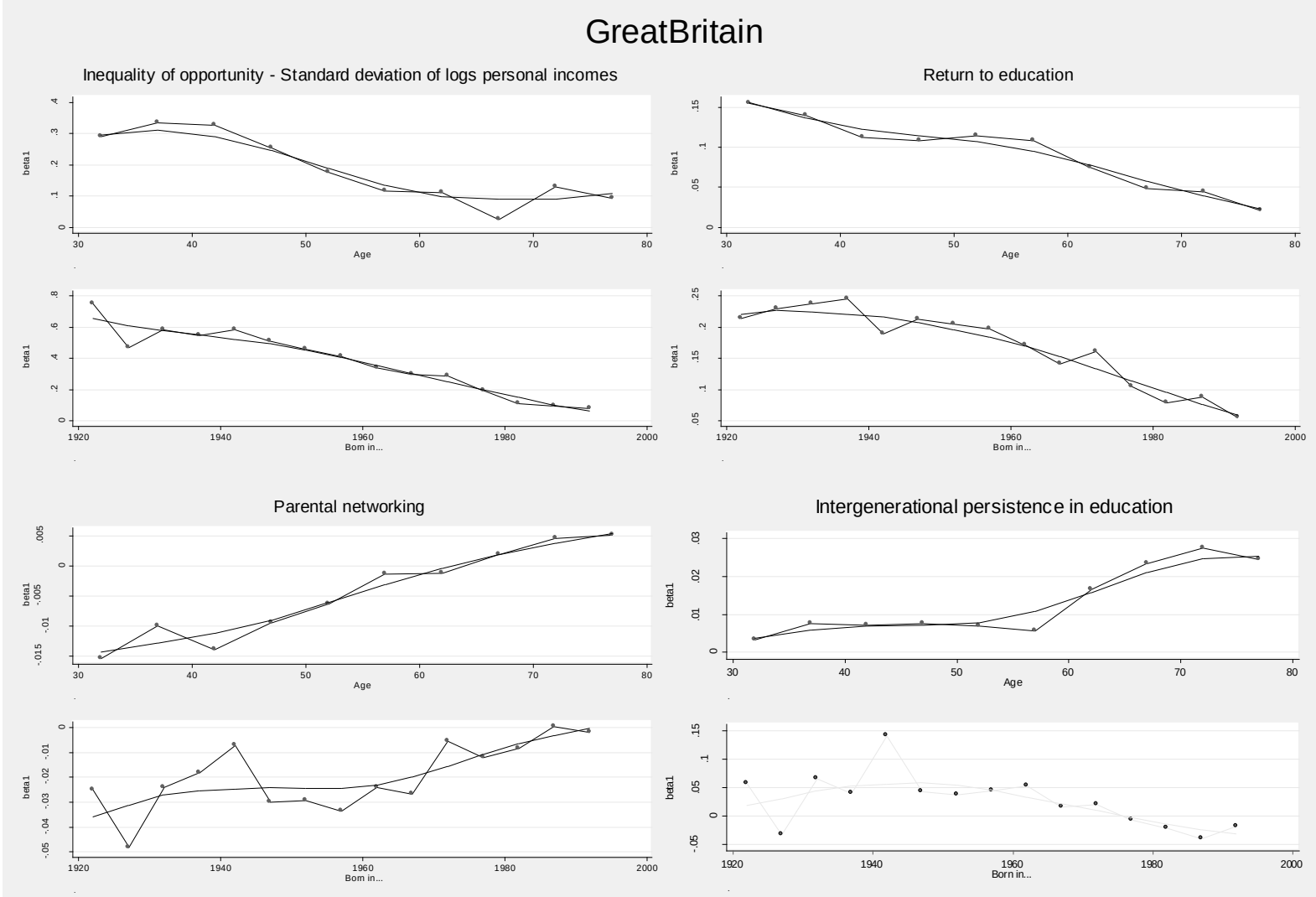
As for the age profiles, the results shows a clear declining pattern in the value of relative inequality of opportunity, which is associated with a declining pattern in the return to education. On the other hand, both parental network and intergenerational persistence of education show an increasing trend.

