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Do Dropouts Drop Out Too Soon?
Evidence from Changes in School-Leaving Laws

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Abstract: This paper investigates if decisions to leave school early are sub-optimal, and whether students benefit from policies, such as a minimum school leaving age, that oblige them to continue. I use changes in minimum school-leaving laws in Great Britain and Ireland, which were remarkably influential, to measure pecuniary and non-pecuniary gains from education. For those compelled to take additional schooling, I find substantial gains in wealth, health, leisure and labor activities, and subjective measures of well-being, which hold up against a wide array of specification checks. The main conclusion is that it is very difficult to reconcile these estimates and those from previous studies with optimal models of school choice. To prefer dropping out early, the one-year cost from attending school would have to exceed a dropout's maximum lifetime annual earnings by a factor of five to seven. Other models that allow for time inconsistent preferences, misguided expectations, or identify appear better suited to describe dropout behavior.

Key Words: returns to education, identity, compulsory school laws

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I. Introduction

Recent studies that use differences in compulsory school laws to estimate returns to education find strikingly large rewards from obliging students to finish school later. Angrist and Krueger (1991) use differences in school-entry laws to identify students dropping out with less education because they were born just after the entry cut-off date as opposed to just prior. Students that finished their schooling with a year less of class because of these laws experienced on average 9.2 percent lower adult earnings than those dropping out later. In another study, Acemoglu and Angrist (2000) use differences in school-leaving laws across the United States and over time to identify adults made to stay in school for different periods before having the option to drop out. Students compelled to take an extra year experienced an average increase of 10.3 percent in adult earnings. Harmon and Walker (1995) also examine the effect on earnings from changes in minimum school-leaving ages in the United Kingdom. They estimate adult earnings rose an average of 15.3 percent for each additional year of school a student had to take.[1]

Other recent work suggests possible non-pecuniary benefits from compelling students to finish school later. Lochner and Moretti (2001), for example, analyze the effect of high school graduation on incarceration using changes in state compulsory attendance laws as an instrument for high school completion. They find substantial reductions in the probability of incarceration among whites and blacks that finished high school as a result from these laws. Lleras-Muney (2001) also uses compulsory attendance laws to examine the effect of education on mortality. She estimates an additional year of education lowers the probability of dying in the next 10 years by 3.6 percentage points (among elderly people).

These benefits are all induced by constraining some individuals to take more school, whether they want to or not. Compulsory schooling laws introduce constraints that restrict individual choices.

A human capital model without positive externalities suggests restricting school choice should lower expected lifetime welfare among those wanting to leave earlier, since those that do drop out early believe they are better off from doing so.[2] But given that the significant gains from an additional year of education may last for many years (and even increase time before death), while most of the costs incur over only one year, it is hard not to wonder whether school attainment decisions are rationalized by other means.

This paper is the first to undertake a systematic cost-benefit analysis of the dropout decision, and examine whether children may benefit from laws, such as a minimum school leaving age, that oblige them to finish school beyond the time they choose on their own. I compare whether models that imply efficiency in early school-leaving decisions can reasonably explain estimates for the total gains from staying in school, or whether alternative models that imply inefficient outcomes are better suited.

Minimum school-leaving laws are ideal instruments to analyze the efficiency of the school choice decision because they prevent some students from leaving school early. In fact, the motivation behind introducing such laws often relates to assumptions that early school-leaving decisions are not optimal.[3] Six such law changes in England and Ireland are used to measure the present value pecuniary and non-pecuniary gains from an extra year of school. The changes influenced a remarkably large number of students and were rigorously enforced.

Similar to previous studies, I find students compelled to take an extra year of school experienced an average increase of 12 percent in annual earnings. I also find students with additional

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[1] Recent studies that use other instruments or exogenous controls for education arrive at very similar estimates for the financial returns to schooling. Card (2001) provides a nice survey and interpretation of these results.

