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Does education affect risk aversion? Evidence from the British education reform

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Individual risk attitudes are frequently used to predict decisions regarding education. However, using risk attitudes as a control variable for decisions about education has been criticized because of the potential for reverse causality. Causality between risk aversion and education is unclear, and disentangling the different directions it may run is difficult. In this study, we make the first attempt to investigate the causal effects of education on risk aversion by examining the British education reform of 1972, which increased the duration of compulsory schooling from age 15 to age 16. Using regression discontinuity design, we find that this additional year of schooling increases the level of risk aversion, which is contrary to previous findings in the literature, and we also find that this result is particularly strong for individuals with less education. This positive causal effect of education on risk aversion might alleviate concerns regarding the endogeneity/reverse causality issue when using risk aversion as an explanatory variable for decisions about education; the sign would remain credible because the coefficients are underestimated.

Keywords: risk aversion; education reform; RDD

JEL Classification: I21; I28; J11; J24

I. Introduction

Can risk aversion explain individual decisions regarding education? In human capital theory, education is generally considered an investment for a worker, who must surrender present earnings to obtain potentially higher future income based on the proposition that education can reduce unemployment risk and lead to increased wages. Thus, although future wages, unemployment and economic

labour market conditions are unknown and continuously in flux, they can be substantially affected at the individual level by a worker's investment in education. Nevertheless, as long as future wages remain uncertain, education may be treated as a risk by those who are risk averse; thus, it should be no surprise that risk-averse workers are generally not willing to exchange present job certainty for further education. With this in mind, various economic analyses have focused on education as an investment in future

income and have implemented education as an independent variable representing individuals' choices about maximizing total utility. In this manner, individuals' risk attitudes may be closely related to their decisions regarding education and lead to future wage differentials.

Many economic analyses have attempted to measure the effects of schooling on future outcomes. Levhari and Weiss (1974) found that income uncertainty is correlated with reduced educational levels. Mincer (1974) investigated how earnings variances differ across educational levels over the life cycle. However, because educational choice is also an endogenous variable, the standard reduced-form technique is not well defined, and the effects of risk aversion on future consumption smoothing have been studied by only a few researchers. Cameron and Taber (2004), Keane and Wolpin (2001) and Sauer (2004) studied the relationship between financing education and future consumption smoothing – in addition to the effects of borrowing constraints on educational decisions – and suggested that borrowing constraints have no effect on decisions about schooling. Furthermore, Cameron and Heckman (1998) empirically showed that borrowing constraints and parental income have little effect on decisions regarding education, but a conclusion can only be reached about the first moment of earnings distributions. It would be useful to better understand the relationship between earnings dispersion (wage and employment rate volatility) and education; this topic has been studied by Belzil and Hansen (2002), who emphasized the importance of risk aversion in educational decision-making in a study that used panel data with dynamic programming models.

However, this reasoning is debatable because of the concern regarding the role of education in determining individual risk aversion, which assumes that risk aversion is uniquely given to individuals and does not vary over time. It has also been suggested that early childhood can determine both individual risk aversion and other characteristics. Dohmen *et al.* (2011) found that risk attitudes are correlated with gender, age, height and parental background. Having highly educated parents has been found to diminish risk aversion. Parents can socialize their children with some effort, and this effort can lead to strong correlations between parental characteristics and those of their children. Thus, Dohmen *et al.* (2012) offered empirical evidence for the

intergenerational transmission of a number of attitudes, including risk aversion.

We explore this issue using the British education reform of 1972 as a natural experiment. The effect of compulsory schooling on economic outcomes has been widely studied. In particular, the econometric foundation and economic consequences of changes in compulsory schooling have been widely examined. For example, Acemoglu and Angrist (2001) estimated monetary returns on schooling in the United States, and this change has been shown to have improved educational levels (Lleras-Muney, 2002; Goldin and Katz, 2003; Oreopoulos, 2006). Most papers on compulsory schooling follow an instrumental variable (IV) strategy. Addressing the British education reform of 1972, Harmon and Walker (1995) employed a standard Mincerian wage equation in which the minimum school-leaving age instrumented the years of education and found that two-stage least squares (2SLS) estimates of the returns to schooling were higher than OLS estimates. Similar results have been obtained in other studies applying this instrument approach (Brunello and Miniaci, 1999; Callan and Harmon, 1999; Levine and Plug, 1999; Vieira, 1999). However, Pischke and Von Wachter (2008) found zero returns from increasing the minimum school-leaving age in West German states during the period 1948–1970, and Oosterbeek and Webbink (2007) found no beneficial effect in extending the length of vocational training programmes in the Netherlands from 3 to 4 years. The regression discontinuity design (RDD) analysis conducted by Devereux and Hart (2010) found no return for women and a modest return for men who were subject to the 1947 British compulsory schooling law that had been previously analysed by Harmon and Walker (1995) and Oreopoulos (2006). More recently, Grenet (2013) conducted a comparative study of the changes in compulsory schooling laws in France and the United Kingdom and found a significant wage increase for each additional year of compulsory schooling under the British reform but found no effects under the French reform.

In addition, both economic and other types of outcomes have been considered in relation to compulsory schooling change. Lochner and Moretti (2004), Milligan *et al.* (2004) and Lleras-Muney (2005) investigated the effect of compulsory schooling laws on criminal behaviours, political participation and health status, respectively. Moreover, subjective well-being and teenage childbirth were examined by Oreopoulos

(2007) and Black *et al.* (2008). Oreopoulos *et al.* (2006) evaluated the intergenerational effects of changes in compulsory schooling and found that parental education indeed affects children's grade retention and dropout rates, whereas Black *et al.* (2005) found no significant intergenerational effect of compulsory schooling laws on children's education in Norway. More recently, using panel study of income dynamics data, Hryshko *et al.* (2011) found that a change in compulsory schooling years reduces the risk aversion of children whose parents were affected by such law.