Figure 7 – Great Britain, by survey



Regressors include gender, age, age², born in England and foreign citizenship
Data trimmed at 99.5th centile - vertical dashed line indicates change of survey

Figure 8 – Great Britain, age-cohort decomposition



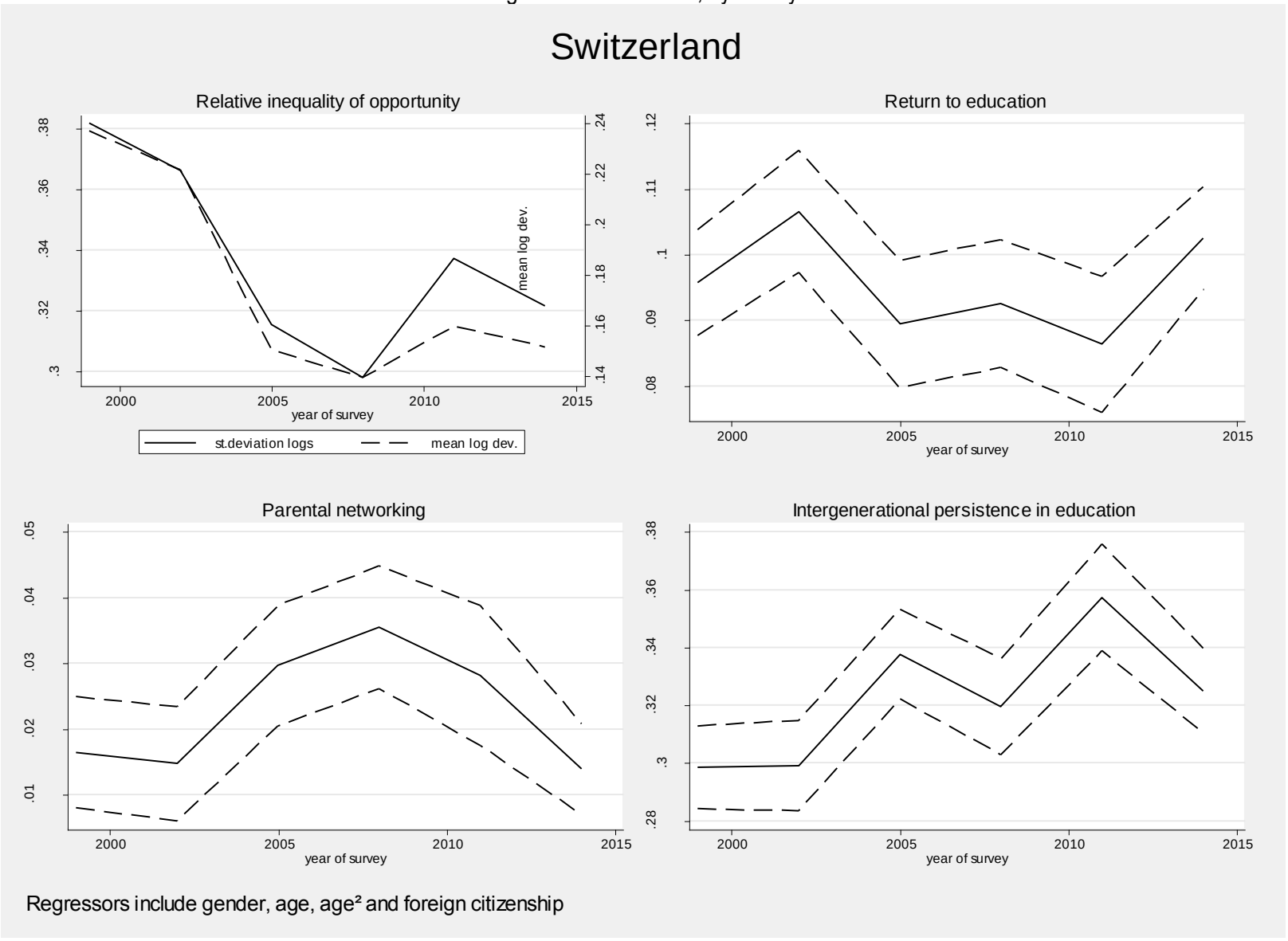
Regressors include gender, age, age², born in England and foreign citizenship - Age and cohort effects obtained from Deaton's decomposition