[2] In Chiswick's (1969) words, 'while those compelled to over-invest [in school] experience an increase in their annual post-investment income, they experience a decrease in their marginal and average internal rates of return'.

[3] The Republic of Ireland school-leaving age changed in 2002 to 16. Minister for Education and Science, Micheal Martin, explained; "We are all too aware of the fact that participation in the education system gives the best chance of success – economic, social and personal – in later life. My aim in this legislation is to improve our ability to ensure that children and young people remain within the education system for as long as possible" [http://www.irlgov.ie/educ/press/press981016.htm, June 17, 2002]. In North Carolina, State Superintendent Michael Ward wants to raise the minimum school-leaving age from 16 to 18. He argues, "It is time to raise the legal school attendance age to 18, an age that better reflects the maturity required to make such an important and life-changing decision" [http://www.ncpublicschools.org/news/01-02/020502.html].

schooling are less likely to report poor health, being depressed, looking for work, being in a low-skilled manual occupation, and being unemployed. The estimates hold up against a wide array of robustness checks. Most interesting, adults who experienced a higher minimum school-leaving law are more likely to report being satisfied overall with the life they lead. The coefficient on this effect falls less than half when income controls are added. In other words, conditional on reporting the same earnings or household income, adults with more education are still likely to report being happier in life.

Whether or not the possibility of non-pecuniary benefits from education are taken into account, the main conclusion of this paper is that it is very difficult to reconcile estimates of the returns to compulsory schooling with efficient models of school choice. To prefer dropping out early, the one-year cost from attending school would have to exceed a dropout's maximum lifetime annual earnings by a factor of five to seven. Models that imply individually and socially inefficient outcomes, that introduce time inconsistent preferences, misguided expectations, or identifying with a social group that considers dropping out the norm may help better explain these results.[4]

Section II develops a simple model that considers when dropping out is the best option for a student that views education as an investment. Section III covers the school leaving law changes in England and Ireland since 1925. The data and methodology for identifying the effects of these laws and the overall effects from additional education are described in Section IV. Returns to schooling estimates are shown in Section V, along with earnings profile estimates from additional schooling and present value estimates of the gains from additional schooling. Section VI considers four alternative school choice models under different behavioral assumptions that may help explain the empirical findings. Section VII concludes.

II. Optimal School Choice

[4] Parents may also influence school leaving decisions. Inefficient school attainment outcomes may arise if parents cannot internalize children's returns [Baland and Robinson, 2000, and Loury, 1981]. I discuss this possibility

In this section, I develop a traditional human capital model of intertemporal school choice that assumes forgone earnings and effort, and possibly being liquidity constrained, are the only costs incurred while attending school.

A. The base model

The base model for considering school attainment decisions, an extension from Card (2000), assumes an individual discounts future consumption geometrically and faces possible effort costs. In year 0, an individual chooses whether to take an additional year of school ($S = 1$), or not ($S = 0$). Her lifecycle utility, extending to year T and conditional on school choice and a given consumption profile is:

$$(1)\ V(S,t) = u(c(0)) - \phi(S) + \sum_{t=1}^{T} \delta^t \left[u(c(t)) + \theta(S,t)\right].$$

Year 0 utility is $u(c(0)) - \phi(S)$. The term $u(c(t))$ denotes year t utility from consumption, which is increasing and concave, and $\phi(S)$ is a function that reflects the relative disutility from attending school.[5] Per-period utility after year 1 is $u(c(t)) + \theta(S,t)$. $\theta(S,t)$ captures the possibility of non-pecuniary utility in year t from school. The individual incurs these benefits independent of changes in consumption from income due to school. She also discounts future utility geometrically at a rate δ.

I examine the school choice decision with and without liquidity constraints. If an individual can borrow or lend freely at a fixed interest rate r, then the intertemporal budget constraint is

$$(2)\ \sum_{t=0}^{T} R^t c(t) = \sum_{t=0}^{T} R^t y(S,t),$$

below. For the theoretical discussion, however, I examine the school choice decision solely from the student's perspective.