A few studies indicate that education is negatively correlated with risk aversion (Donkers *et al.* 2001; Hartog *et al.*, 2002). However, no study has examined the direct effect of education on determining individual risk aversion due to the lack of data containing information on both risk aversion and exogenous educational shocks. With this in mind, we undertake the first attempt to examine the direct causal effects of education on risk aversion and use the recent wave of the British Household Panel Survey (BHPS) that enables us to elicit individual risk-aversion data and data regarding the British education reform of 1972.

In this article, we use the British education reform of 1972 as an instrument for education, which enables us to observe a rise in the average education level after 1 September 1972. We use this reform as an exogenous education variable and observe the direct effect of education on individual risk aversion by using IV_{2SLS} and RDD, as suggested by Imbens and Lemieux (2008) and Lee and Lemieux (2010), which is a strong and useful tool with which to evaluate the impact of the reform. In contrast to the previous literature, we find that the reform increased risk aversion. This effect was significant only for individuals with lower education (those with at most a high school diploma or those who left school prior to completing high school), whereas those who attained higher educational levels were not significantly affected by the reform. From this result, we can infer that the negative relationship between education and risk aversion is primarily based on whether a student completes higher education (tertiary education). Our contribution is significant because this study is the first attempt to examine the direct causal impact of education on risk attitudes using the compulsory schooling law change.

II. Background

The school year begins for British pupils on 1 September, and education is compulsory for all children from their fifth birthday to the last Friday in June of the school year in which they turn 16. The change in the minimum school-leaving age analysed in our article was part of the 1972 Education Act that took effect on 1 September 1972. Individuals who were born before September 1957 and who turned 15 before the law changed could leave school at the end of the term in which they turned 15 (the UK school year is divided into three terms). Individuals who were born in September 1957 or later and who turned 15 after the law changed were required to remain in school until the end of the term in which they turned 16, that is, until the summer of 1972. This statutory change had a substantial effect on the average age at which British pupils left school (Harmon and Walker, 1995; Oreopoulos, 2006).

The objective of the 1972 Education Act was to expand access to secondary education in England and Wales. Before the reform, in the early 1950s, the system was so exclusive that only one-quarter of good students could enter the selective grammar schools, the academic track that leads to higher education.¹ The elite promotion of secondary education led to criticism and triggered education reform. As a replacement for the old system, the more open and equal 'comprehensive' system was introduced by the reform (Pischke and Manning, 2006).

Against this background, the 1972 Education Act is considered an important change in many ways, not only in terms of institutions but also because this reform affected individuals in various aspects of their lives, as discussed above. Thus, we use this reform as a reliable exogenous change in education to evaluate its effect on individual characteristics and on risk aversion, in particular, in this article.

III. Data

We use the BHPS, which began in 1991. The first wave consists of approximately 5500 households and 10 300 individuals that were sampled in 250 regions of Great Britain. Additional samples of 1500 households from each of Scotland and Wales were added to the main sample in 1999, and a sample of 2000

¹ There were three categories of secondary education: grammar schools, technical schools and modern schools.

households was added from Northern Ireland in 2001, which makes the BHPS a representative sample of the United Kingdom.

We use the eighteenth wave, which was collected in 2009 and poses a self-reported risk-aversion question to respondents. The question is presented as, 'Are you generally a person who is fully prepared to take risks or do you try to avoid taking risks?', and the respondents are asked to answer using a 10-point Likert scale from 0 (not willing at all: most risk averse) to 9 (fully: most risk seeking). We converted this measure by subtracting it from 10 to create a risk-aversion measure that increases with risk aversion. Only individuals who were born between 1945 and 1975 are considered as the reform was implemented within this period (for the 1957 cohort). Another

reason to select only a subsample of the wave is to reduce the age effect that might ensue with much older or much younger generations. In this manner, we obtained a working sample of 6513 observations. The descriptive statistics are presented in Table 1.

As the reform divides cohorts into two groups according to their dates of birth, Table 2 presents summary statistics for those who were affected by the reform and those who were not affected. The average age of those who were affected by the reform is, of course, lower than the average age of those who were not affected. The number of years of schooling differs between the affected and unaffected individuals: after the reform, the average number of years of education increased by approximately 0.8 years. There are two reasons for this difference: one is the

Table 1. Summary statistics

Variable	Mean	SD	Min	Max	Observations
<i>Individual characteristics</i>					
School cohort	1960.27	8.62	1945	1975	6513
% women	0.54	0.50	0	1	6513
Age	47.07	8.64	32	64	6513
Risk aversion	4.54	2.03	0	9	6513
Income	1419	1086	0	32 619	5032
Married (=1)	0.68	0.47	0	1	6513
Father is manager (=1)	0.33	2.03	0	9	6513
<i>Schooling</i>					
Reform in 1972	0.65	0.48	0	1	6513
Age left school	19.25	5.98	9	29	6513

Table 2. Descriptive statistics: by reform

	(1) Not in reform		(2) In reform		
Variable	Mean	SD	Mean	SD	Diff (1)–(2)
<i>Individual characteristics</i>					
School cohort	1950.41	3.46	1965.62	5.18	***
% women	0.54	0.50	0.55	0.50	
Age	56.94	3.50	41.72	5.20	***
Risk aversion	4.78	2.05	4.40	2.01	***
Income	1358	1307	1445	974	*
Married (=1)	0.73	0.44	0.65	0.48	***
Father is manager (=1)	0.31	0.46	0.34	0.47	***
<i>Schooling</i>					
Reform in 1972	0	0	1	0	
Age left school	18.64	6.19	19.57	5.84	***
Obs.	2292		4221		

Notes: * and *** denote significance at the 10% and 1% levels, respectively.

reform, and the other is a general cohort effect in which the younger generation tends to pursue higher education at a higher rate than the preceding generation. By contrast, the risk-aversion score decreases after the reform, although it is unclear whether risk aversion decreases due to the reform or because of the age difference in the samples² because younger individuals are found to be less risk averse than older individuals.