5 Switzerland

The analysis by survey shows a clear declining pattern in relative IOp, which takes values between 30% and 40% in case of standard deviation of logs (between 15% and 25% in case of MLD). This is complemented by a fairly increasing pattern of both intergenerational education persistence and parental networking, while the return to education shows a decreasing trend

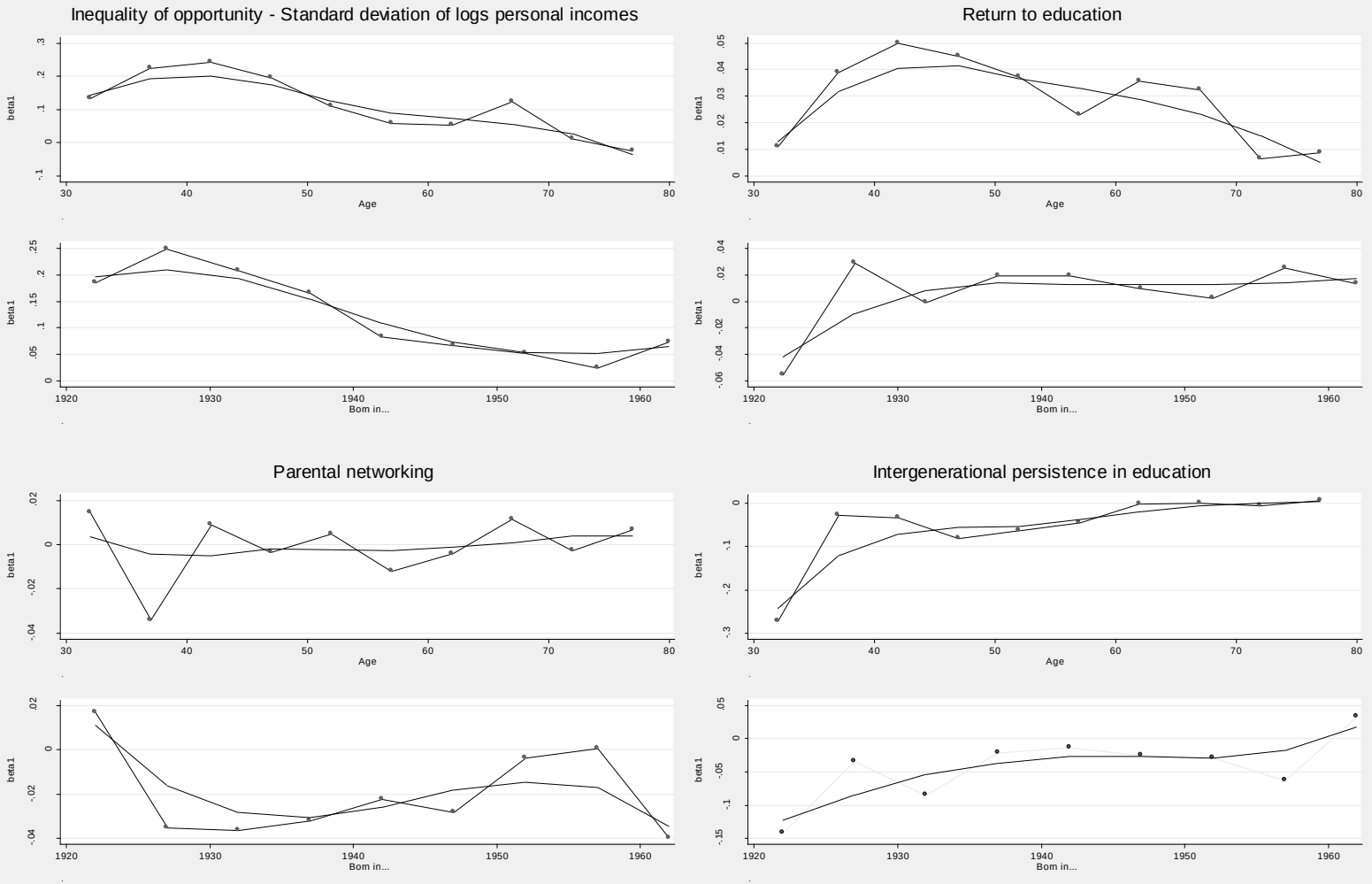
As for the age profiles, the results shows a clear declining pattern in the value of relative inequality of opportunity, which is associated with an inverted U-shape of the return to education, a fairly stable trend of parental networking and an increasing pattern of intergenerational persistence of education. The cohort profile follows a fairly similar path, except for the return to education that, after an increase for the first cohorts, then remains stable.