[5] $\phi(S)$ might be a negative function of S, in which case an individual would gain utility from attending additional school.

where $R^t = \frac{1}{(1+r)^t}$, and $y(S,t)$ is school dependent income in year t. With known benefits and costs from schooling in the first period, but uncertain consequences afterwards, an individual's optimal schooling choice and optimal consumption path maximize

$$(3)\quad \Omega(S,t,\lambda) = u(c(0)) - \phi(S) + \sum_{t=1}^{T} \delta^t E\left[u(c(t)) + \theta(S,t)\right] - \lambda\left\{\sum_{t=0}^{T} R^t c(t) - \sum_{t=0}^{T} R^t y(S,t)\right\}.$$

The individual's optimal strategy is not to take an additional year of school if the marginal cost from the additional year exceeds the present value of the marginal benefit. That is, the first-order conditions imply an individual prefers to drop out if:

$$(4)\ -\frac{\partial y(S,0)}{\partial S} + \frac{1}{\lambda}\frac{\partial \phi(S)}{\partial S} > \sum_{t=1}^{T} R^t \left[\frac{\partial y(S,t)}{\partial S}\right] + \frac{1}{\lambda}\sum_{t=1}^{T} \delta^t \frac{\partial E\theta(S,t)}{\partial S},$$

The first term on the left-hand side of (4), $-\frac{\partial y(S,0)}{\partial S}$, captures the foregone earnings from working full-time relative to that from part-time and summer employment while in school (the term is positive). The second term measures the additional effort costs incurred while a student for the additional year. The benefits from additional schooling, on the right-hand side of (4), include the expected present-value earnings gains from more education, plus the non-pecuniary benefits, discounted by δ^t. A nice feature of equation (4) is that both costs and benefits are expressed in currency. This arises because utility is discounted by the shadow price for a unit of year 0 consumption, which is λ.

Notice if the direct disutility from school is zero and non-pecuniary benefits are zero, the decision to continue becomes purely a financial one: when the expected present value of earnings exceeds the loss in earnings while in school, the individual takes the extra year of school. Earnings are discounted by R^t and not δ^t because earnings can be used for consumption in any period if no borrowing constraints are faced.

A worthwhile alternative case to consider is when the individual is liquidity constrained. Suppose that the individual cannot borrow in year 0, the year she must decide whether or not to continue school.[6] Under this scenario, the individual chooses education and consumption to maximize:

$$(5)\ \Omega^*(S,t,\lambda) = u(y(S,0)) - \phi(S) + \sum_{t=1}^{T} \delta^t E\left[u(c(t)) + \theta(S,t)\right] - \lambda^* \left\{ \sum_{t=1}^{T} R^t c(t) - \sum_{t=1}^{T} R^t y(S,t) \right\}.$$

The individual's new optimal strategy is not to take additional schooling if:

$$(6)\qquad -\frac{1}{\lambda^*}\frac{\partial u(y(S,0))}{\partial S} + \frac{1}{\lambda^*}\frac{\partial \phi(S)}{\partial S} > \sum_{t=1}^{T} R^t \left[\frac{\partial y(S,t)}{\partial S}\right] + \frac{1}{\lambda^*}\sum_{t=1}^{T} \delta^t \, \frac{\partial E\theta(S,t)}{\partial S}.$$

Equation (6) is very similar to equation (4), with the main exception that the individual's marginal cost from an additional year of school now includes her disutility from less consumption compared to that if she worked and weighted by $\frac{1}{\lambda^*}$, the inverse shadow price for first year consumption.