Table 3 compares the two groups, that is, those with less education (a high school diploma at most) and those with higher education. Clearly, those who attained higher education have different characteristics: they are younger, they earn more and they are less risk averse. Table 4 shows the distribution of risk aversion across gender and education groups. In general, women are more risk averse than men (4.87 versus 4.14), and self-assessments of higher educated individuals were less risk averse than the self-

assessments of less-educated individuals. Therefore, we assume that the educational reform may have had an effect in terms of individual risk aversion. We introduce our empirical strategy in the following section.

IV. Empirical Method

Table 5 presents the correlation matrix for the variables of interest, including risk aversion, female gender, age, years of schooling, father's occupation and marital status. Similar to previous findings (Dohmen *et al.*, 2011), risk aversion is positively correlated with being female and with age but negatively correlated with years of schooling (as noted above, i.e. based on human capital theory). Unlike female gender and age, which are given exogenously, education is an individual choice *per se*. Therefore, with this

Table 3. Descriptive statistics: by education

	Low education		High education		
Variable	Mean	SD	Mean	SD	Diff (1)–(2)
<i>Individual characteristics</i>					
School cohort	1959.33	8.64	1961.40	8.47	***
% women	0.55	0.50	0.54	0.50	
Age	48.02	8.66	45.94	8.48	***
Risk aversion	4.73	2.06	4.30	1.98	***
Income	1212	1059	1634	1072	***
Married (=1)	0.67	0.47	0.69	0.46	
Father is manager (=1)	0.24	0.43	0.44	0.50	***
<i>Schooling</i>					
Reform in 1972	0.60	0.49	0.70	0.46	***
Age left school	15.88	0.76	23.29	6.93	***
Obs.	3554		2959		

Note: *** denotes significant at the 1% level.

Table 4. Distribution of risk aversion

	Mean	SD	Min	Max	Obs.	Diff
Full sample	4.54	2.03	0	9	6513	
Men	4.14	1.98	0	9	2966	***
Women	4.87	2.02	0	9	3550	
Low education	4.73	2.05	0	9	3555	***
High education	4.3	1.98	0	9	2961	

Note: *** denotes significant at the 1% level.

² Age and reform are negatively correlated.

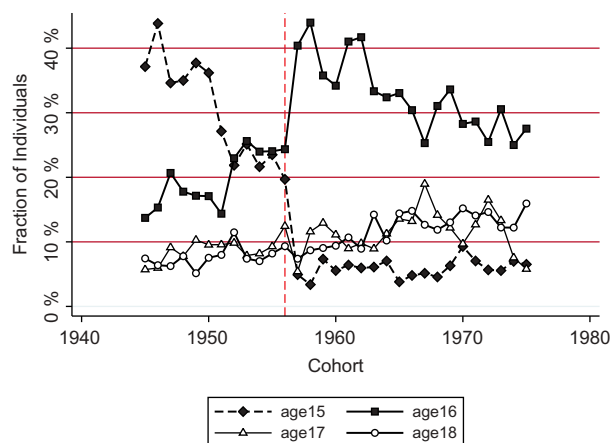
Table 5. Correlation matrix of variables of interest

	Risk aversion
Woman (=1)	0.18*
Age	0.26*
Years of schooling	-0.15*
Tertiary education (=1)	-0.13*
Professional/manager/skilled father (=1)	-0.06*
Married (=1)	0.03*

Note: * denotes significant at the 10% level.

correlation, we cannot identify causality, but we can clearly state that women and older individuals are more risk averse. In human capital theory, less risk-averse individuals tend to choose another year of schooling as an investment in future income. Given the possibility that risk aversion may be time varying, early childhood education may affect individual characteristics, such as risk aversion. Therefore, this correlation consists of two directions of composite effects: one from risk aversion to educational choices and the other from education to determining individual risk aversion. In this section, we establish our empirical strategy to investigate the direction of causality from education to risk aversion using RDD, which will present the local average treatment effect (LATE) of the compulsory schooling on both the leaving age of school and on risk attitudes, in addition to 2SLS estimates of the impact of secondary education on risk aversion.

Our empirical model follows a regression-discontinuity design (e.g. Oreopoulos, 2006; Devereux and Hart, 2010). We observe a positive shift in compulsory education after the reform of 1972 (cohort 1957). The education reform can help identify the causal effect of education on risk attitudes. Figure 1 shows the distribution of school-leaving ages across school cohorts for 1945–1975 in the United Kingdom. Each curve presents the fraction for each school cohort who left school by a given age. This graph shows that the new compulsory schooling law introduced with the 1972 British reform significantly increased the proportion of individuals who would likely have left at age 15 without the reform but who were forced to remain in school until age 16. After the reform, as a consequence, the percentage of individuals who left at age 16 sharply increased to equal the percentage reduction in 15-year-olds leaving school (i.e. the 1957

**Fig. 1. Distribution of school-leaving ages in the United Kingdom across school cohorts, 1945–1975**

cohort). In this figure, we observe an increase in the number of years of schooling for individuals after the reform was implemented.