Figure 9 – Switzerland, by survey



Regressors include gender, age, age² and foreign citizenship

Figure 10 – Switzerland, age-cohort decomposition



Regressors include gender, age, age² and foreign citizenship - Age and cohort effects obtained from Deaton's decomposition

Summing up

Our empirical results are consistent with theoretical expectations.

It is possible to highlight the following stylized facts:

i) in all the countries and the period considered, inequality of opportunity represents an important portion of total income inequality, with values ranging from 30% to 50% according to standard deviation of logs

ii) in general, inequality of opportunity shows a stable or declining pattern over the period considered in all countries;

iii) on the other hand, in all countries considered, there has been a clear enhancement of equality of educational opportunities (as captured by the intergenerational education persistence);

iv) in some countries the egalitarian process taking place in the education system has failed to translate into decreasing opportunity inequality in the space of income because of the increasing role of parental networking and the reduced "value" of education in the labour market.

The decomposing of inequality of opportunity trends according to the age and cohort effects, allow to identify the following additional facts:

v) in all the countries considered, inequality of opportunity decreases with age: the effect of the circumstances at birth seem to weaken over the life cycle.
vi) the cohort analysis shows a more mixed picture: while for Great Britain and Germany the data show a declining path in the values of inequality of opportunity, with younger generation experiencing a lower IOp levels, both Italy and France are characterized by an inverted U-shape pattern;

Concluding remarks

This paper contributes to the analysis of inequality of opportunity in three respects.

① by using extended samples, it is capable to detect time trends, showing that the role of circumstances (parental background, gender age and place of birth) in shaping income distribution has declined over the last two decades in all countries considered in the present analysis.

② we exploit the large sample sizes to obtain inequality measures by age group and birth cohorts, thus being able to decompose observed trends in age profiles and birth cohort changes.

③ we have proposed a theoretical framework offering predictions on the changes of inequality of opportunity.

Appendix

Table 1 – Descriptive statistics - Italy

survey year	observations	personal disposable income (mean)	personal disposable income (median)	st.deviation logs personal disposable incomes	respondent years of education (mean)	respondent years of education (st.deviation)	highest years of education in the parental couple (mean)	highest years of education in the parental couple (sd.deviation)	fraction of women	fraction of born abroad
Italy										
1993	12851	17491.9	15335.0	1.21	7.90	4.32	4.52	4.17	0.52	0.00
1995	12875	17103.5	15019.8	1.21	8.16	4.38	4.55	4.14	0.52	0.00
1998	11275	18497.0	16457.8	1.21	8.95	4.30	5.20	4.21	0.52	0.00
2000	11280	18827.7	16973.7	1.19	8.94	4.25	5.04	4.13	0.51	0.00
2002	10161	18797.5	16839.8	1.21	8.94	4.17	5.21	4.13	0.52	0.00
2004	9983	19741.8	17396.7	1.17	9.18	4.15	5.25	4.24	0.52	0.00
2006	9734	20611.4	18504.9	1.15	9.55	4.01	5.53	4.11	0.52	0.02
2008	6239	22629.3	19974.7	0.92	9.70	4.05	5.58	4.16	0.36	0.04
2010	6127	22123.2	19667.8	0.95	10.11	4.02	5.89	4.20	0.43	0.04
2012	6179	20435.3	18239.1	0.94	10.22	4.02	5.96	4.26	0.43	0.07
2014	11142	17817.8	16666.9	1.11	9.99	3.99	5.78	4.08	0.53	0.07
Total	107846	19065.8	17129.5	1.15	9.09	4.24	5.23	4.19	0.50	0.02