To get some idea of the implications from such a model, consider the case when $R = \delta$, so that consumption is constant after the first year, and changes in consumption from schooling are proportionate to changes in present value earnings (after year 0). Let the yearly marginal benefit from

[6] The single year liquidity constraint simplifies the discussion but is not a restrictive assumption. Being liquidity constrained for later years leads to similar conclusions.

additional schooling be constant, so that $\frac{\partial E\left[u(c(S,t))+\theta(S,t)\right]}{\partial S}=\frac{\partial E\left[u(c(S))+\theta(S)\right]}{\partial S}$, with these benefits beginning in year τ. Then we can express the decision rule in terms of the ratio of the initial costs from schooling to the annual benefit stream, which is dependent only on R, τ, and T:

$$(7)\quad \frac{\frac{\partial\phi(S)-\partial u(y(S,0))}{\partial S}}{\frac{\partial E\left[u(c(S))+\theta(S)\right]}{\partial S}} > \sum_{t=\tau}^{T} R^{t}\ .$$

How much would first year costs have to exceed annual benefits from additional school to rationalize dropping out? Table 1 shows the minimum magnitude of the costs to yearly benefits ratio in order to compel an individual to drop out. If we assume an annual stream of benefits for 50 years after the additional year of school, and a discount factor of .95 (so $r=5.2\%$), the relative disutility from attending school would have to be 17.5 times greater than the relative annual gain from school. Even with lower discount rates, or postponing the start of benefits, the ratio seems substantial.

What is the present value stream of benefits from additional school? My strategy is to estimate lifecycle gains in earnings from additional schooling and to estimate how much of an increase in subjective well-being from additional school is due to earnings to approximate the entire right-hand side of (4) or (6). Note the empirical estimates of the total discounted benefits from education are the same whether one believes the liquidity or non-liquidity constrained case above. Only the interpretation of the opportunity cost of education differs.

B. Discounting

In the base model, a student drops out if the forgone earnings and effort costs from continuing another year are larger than the present value financial returns from the extra year plus possible non-pecuniary gains. Compelling a would-be-dropout under this model to take the extra year would lower her lifetime expected utility.

In order to begin to evaluate whether the base model explains dropout behaviour, we must consider appropriate discount rates for R and δ. The appropriate financial discount rate to use is similar to that for treating education as an investment decision. A better depiction of the school-choice model involves choosing between alternative earnings distributions. If a student is risk-neutral, then only differences in expected returns matter and a risk-free financial discount rate to convert future expected returns to present value should be used. If a student is risk-averse, higher expected returns from additional schooling may matter less if the variance in expected earnings is also higher.

To assess the degree of risk ideally, we would like to know the counterfactual earnings that dropouts would have made had they continued one more year (and vice versa). Without this information, of the small literature that investigates this issue, the most common approach to measure riskiness of education involves comparing variances of log earnings among different education groups for students with similar characteristics. The previous literature focuses on whether earnings uncertainty increases when extending schooling beyond high school (e.g. Levhari and Weiss, 1974 and Chen, 2002). The uncertainty from extending a student's minimum education attainment level by one year, however, is not comparable with these earlier estimates since additional high school is unlikely to contribute to human capital specialization.

The appendix provides evidence that additional high school is <u>less</u> risky than without. I also find dropouts that faced more restrictive school-leaving ages are less likely to be unemployed. The results support a preference for using a risk-free financial discount rate to make present value comparisons. For sensitivity analysis, I consider a range of possible rates: 3 percent, 5 percent, and 8 percent. All three assumptions generate similar conclusions.

A high geometric time preference rate (a low δ) raises the weight on effort costs and lowers the present value of non-pecuniary education gains. However, values of δ below 0.90 or even below

0.95 imply changes to a student's utility more than 15 years from now are almost inconsequential compared to similar changes that happen immediately. A discount factor can serve as a useful control for future uncertainties such as the probability of death or severe illness. O'Donoghue and Rabin (2001), however, point out that it seems inappropriate to place 5 times more emphasis on our well being at age 15 than our well being at age 35 when making school attainment decisions. A student should evaluate her school attainment decision with a δ closer to one if she wants to account for expected consequences of her decision when of working age and when old.[7]