We consider risk aversion (R) to be a function of education and other socio-demographic characteristics, such as gender and age, all of which are found to be correlated with risk aversion: women are more risk averse, and young people are less risk averse. We set the treatment status T_i as a deterministic and discontinuous function of the covariate ‘date of birth’ DOB_i .

$$T_i = \begin{cases} 1 & \text{if } DOB_i \text{ is after September 1957} \\ 0 & \text{if } DOB_i \text{ is before September 1957} \end{cases}$$

Therefore, potential outcomes can be described by a linear constant-effects model:

$$E[R_{oi}|X_i] = \alpha + X_i\beta \quad (1)$$

$$R_{1i} = R_{0i} + \theta \quad (2)$$

where X_i is the vector of socio-demographic controls, such as gender, age, age², marital status, father’s occupation, region, and SE are clustered at the father’s occupational (social status), the regional and the school cohort levels. Here, the level of risk aversion for those affected rises by θ compared with the level of risk aversion for those not affected. This reasoning leads to the following regressions:

$$R_i = \theta_0 + \theta_1 T_i + X_i \theta_2 + f(C_i - c) + \mu_i \quad (3)$$

$$E_i = \gamma_0 + \gamma_1 T_i + X_i \gamma_2 + f(C_i - c) + \eta_i \quad (4)$$

These equations are the first stage and the reduced form of the effect of compulsory schooling on the leaving age from school (E_i) and on risk aversion (R_i). In general, the direction of causality between risk aversion and education is unclear. We frequently use risk aversion as an explanatory variable for individual education decisions, although it might be argued that early education modifies individuals' risk aversion. Thus, we must investigate an exogenous effect that addresses the reverse causality issue of risk aversion on education. In our specification, we do not face an endogeneity problem; we use "reform" as an instrument that varies exogenously with the policy change in 1972. Therefore, we can directly observe the effect of education on individual risk attitudes.

We use RDD to evaluate the impact of the reform on risk aversion. We centre the cohort variable on the cut-off date for the reform in the compulsory schooling law, 1 September 1957, and we estimate the RDD for the first stage and the reduced form specification. $f(C_i - c)$ is a quadratic function of the school cohort centred at the cut-off point, c , which is 1 September

1957.³ $\hat{\gamma}_1$ would be the average causal effect of the reform on education; with $\hat{\theta}_1$, we observe the average causal effect of the reform on risk aversion.

Finally, we obtain the return to schooling on risk aversion using 2SLS:

$$R_i = \lambda_0 + \lambda_1 E_i + X_i \lambda_2 + f(C_i - c) + v_i \quad (5)$$

With $hit\lambda_1$, we can estimate the impact of secondary education on risk aversion. Therefore, with the LATE and 2SLS results, we are able to determine whether the general causal effect of risk aversion on educational choices is biased by endogeneity/reverse causality issues.

V. Results

Figures 2–5 show the average school-leaving age and the average risk aversion with the quadratic fitted values for each cohort by education. The left figure represents the sample of those who achieved at most secondary education, and the right figure represents the sample of those with tertiary education. There is a clear increase after the reform only for the low-educated sample. These figures provide graphical evidence that there is a jump at the cut-off point for

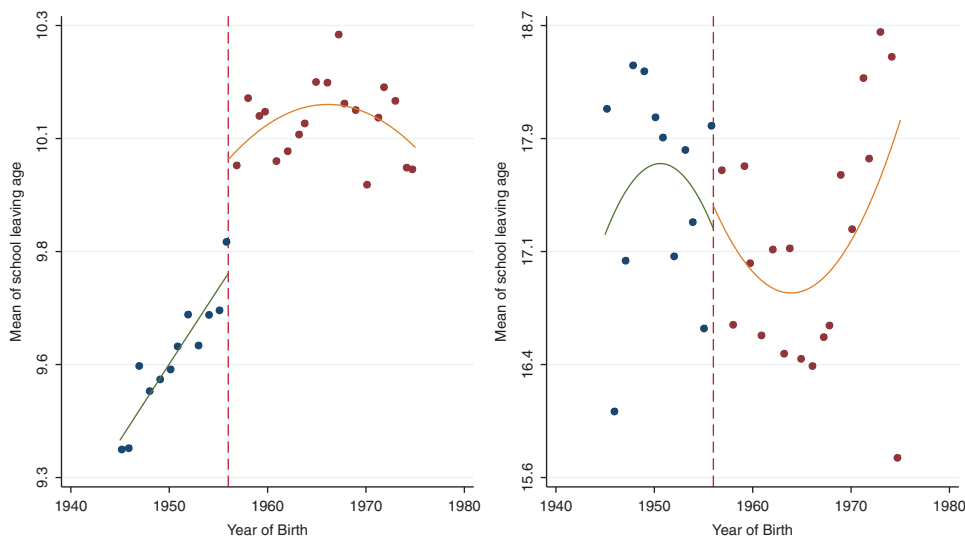


Fig. 2. Cohort average school-leaving age, yearly bins: low education versus high education

³ We do not present the results using higher order polynomial functions than the second order, as suggested by Gelman and Imbens (2014). However, the results remain similar to our specifications using quadratic functions.