Table 2 – Descriptive statistics – Germany

survey year	observations	personal disposable income (mean)	personal disposable income (median)	st.deviation logs personal disposable incomes	respondent years of education (mean)	respondent years of education (st.deviation)	highest years of education in the parental couple (mean)	highest years of education in the parental couple (sd.deviation)	fraction of women	fraction of born abroad
Germany										
1984	7034	15832.1	14558.9	1.57	10.38	3.16	8.50	2.68	0.51	0.24
1987	6833	17040.5	15627.8	1.50	10.45	3.17	8.54	2.65	0.51	0.24
1991	9270	23964.3	19590.6	1.23	11.18	3.47	8.82	2.31	0.52	0.17
1992	9118	24713.8	21100.3	1.21	11.21	3.46	8.86	2.28	0.52	0.17
1995	9343	25353.1	21669.0	1.17	11.37	3.46	8.89	2.26	0.52	0.18
1998	10002	26218.4	22023.8	1.09	11.49	3.48	9.03	2.14	0.53	0.15
2001	17188	32599.4	23837.3	1.11	12.08	3.57	9.34	1.94	0.52	0.12
2004	15349	31976.3	23460.1	1.09	12.20	3.60	9.42	1.91	0.52	0.11
2007	14611	31331.3	22767.6	1.05	12.33	3.62	9.52	1.85	0.52	0.09
2010	16010	29897.0	22305.6	1.03	12.32	3.62	9.61	1.78	0.53	0.09
2013	18709	30436.0	23221.5	0.98	12.49	3.65	9.78	1.80	0.55	0.09
Total	133467	27957.3	21313.8	1.18	11.82	3.59	9.25	2.11	0.53	0.13

Table 3 – Descriptive statistics – France

survey year	observations	personal disposable income (mean)	personal disposable income (median)	st.deviation logs personal disposable incomes	respondent years of education (mean)	respondent years of education (st.deviation)	fraction of parents in top occupations (mean)	fraction of parents in top occupations (st.dev)	fraction of women	fraction of born abroad
France										
1978	13617	22298.4	18697.3	1.22	6.99	5.28	0.13	0.34	0.47	0.05
1984	15921	18460.3	16610.8	1.10	6.71	5.01	0.14	0.35	0.50	0.04
1989	12411	18854.2	16599.4	1.02	7.19	5.07	0.16	0.37	0.50	0.04
1994	16275	20397.3	17392.7	1.12	8.31	5.00	0.19	0.39	0.52	0.08
2000	15623	20749.7	17747.5	1.02	8.74	5.02	0.21	0.41	0.53	0.10
2005	15272	21892.6	18936.3	0.98	9.37	5.05	0.24	0.42	0.53	0.12
Total	89119	20444.9	17646.2	1.08	7.92	5.16	0.18	0.38	0.51	0.07

Table 4 – Descriptive statistics – Switzerland

survey year	observations	personal disposable income (mean)	personal disposable income (median)	st.deviation logs personal disposable incomes	respondent years of education (mean)	respondent years of education (st.deviation)	highest years of education in the parental couple (mean)	highest years of education in the parental couple (sd.deviation)	fraction of women	fraction of born abroad
Switzerland										
1999	4327	63707.1	57579.3	1.19	12.81	2.08	11.76	2.30	0.52	0.00
2002	3737	62533.1	54500.3	1.22	12.93	2.10	11.82	2.30	0.54	0.00
2005	5006	64389.9	54462.5	1.22	13.09	2.11	11.93	2.31	0.55	0.15
2008	5373	64798.3	55044.9	1.24	13.17	2.13	11.93	2.31	0.56	0.15
2011	5341	70051.9	58400.3	1.13	13.24	2.13	11.96	2.31	0.55	0.15
2014	7489	72643.8	60558.3	1.15	13.40	2.18	11.98	2.48	0.53	0.16
Total	31273	67087.3	57076.7	1.19	13.15	2.14	11.91	2.35	0.54	0.12