III. Minimum School-Leaving Laws in Great Britain and Ireland[8]

Legislation from Great Britain's 1944 Education Act led the school leaving age in England, Scotland, and Wales to rise in 1947 from 14 to 15 years.[9] In 1973, the leaving age increased again to 16 years. Figure 1 displays the remarkable effect these legislative changes had on early school-leavers. Before 1947, a very high fraction of children left full-time school at age 14 (or less). Over just three years however – between 1945 and 1948 – the portion of 14 year-olds leaving schools falls from about 57 percent to less than 10 percent.[10] The ability to accommodate the massive rise in enrolment was possible through a concerted, almost military-like, national operation that expanded the supply of teachers, buildings, and furniture within the three-year span. The 1947 change seems to have little

[7] Even if a lower intertemporal discount rate is preferred, present-value estimates of the benefits from education are not altered significantly since the financial discount rate should be used to compute monetary present value gains.

[8] Immensely influential changes in school-leaving laws in Britain and Ireland provide a means to estimate the returns to compulsory schooling over a wide array of outcomes using several large datasets. The results are used below to discuss optimality or sub-optimality of school leaving decisions. But the discussion does not rely solely on the UK results. It is worth mentioning that the discussion also applies to similar results found for different countries, under different circumstances [e.g. Angrist and Acemoglu, 2002, Oreopoulos, 2003b].

[9] For a more detailed analysis of the history of British education and the 1944 Education Act in particular, see Halsey, Heath and Ridge (1980). The authors argue, "the 1944 Act put a legislative stamp on forty years of progress towards separate, competitive, and free secondary education for all". Although other reforms were included in the Act, the changing of the school-leaving age in 1947 had, by far, the most sudden and influential impact on students.

[10] The finding that some adults reported finishing school at age 14, even after the school-leaving age had changed, likely reflects measurement error, noncompliance, or delayed enforcement.

effect on the fraction of children leaving school at age 15 or less – it appears virtually everyone that would have left school at age 14, left at age 15 after the change. By 1971, the fraction of 15 year-olds leaving school at age 15 or less is 30 percent. Two years later, the fraction drops to 8 percent, corresponding with the school-leaving age rising from 15 to 16 in 1973.

The prime motivation for increasing the school leaving age was to 'improve the future efficiency of the labour force, increase physical and mental adaptability, and prevent the mental and physical cramping caused by exposing children to monotonous occupations at an especially impressionable age' [Halsey et al., (1980, p. 126)]. Support for raising the school-leaving age was widespread for many years before the legislation was enacted. Most in favor stressed the new law would diminish the number of jobs with few promotion opportunities while expanding the nation's aggregate human capital. Opposition for the change was mainly driven by concerns with short-run reductions in the supply of juvenile labor [O'keefe, 1975].

For those wanting to advance in school beyond age 14 prior to 1947, the process typically involved moving from elementary to secondary school at age 12. Elementary schools offered education past age 11, but usually students that stayed did so until reaching age 14. Pupils transferred to secondary school at age 11, at no cost, on the basis of competitive examinations. The proportion of free places began in 1907 at 25 percent of total attendance, and rose to more than 50 percent by 1931. The other half entered by paying fees that were subsidized more than two-thirds by the state. The 1944 Education Act removed these fees, in addition to making the first year of secondary school compulsory.[11]

The 1947 Education Act in Northern Ireland was closely modeled on the British one. The rise in the school-leaving age, from 14 to 15, however, was not implemented until 1957. Figure 2 charts the proportion of youths aged 14 dropping out, and the proportion dropping out at 15 or less. A clear break occurs for the portion of early school-leavers in 1957. Both the fraction of school-leavers aged 14 and

[11] For a discussion of the history of British and Irish education over the period of analysis, see Halsey at al. [1980], Barnard [1961], Dent [1954, 1957, 1970, 1971], Gosden [1969] and Durcan [1972].

15 in 1957 fall discontinuously. The influence on school attainment from the other school-leaving age change, from 15 to 16 in 1973, is clearly visible.