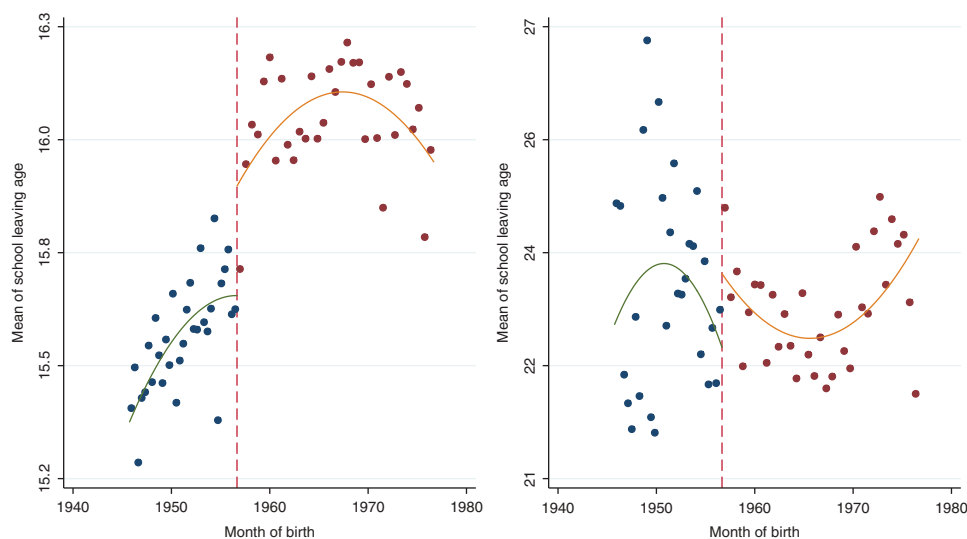


Fig. 3. Cohort average school-leaving age, monthly bins: low education versus high education

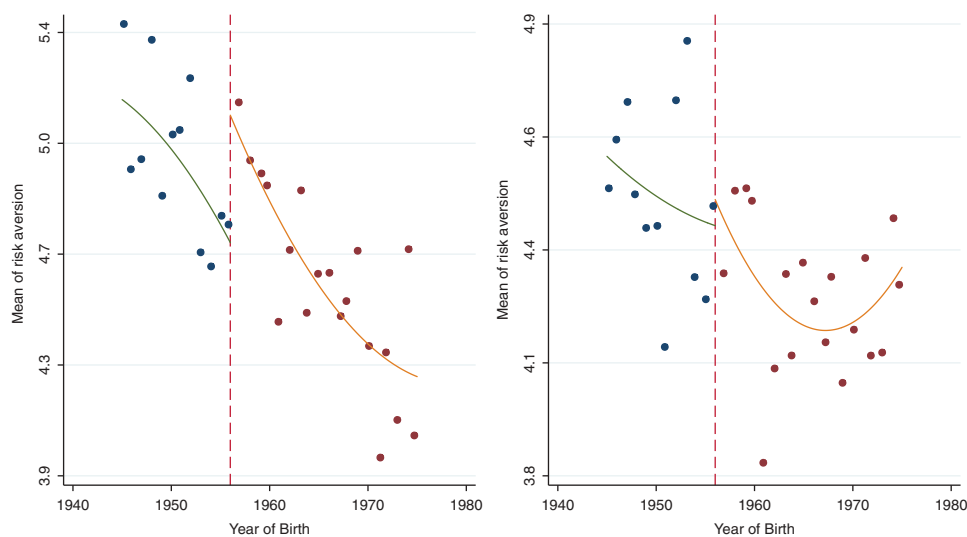


Fig. 4. Cohort average risk aversion, yearly bins: low education versus high education

the school-leaving age and risk aversion for those with lower education, while it is rather vague in defining a jump for those with higher education. In other words, individuals with lower education were the most strongly affected by the reform. For this reason, RDD offers a clearer picture of the impact of the reform on our variables of interest. Figures 6 and 7 represent the cohort average using the linear fitted value for the school-leaving age and risk aversion. Similar to the previous figures using a quadratic fit, we observe a significant shift after the reform, but the shift is not clear for those with higher education.

Tables 6 and 7 present the results from RDD with different sizes of bins: yearly and monthly. We examine samples to determine whether there is a LATE of the education reform on risk aversion.

The results from the first-stage regression are found in the first three columns. As expected, the reform slightly increased the number of years of schooling (although insignificant). To observe the effect in greater detail, we selected two subsamples based on education level. The column 'Edu_{low}' corresponds to those who have at most a high school diploma, whereas the column 'Edu_{high}' contains

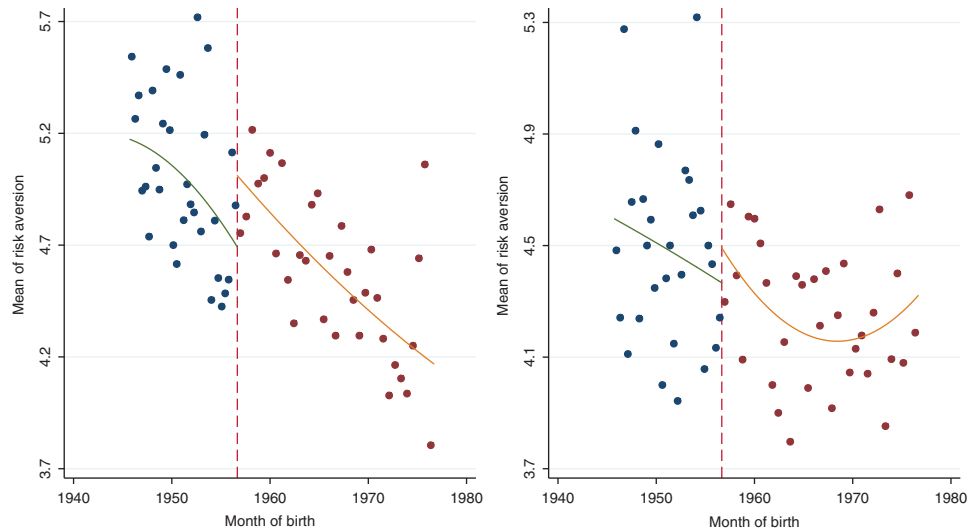


Fig. 5. Cohort average risk aversion, monthly bins: low education versus high education