Table 5 – Descriptive statistics – Great Britain

survey year	observations	personal disposable income (mean)	personal disposable income (median)	st.deviation logs personal disposable incomes	respondent years of education (mean)	respondent years of education (st.deviation)	highest years of education in the parental couple (mean)	highest years of education in the parental couple (sd.deviation)	fraction of women	fraction of born abroad
Great Britain										
1991	4250	9628.8	7793.0	1.05	10.80	1.33	9.86	2.55	0.56	0.06
1992	4344	10175.4	8418.7	1.02	10.83	1.32	9.90	2.58	0.56	0.06
1993	4444	10487.5	8582.7	1.01	10.85	1.31	9.94	2.61	0.56	0.06
1994	4599	10748.2	8651.2	1.01	10.87	1.31	9.99	2.62	0.56	0.05
1995	4752	11356.6	9149.7	1.00	10.89	1.31	10.04	2.66	0.55	0.05
1996	4988	11775.5	9684.9	0.98	10.92	1.31	10.07	2.66	0.55	0.05
1997	5125	12343.4	10279.9	0.99	10.93	1.30	10.11	2.68	0.55	0.05
1998	5276	12673.5	10487.1	0.98	10.95	1.29	10.14	2.68	0.55	0.05
1999	7974	12660.5	10461.3	0.97	10.94	1.27	10.11	2.67	0.55	0.05
2000	8382	13478.0	11081.8	0.95	10.95	1.26	10.13	2.67	0.55	0.05
2001	10457	13865.6	11349.4	0.91	10.97	1.28	10.03	2.64	0.55	0.05
2002	10629	14628.7	11920.2	0.94	10.99	1.27	10.07	2.67	0.55	0.05
2003	11149	15243.9	12451.8	0.92	11.02	1.27	10.11	2.68	0.54	0.05
2004	10339	15838.2	13100.0	0.89	11.04	1.26	10.14	2.71	0.55	0.04
2005	9950	16374.9	13511.4	0.90	11.05	1.25	10.16	2.71	0.55	0.05
2006	9540	17001.2	13916.2	0.87	11.06	1.25	10.17	2.71	0.55	0.04
2007	9000	17734.9	14355.5	0.88	11.08	1.24	10.19	2.73	0.55	0.04
2008	8553	18462.5	15011.6	0.87	11.10	1.22	10.21	2.74	0.55	0.04
2009	28934	19932.8	15814.4	0.99	11.26	1.28	10.62	3.05	0.56	0.16
2010	35477	20650.6	16680.0	0.92	11.26	1.26	10.59	3.02	0.56	0.14
2011	30910	21255.4	17324.6	0.92	11.28	1.25	10.62	3.02	0.56	0.13
2012	28631	21792.4	17696.6	0.92	11.31	1.24	10.68	3.05	0.56	0.13
2013	26803	22235.6	18004.2	0.91	11.33	1.23	10.72	3.07	0.56	0.13
2014	24119	23403.6	18828.8	0.94	11.35	1.23	10.76	3.09	0.56	0.13
Total	308625	18357.2	14641.7	0.97	11.16	1.27	10.42	2.91	0.56	0.10