In the Republic of Ireland, the minimum school-leaving age did not change to 15 from 14 until 1972. Figure 3 displays the fraction of school-leavers at age 14 or less and age 15 or less. The downward trend of the early dropout rate declines at a fairly constant rate. The law change in 1972 does not seem to have affected school leaving patterns. The dropout rate among 14 year-olds is already low by that time.

IV. Empirical Approach and Data

The changes in minimum school-leaving laws presented above are combined to identify the effects of additional schooling on earnings, subjective well-being, and other outcomes. This section presents the methodology to estimate these effects and to convert projected earnings profiles into present value. The data is discussed at the end of this section.

A. Measuring Returns to Compulsory Schooling

The reduced form analysis examines the effect the British and Irish minimum school-leaving laws had on particular outcomes – earnings in particular. Define y_{ijklmn} as an outcome variable for individual i, at survey age j, from birth cohort k, from nation l, surveyed in year m, and finished full time schooling at age n. Since the level of dropout-age variation is not at the individual level but at the birth cohort and nation level, outcomes are first grouped into cell means. Define $\bar{y}_{jklmn}$ as the mean outcome for individuals within cell i, j, k, l, and m. To correct for serial correlation, all regressions are further clustered by nation, and weighted by group cell sample size. The baseline reduced form regression equation is:

(8) $$\bar{y}_{jklmn} = \gamma_1 drop15_{kl} + \gamma_2 drop16_{kl} + e_j + e_k + e_{lm} + e_{jklmn},$$

where $drop15_{kl}$ and $drop16_{kl}$ are indicator variables for whether a birth cohort from nation l may leave school at age 15 or age 16 respectively. The omitted variable indicates whether a cohort may leave school at age 14. The terms e_j and e_k, are age and birth cohort fixed effects. I also include nation fixed effects interacted with survey year, to accommodate inflation and different business cycles across nations. Multiple years of cross-section data allow for simultaneous age, birth cohort, and survey year fixed effects. Two of these fixed effects must be assumed the same. I assume the effects for the earliest two birth cohorts are the same. Alternative assumptions are inconsequential. The remaining error term, e_{jklmn}, is assumed identically and independently distributed. Only individuals aged 18 to 65 are included in the analysis.[12] Huber-Eicker-White standard errors are clustered by nation in all estimates.

Equation (8) uses more than time discontinuities to identify the effects from school-leaving laws. Time trends in the outcome variable are controlled for with birth cohort and nation fixed effects. Identifying the effects from school-leaving laws comes from differences in the timing of these laws across nations. The analysis is therefore similar to difference-in-difference estimation, but with more than one intervention and more than one 'treatment group'. The effects from school-leaving laws are not identified if time trends in the outcome variable vary by nation. Several specification checks are carried out in Section IV to examine this possibility.

The baseline instrumental variable equation is:

(9) $$\bar{y}_{jklmn} = B^{IV}\bar{S}^{IV}_{jklmn} + e_j + e_k + e_{lm} + e_{jklmn},$$

where $\bar{S}^{IV}_{jklmn}$ is the predicted mean school attainment from estimating $\bar{S}_{jklmn} = \gamma_1 drop15_{kl} + \gamma_2 drop16_{kl} + e_j + e_k + e_{lm} + e_{jklmn}$ by instrumental variables. B^{IV} is the instrumental variable estimate for the returns to schooling on the outcome variable (identified by those affected by the law changes).