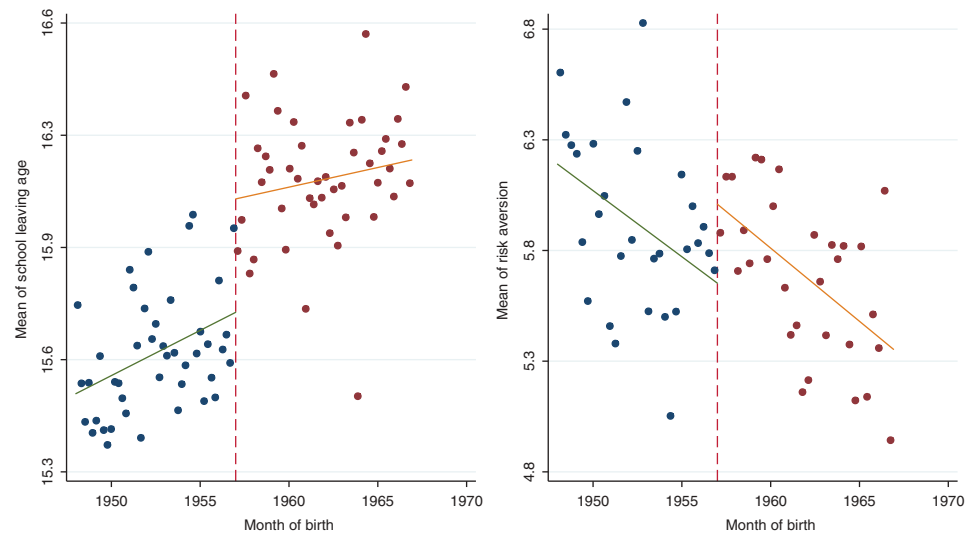


Fig. 6. Linear fitted cohort average school-leaving age and risk aversion: secondary education (low education, treated), monthly bins

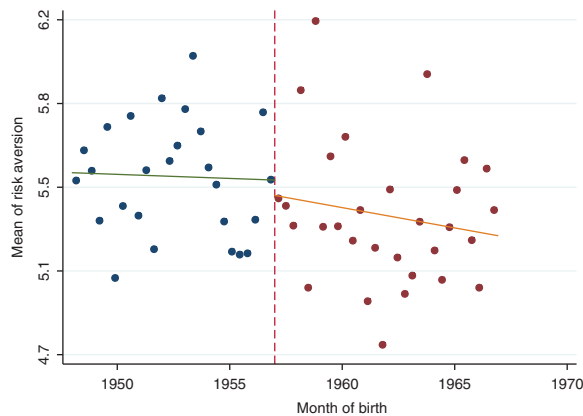


Fig. 7. Linear fitted cohort average risk aversion, monthly bins: tertiary education (untreated)

those with tertiary education. In the subsample analysis, the reform tends to affect those with lower levels of education more strongly. Clearly, this result ensues because the increase in compulsory schooling would not greatly affect those who would have pursued higher education in any event. The last three columns show the results for the reduced form. We use the reform variable to explain the level of risk aversion. The reform, which increased the number of years of schooling, also increased the level of risk aversion. This finding implies that a 1-year increase of compulsory schooling increased risk aversion by 0.26 points, although this effect is nonsignificant. This result contrasts with the findings of other studies

Table 6. Regression discontinuity design, cohort 1945–1975, yearly bins

	Impact of the reform on education and risk aversion					
	First stage			Reduced form		
	School-leaving age			Risk aversion		
	Full	Edu _{low}	Edu _{high}	Full	Edu _{low}	Edu _{high}
Treated (=1)	0.377 (0.440)	0.264*** (0.060)	0.221 (0.845)	0.249* (0.151)	0.341* (0.178)	0.110 (0.234)
Obs.	6513	3554	2959	6513	3554	2959
Adjusted R^2	0.033	0.145	0.007	0.045	0.056	0.024
F	19.87	76.34	3.326	59.89	30.83	12.14
	Impact of education on risk aversion					
	OLS: risk aversion			2SLS: risk aversion		
	Full	Edu _{low}	Edu _{high}	Full	Edu _{low}	Edu _{high}
	School-leaving age					
School-leaving age	−0.0283*** (0.004)	−0.0497 (0.048)	−0.0166*** (0.005)	0.282 (0.186)	0.267 (0.428)	0.172 (0.210)
Obs.	6513	3554	2959	6513	3554	2959
Adjusted R^2	0.051	0.056	0.027	0.043	0.049	0.023
F/χ^2	79.54	40.98	17.38	273.6	346.8	93.55

Notes: Robust SEs obtained by clustering at the regional, the father's occupational and the school cohort levels.

Gender, marital status, father's occupation, region and the quadratic function of cohort centred at 1 September 1957 are controlled.

* and *** denote significance at the 10% and 1% levels, respectively.

Table 7. Regression discontinuity design, cohort 1945–1975, monthly bins

	Impact of the reform on education and risk aversion					
	First stage			Reduced form		
	School-leaving age			Risk aversion		
	Full	Edu _{low}	Edu _{high}	Full	Edu _{low}	Edu _{high}
Treated (=1)	0.389 (0.392)	0.382*** (0.059)	−0.0524 (0.766)	0.259** (0.130)	0.419** (0.170)	0.0538 (0.207)
Obs.	6516	3555	2961	6516	3555	2961
Adjusted R^2	0.008	0.130	0.000	0.012	0.018	0.003
F	11.06	91.09	1.233	16.40	10.58	2.596
	Impact of education on risk aversion					
	OLS: risk aversion			2SLS: risk aversion		
	Full	Edu _{low}	Edu _{high}	Full	Edu _{low}	Edu _{high}
	School-leaving age					
School-leaving age	−0.0298*** (0.004)	−0.0552 (0.048)	−0.0165*** (0.005)	0.272 (0.198)	0.436 (0.362)	0.166 (0.244)
Obs.	6513	3554	2959	6513	3554	2959
Adjusted R^2	0.051	0.056	0.027	0.026	0.027	0.013
F/χ^2	70.32	48.17	20.46	228.5	235.2	57.11

Notes: Robust SEs obtained by clustering at the regional, the father's occupational and the school cohort levels.