Table 6 – Inequality and inequality of opportunity - Italy

	1	2	3	4	5	6
survey	st.dev.log incomes	st.dev.log predicted incomes (absolute IOp)	relative inequality of opportunity (2/1)	mean log deviation incomes	mean log deviation predicted incomes (absolute IOp)	relative inequality of opportunity (5/4)
Italy						
1993	1.206	0.580	0.481	0.448	0.166	0.370
1995	1.206	0.562	0.466	0.440	0.158	0.358
1998	1.214	0.587	0.483	0.458	0.170	0.371
2000	1.190	0.592	0.497	0.425	0.174	0.409
2002	1.207	0.588	0.487	0.418	0.171	0.408
2004	1.171	0.580	0.496	0.414	0.166	0.402
2006	1.145	0.542	0.473	0.384	0.144	0.375
2008	0.921	0.415	0.450	0.267	0.084	0.314
2010	0.946	0.441	0.466	0.298	0.095	0.320
2012	0.941	0.423	0.450	0.294	0.088	0.300
2014	1.108	0.523	0.471	0.363	0.137	0.377
Total	1.140	0.545	0.477	0.397	0.148	0.370

Table 7 – Inequality and inequality of opportunity - Germany

	1	2	3	4	5	6
survey	st.dev.log incomes	st.dev.log predicted incomes (absolute IOp)	relative inequality of opportunity (2/1)	mean log deviation incomes	mean log deviation predicted incomes (absolute IOp)	relative inequality of opportunity (5/4)
Germany						
1984	1.569	0.841	0.536	0.669	0.325	0.486
1987	1.495	0.762	0.510	0.619	0.271	0.438
1991	1.232	0.619	0.502	0.469	0.185	0.394
1992	1.216	0.613	0.504	0.456	0.181	0.397
1995	1.177	0.547	0.465	0.435	0.145	0.334
1998	1.099	0.488	0.444	0.400	0.116	0.291
2001	1.112	0.484	0.435	0.467	0.114	0.244
2004	1.090	0.457	0.419	0.449	0.102	0.227
2007	1.048	0.454	0.433	0.433	0.100	0.231
2010	1.032	0.431	0.418	0.407	0.091	0.224
2013	0.980	0.403	0.411	0.387	0.080	0.206
Total	1.136	0.515	0.449	0.453	0.134	0.286

Table 8 – Inequality and inequality of opportunity – France

	1	2	3	4	5	6
survey	st.dev.log incomes	st.dev.log predicted incomes (absolute IOp)	relative inequality of opportunity (2/1)	mean log deviation incomes	mean log deviation predicted incomes (absolute IOp)	relative inequality of opportunity (5/4)
France						
1978	1.22	0.558	0.457	0.505	0.148	0.293
1984	1.099	0.471	0.429	0.399	0.107	0.269
1989	1.02	0.428	0.419	0.363	0.09	0.247
1994	1.121	0.444	0.396	0.398	0.098	0.245
2000	1.019	0.406	0.399	0.347	0.082	0.238
2005	0.981	0.363	0.37	0.32	0.066	0.206
Total	1.076	0.444	0.411	0.387	0.098	0.249

Table 9 – Inequality and inequality of opportunity – Switzerland

	1	2	3	4	5	6
survey	st.dev.log incomes	st.dev.log predicted incomes (absolute IOp)	relative inequality of opportunity (2/1)	mean log deviation incomes	mean log deviation predicted incomes (absolute IOp)	relative inequality of opportunity (5/4)
Switzerland						
1999	1.194	0.456	0.382	0.428	0.102	0.237
2002	1.223	0.448	0.366	0.449	0.100	0.222
2005	1.225	0.386	0.315	0.496	0.075	0.150
2008	1.240	0.370	0.298	0.491	0.069	0.140
2011	1.132	0.381	0.337	0.454	0.073	0.160
2014	1.149	0.369	0.322	0.447	0.068	0.151
Total	1.189	0.396	0.333	0.461	0.078	0.171