B. Data[13]

I use three different sets of surveys. The advantage with using the British Labor Force Surveys is that they are very large, but, unfortunately, they are without earnings information prior to 1993. The British and Northern Ireland General Household Surveys include several years of individual and family income data for the UK, but limited earnings variables for Northern Ireland. The advantage with using the Eurobarometer Surveys is that they contain measures of subjective well-being and include data for the Republic of Ireland. The disadvantage is that they report family, not individual earnings.

i. General Household Surveys

I match 15 UK General Household Surveys (GHHS), from 1983 to 1998, to 13 Northern Ireland Continuous Household Surveys, from 1985 to 1998. I shall refer to both as General Household Surveys, since both questionnaires are almost identical. The major difference is that earnings

[12] Questions about labor market earnings in one of the surveys used are asked only to adults aged 65 or less. Alternative age restrictions do not change the findings.

information from the UK GHHS is coded exactly, while earnings are grouped into categories in the NI GHHS. Both include information about household income, individual earnings, unemployment status, general health status, leisure activities, and age completed full time education. Average earnings are assigned for Northern Irish individuals within grouped earnings categories. The combined dataset contains 321,656 individuals aged 18 to 65, although not every survey year contains the same questions. Only British born adults are included, however, foreigners living in Northern Ireland are not identified.

ii. Labor Force Surveys

I combined 32 annual and quarterly Labour Force Surveys (LFS) between 1985 and 1998 to create a large sample of 2,411,502 native born adults aged 18 to 65, with 2,425,296 from Great Britain, and 86,206 from Northern Ireland. The LFS contains information on employment, disability, and income after 1993.

iii. Eurobarometer Surveys

The Eurobarometer Surveys began in 1970 by the Commission of the European Community, and are designed to track opinions, attitudes, and subjective satisfaction among members of the EC. Each survey contains a sample of about 1,000 nationally representative individuals per country. Northern Ireland is treated separately from Great Britain, with a sample of about 300 per survey. Surveys are carried out more than once a year, from 1973 to 1998. A total of 50 surveys are combined to create a dataset with 87,475 individuals aged 18 to 65 from Great Britain, the Republic of Ireland, and Northern Ireland. Some of the more useful variables include respondents' age when they finished

[13]The STATA code for generating the data for this study is available on request. All surveys used are available

full-time school; self-reports of unemployment; family income (measured in brackets), and a measure of subjective well-being. Each survey asks, "On the whole, are you very satisfied, fairly satisfied, not very satisfied, or not at all satisfied with the life you lead?" And about half of the surveys ask, "Taking all things together, how would you say things are these days – would you say you're very happy, fairly happy, or not too happy these days?"[14] Family income amounts are assigned according to the average between the upper and lower earnings bracket an individual is in.

V. Results

A. OLS and IV Estimates

Least squares and instrumental variable estimates for the returns to schooling on earnings and income using all three surveys are shown in Table 2. All regressions include fixed effects for age, sex, birth year, and nation interacted with survey year. Data are grouped into means by age, sex, birth year, nation, survey year, and age finished full time schooling. Huber-Eicker-White standard errors are shown from clustering for nation.

Columns 1 and 2 give the reduced form results from regressing earnings on the variables indicating whether individuals were allowed to leave school at age 15 or 16. Without observations from the Republic of Ireland, the GHHS and LFS are not able to identify the effect from a school leaving age of 16, since the change occurred in the same year for Britain and Northern Ireland. The first-stage effects of minimum school-leaving laws on education attainment are large enough (see

through UK Data Archive.

[14] In an earlier version of this paper, Oreopoulos [2003a], I discuss the validity and interpretation of the instrumental variables estimates using subjective well-being measures for the dependent variable. The approach identifies an effect of additional schooling on self-reported well-being if those constrained to take an extra year of schooling are more likely to report being satisfied with life than those unconstrained, controlling for age, nation, birth cohort, and survey year. Under minimal assumptions, the estimated returns to compulsory schooling on a

previous figures) to observe a large reduced form effect. Individuals not able to leave school until age 15 received, on average, 6 percent higher earnings than those able to leave school at age 14. Those constrained by a school-leaving age of 16 experienced even larger increases in earnings.