Gender, marital status, father's occupation, region and the quadratic function of cohort centred at 1 September 1957 are controlled.

** and *** denote significance at the 5% and 1% levels, respectively.

in which education has been shown to decrease risk aversion (Dohmen *et al.*, 2011; Hryshko *et al.*, 2011). Moreover, the subsample analysis is more interesting. Although the reform did not greatly affect those with higher education, the reform did affect those with lower education: they become more risk averse after the increase in the amount of compulsory schooling. From this result, we infer that the negative correlation between education and risk aversion is not always clear. The finding that education reduces risk aversion may only apply to those with higher education because increases in lower education levels may in fact increase risk aversion.

The second panel presents the comparison between the *OLS* estimations and the *IV*_{2SLS} estimations. In the full sample analysis, *OLS* yields a negative and significant coefficient for the effect of education (years of schooling), which is consistent with what is generally found in other studies and suggests that risk aversion is a determinant of education. However, from this correlation, we cannot determine whether education decreases risk aversion because of possible endogeneity or reverse causality issues. By contrast, the *IV*_{2SLS} estimations suggest the opposite direction of correlation (although nonsignificant): the number of years of schooling increases risk aversion. Education here is instrumented with the reform variable by RDD estimations, and a positive coefficient is then found. This finding is stronger and significant only for those with lower education: with *OLS*, the effect of education is negative, whereas with *IV*_{2SLS}, the effect is positive. In general, risk aversion is negatively correlated with education for those with lower education. However, the causal effect of education on risk aversion via the IV method is positive. From this result, we can infer that the effect of risk aversion on the choice of education level for those with lower education may be even higher than the *OLS* coefficient because there is an opposite direction for the education effect on risk aversion. Therefore, when we use risk aversion as an explanatory variable for education choice, the coefficient might be biased towards zero. This result may support the use of risk aversion as an explanatory variable for educational choices because we might yet insist that risk aversion affects decision-making, although the effect is biased. Again, the results are different for those with higher education, who were less affected or unaffected by the reform.

Heterogeneous impact across genders

We conduct a subgroup analyses to allow for heterogeneous impacts of the reform, particularly across genders. For these analyses, we only consider those with secondary education who were mostly affected by the reform. Tables 8 and 9 present the RDD results across genders using yearly and monthly bins. It is still notable that the impact of the reform on the school-leaving age is bigger for male samples, although the reform was acted for everyone. The reform effect on risk aversion is also stronger for the male sample, as found in the reduced form (columns 3 and 4). The second panel presents the comparison between the *OLS* and 2SLS estimations. We found a significant negative correlation between education and risk aversion in the female sample using *OLS*, whereas the sign has become positive when we use 2SLS with the reform variable instrumenting education (although this result is nonsignificant). These results reinforce support for our hypotheses that compulsory schooling may increase risk aversion (as opposed to the conventional wisdom) and also indicate that the negative sign that we found for secondary education on risk aversion may only show correlation and not causality.

As robustness checks, we used different cohort windows for the reduced form only for those with secondary education. Table 10 presents the various estimations using different cohort windows from ± 5 to ± 15 around the cut-off date. We thus have four different specifications in columns (1–4) as follows:

$$(1) R_i = \theta_0 + \theta_1 T_i + X_i \theta_2 + \eta_1 (C_i - c) + \mu_i$$

$$(2) R_i = \theta_0 + \theta_1 T_i + X_i \theta_2 + \eta_1 (C_i - c) + \eta_2 (C_i - c)^2 + \mu_i$$

$$(3) R_i = \theta_0 + \theta_1 T_i + X_i \theta_2 + \eta_1 (C_i - c) + \sigma_1 (C_i - c) \times T_i + \mu_i$$

$$(4) R_i = \theta_0 + \theta_1 T_i + X_i \theta_2 + \eta_1 (C_i - c) + \eta_2 (C_i - c)^2 + \sigma_1 (C_i - c) \times T_i + \sigma_2 (C_i - c)^2 \times T_i + \mu_i$$

where X_i includes gender, marital status, father's occupation and regions. As the windows become wider, the reform has a more significant impact on risk aversion. Thus, we find that the reform has a

Table 8. Regression discontinuity design, subgroups with secondary education, yearly bins

	Impact of the reform			
	First stage		Reduced form	
	School-leaving age		Risk aversion	
	Female	Male	Female	Male
Treated (=1)	0.216** (0.089)	0.333*** (0.098)	0.240 (0.273)	0.448* (0.266)
Obs.	1961	1593	1961	1593
Adjusted R^2	0.156	0.131	0.021	0.018
F	65.97	30.33	6.083	5.239
	Impact of education on risk aversion			
	OLS: risk aversion		2SLS: risk aversion	
	Female	Male	Female	Male
	Female	Male	Female	Male
School-leaving age	-0.0984* (0.059)	0.0109 (0.078)	0.314 (0.569)	0.328 (0.590)
Obs.	1961	1593	1961	1593
Adjusted R^2	0.022	0.017	0.001	0.005
F/χ^2	10.28	7.732	36.36	29.60

Notes: Robust SEs obtained by clustering at the regional, the father's occupational and the school cohort levels. Marital status, father's occupation, regions and the quadratic function of cohort centred at 1 September 1957 are controlled.