Table 10 – Inequality and inequality of opportunity – Great Britain

	1	2	3	4	5	6
survey	st.dev.log incomes	st.dev.log predicted incomes (absolute IOp)	relative inequality of opportunity (2/1)	mean log deviation incomes	mean log deviation predicted incomes (absolute IOp)	relative inequality of opportunity (5/4)
Great Britain						
1991	1.011	0.510	0.505	0.391	0.129	0.329
1992	0.994	0.473	0.476	0.378	0.111	0.294
1993	0.983	0.467	0.475	0.369	0.108	0.293
1994	0.989	0.456	0.461	0.369	0.103	0.278
1995	0.985	0.445	0.451	0.368	0.098	0.267
1996	0.966	0.418	0.433	0.353	0.087	0.246
1997	0.954	0.441	0.462	0.346	0.096	0.277
1998	0.947	0.437	0.462	0.343	0.094	0.275
1999	0.947	0.416	0.440	0.337	0.086	0.254
2000	0.925	0.415	0.448	0.325	0.085	0.260
2001	0.904	0.425	0.470	0.318	0.089	0.279
2002	0.936	0.416	0.444	0.332	0.084	0.254
2003	0.911	0.406	0.446	0.322	0.080	0.250
2004	0.886	0.394	0.445	0.303	0.076	0.251
2005	0.899	0.390	0.434	0.306	0.075	0.244
2006	0.874	0.353	0.404	0.295	0.062	0.208
2007	0.878	0.354	0.403	0.304	0.062	0.203
2008	0.857	0.358	0.417	0.291	0.063	0.216
2009	0.991	0.329	0.332	0.360	0.053	0.146
2010	0.926	0.301	0.325	0.324	0.045	0.138
2011	0.924	0.290	0.314	0.317	0.042	0.132
2012	0.925	0.288	0.311	0.315	0.041	0.130
2013	0.920	0.282	0.307	0.311	0.040	0.127
2014	0.933	0.290	0.311	0.317	0.042	0.133
Total	0.933	0.350	0.375	0.327	0.063	0.190

Table 11 – Deaton's decomposition by age-cohort subgroups – Italy - OLS

	1	2
	unconstrained	constrained
dep.variable	lOp st.dev.log	lOp st.dev.log
age=27	0.007	0.089**
	[0.034]	[0.033]
age=32	0.032	0.101***
	[0.026]	[0.031]
age=37	0.022	0.084***
	[0.028]	[0.029]
age=42	0.04	0.094***
	[0.026]	[0.028]
age=47	0.043*	0.090***
	[0.024]	[0.026]
age=52	0.060**	0.099***
	[0.022]	[0.025]
age=57	0.042*	0.072***
	[0.021]	[0.023]
age=62	0.040**	0.063***
	[0.019]	[0.021]
age=67	0.037**	0.052**
	[0.018]	[0.020]
age=72	0.039**	0.046**
	[0.017]	[0.019]
birth=1917		0.093*
		[0.050]
birth=1922	-0.039	0.05
	[0.031]	[0.044]
birth=1927	0.017	0.104**
	[0.029]	[0.042]
birth=1932	0.018	0.092**
	[0.027]	[0.040]
birth=1937	0.035	0.102**
	[0.025]	[0.039]
birth=1942	0.076***	0.136***
	[0.025]	[0.038]
birth=1947	0.048*	0.099**
	[0.025]	[0.037]
birth=1952	0.036	0.079**
	[0.025]	[0.036]
birth=1957	0.062**	0.098***
	[0.025]	[0.035]
birth=1962	0.056**	0.083**

	[0.025]	[0.033]
birth=1967	0.054**	0.073**
	[0.026]	[0.033]
birth=1972	0.032	0.044
	[0.028]	[0.033]
birth=1977	0.017	0.02
	[0.030]	[0.034]
survey=1994	0.016	-0.007*
	[0.014]	[0.004]
survey=1999	0.035**	0.012*
	[0.014]	[0.007]
survey=2004	0.02	-0.005*
	[0.012]	[0.003]
survey=2009	-0.011	
	[0.012]	
Constant	0.385***	0.315***
	[0.021]	[0.041]
Observations	53	53
R-squared	0.81	

Standard errors in brackets - statistical significance *** p<0.01, ** p<0.05, * p<0.1
Constraints: (1) - survey1 - survey2 - survey3 - omitted.survey4 - omitted.survey5 = 0
(2) - survey1 - 5*survey2 - 10*survey3 - 15*omitted.survey4 - 20*oomitted.survey5 = 0