*, ** and *** denote significance at the 10%, 5% and 1% levels, respectively.

Table 9. Regression discontinuity design, subgroups with secondary education, monthly bins

	Impact of the reform			
	First stage		Reduced form	
	School-leaving age		Risk aversion	
	Female	Male	Female	Male
Treated (=1)	0.363*** (0.079)	0.414*** (0.092)	0.271 (0.241)	0.455* (0.244)
Obs.	1961	1594	1961	1594
Adjusted R^2	0.142	0.117	0.019	0.012
F	70.21	29.20	8.028	4.699
	Impact of education on risk aversion			
	OLS: risk aversion		2SLS: risk aversion	
	Female	Male	Female	Male
	Female	Male	Female	Male
School-leaving age	-0.0984* (0.059)	0.0109 (0.078)	0.664 (0.486)	0.332 (0.533)
Obs.	1961	1593	1961	1593
Adjusted R^2	0.022	0.017	0.001	0.005
F/χ^2	10.28	7.732	35.89	29.32

Notes: Robust SEs obtained by clustering at the regional, the father's occupational and the school cohort levels. Marital status, father's occupation, regions and the quadratic function of cohort centred at 1 September 1957 are controlled.

* and *** denote significance at the 10% and 1% levels, respectively.

Table 10. LATE of reform on risk aversion: using different cohort windows

Sample used	(1)	(2)	(3)	(4)
Born in 1957 \pm 5	0.333* (0.195)	0.181 (0.218)	0.279 (0.225)	-0.0390 (0.395)
Obs.	1028	1028	1028	1028
Adjusted R^2	0.001	0.005	0.005	0.007
F	1.866	3.405	4.938	3.510
Born in 1957 \pm 7	0.255* (0.138)	0.221 (0.149)	0.297* (0.158)	0.356 (0.331)
Obs.	1501	1501	1501	1501
Adjusted R^2	0.001	0.000	0.002	0.001
F	2.486	2.378	4.012	2.712
Born in 1957 \pm 9	0.318** (0.153)	0.290 * (0.159)	0.312* (0.169)	0.316 (0.237)
Obs.	1998	1998	1998	1998
Adjusted R^2	0.005	0.005	0.006	0.005
F	6.281	4.701	5.261	3.534
Born in 1957 \pm 11	0.312* (0.114)	0.302** (0.119)	0.323** (0.126)	0.320 (0.197)
Obs.	2480	2480	2480	2480
Adjusted R^2	0.011	0.011	0.011	0.011
F	29.35	21.24	21.71	15.95
Born in 1957 \pm 13	0.229* (0.115)	0.223* (0.121)	0.241* (0.128)	0.406** (0.173)
Obs.	2971	2971	2971	2971
Adjusted R^2	0.013	0.012	0.013	0.013
F	24.47	16.90	16.89	10.90
Born in 1957 \pm 15	0.309** (0.124)	0.323** (0.121)	0.340** (0.127)	0.254** (0.146)
Obs.	3448	3448	3448	3448
Adjusted R^2	0.025	0.025	0.026	0.026
F	81.30	53.50	53.83	35.04

Notes: Robust SEs obtained by clustering at the regional, the father's occupational and the school cohort levels. Marital status, father's occupation, regions and the quadratic function of cohort centred at 1 September 1957 are controlled.

* and ** denote significance at the 10% and 5% levels, respectively.

consistent positive impact on risk aversion. On average, the reform increases risk aversion by 0.25–0.35 points for those who attained at most a secondary education.

VI. Conclusion

We conducted an empirical analysis to investigate the effect of education on risk aversion. The correlation between risk aversion and education has been widely studied, but the direction of causality nonetheless remains unclear. Previous researchers who have attempted to use risk aversion to explain decisions regarding education have found that education is

negatively correlated with risk aversion: the more risk averse an individual is, the earlier he/she quits school. However, there are concerns regarding endogeneity or reverse causality with such analyses, suggesting that education *per se* may influence the formation of individual risk aversion. To address these potential problems, we consider British education reform under the 1972 Education Act and use this reform as an instrument for education because it exogenously increased the amount of compulsory schooling by 1 year. Thus, we conducted IV_{2SLS} and RDD analyses to investigate the causal effects of education on risk aversion.

We found that a 1-year increase in compulsory schooling has a positive effect on risk aversion. We

can infer from this result that education may increase risk aversion, which contrasts with previous findings in the literature. However, the result is clear only for those with lower education. The reform did not have a significant effect on the risk aversion of those with higher education, which makes sense because these individuals would have pursued higher education with or without the reform. Our findings thus depart from the conventional wisdom that education reduces risk aversion (Dohmen *et al.*, 2011; Hryshko *et al.*, 2011). We suggest that the effects of higher and lower levels of education may differ in this respect. The negative coefficient we found for the effect of education on the risk aversion of those with higher education suggests that tertiary education may diminish risk aversion by offering illumination and knowledge regarding how to manage risk, whereas increased early education may increase risk aversion by making individuals more aware of the risks they face.

Finding a positive effect for compulsory education on risk aversion may encourage the use of risk aversion as an explanatory variable for educational choice. Although the coefficient on risk aversion is biased, we may yet argue that there is an effect because the coefficient is also underestimated. In other words, because the potential reverse causality issue is in the direction that reduces the size of the effect towards zero, we can rely on the sign of the risk aversion's effect on education.

Disclosure Statement

No potential conflict of interest was reported by the author.

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