The instrumental variable (IV) returns to schooling estimates under column (5) are similar across surveys, ranging from 12.4 to 13.8 percent. These results are also comparable to those found by Harmon and Walker (1995). The ordinary least squares (OLS) returns to schooling estimates are lower, but the sample behind these include adults in all education attainment categories, whereas identification in the IV case comes from only those affected by the law changes. When OLS estimates are taken for only those who finished schooling before age 17, the coefficients are similar to the IV ones, suggesting returns to schooling were higher at lower levels of education. For this reason, all subsequent OLS comparisons use the sample that finished schooling before age 17.[15]

The results in Table 3 show other effects from schooling. Health outcomes are strongly associated from the minimum school-leaving age changes, corroborating with Lleras-Muney's (2002) finding that schooling lowers mortality. The GHHS questionnaire asks respondents to self report whether they are in good, fair, or poor health. A one-year increase in schooling lowers the probability of reporting being in poor health by 3.7 percentage points, and raises the chances of reporting being in good health by 8.2 percentage points. Additional schooling reduces the chances of having a work-restricting disability, which includes depression.

Schooling also affects many labor market outcomes in addition to earnings. In all three datasets, individuals compelled to drop out later are less likely to work in blue collar, unskilled manual occupations and more likely to work in service sector and semi-skilled occupations. Results from the Labor Force Surveys show education reduces the likelihood of receiving unemployment insurance by about half a percentage point per year. Data from the Eurobarometer surveys show adults with an extra

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binary measure of well-being can be interpreted as the increase in likelihood that an individual's utility exceeds an unknown, but constant, threshold.

[15] Oreopoulos [2003a] includes OLS results with the full sample.

year of schooling are 1.9 percentage points less likely to self-report being unemployed. More educated workers are also less likely to actively seek employment elsewhere.

Table 4 shows the effect of education on subjective well-being. The first row uses the Eurobarometer life-satisfaction variable, assigning a value of 1 if an individual reports being not at all satisfied with life, 2 if not satisfied, 3 if fairly satisfied, and 4 if very satisfied. Life satisfaction increased for those who faced more restrictive minimum school-leaving laws. From column (4), IV estimates find one year of additional schooling increases the likelihood of being overall satisfied with life by 5.4 percent, and increases the likelihood of being very satisfied by 2.4 percent. The IV coefficient estimates are similar to the OLS ones. Adults from the Eurobarometers that faced higher school-leaving ages are also happier. Those with additional schooling are more likely to report being very happy or fairly happy, compared with those with less schooling.

These estimates are robust to regressing over any two-nation sample instead of three, or restricting the data to a 20 year birth cohort and estimating returns to compulsory schooling solely from the 1947, 1957, or 1973 change in the school leaving age. The minimum school leaving laws affect survey responses from adults who finished schooling before age 17, but not after, as we would expect, since those with higher education already intended to finish school beyond the minimum leaving age. These robustness checks are shown in the appendix.

C. Present Value Gains from Additional Schooling

i) Financial Returns from Schooling

I use the same laws to estimate the expected present value earnings gains implied by finishing school at age 16, rather than 15. Instrumental variables estimates for the returns to schooling on earnings that use changes in the school leaving age in 1947 and 1957 cannot identify the effects of additional schooling for earlier ages than 41 in my data. Since we would like to convert gains to present value, we should analyze whether they occur at younger ages. To do this, I drop birth year fixed effects from the regressions to allow identification of the returns to schooling for younger years from the minimum school-leaving age change in 1972. I also calculate earnings profiles for males only, to avoid women's labor supply issues, and use the GHHS British sample that contains the most accurate and largest earnings data of the three surveys.

Figure 4 graphs the log earnings profiles (measured in 1998 British pounds) for males leaving school at age 15 and age 16, estimated from least squares regression with the sample restricted to those finishing school before age 17. The regression includes age, age squared, and age cubed, survey year fixed effects, and age finished full-time education. Since these results are used to estimate expected future earnings, I did not restrict the sample by looking only at employed or full-time workers. This may explain the steep earnings progression at younger ages. Those who left school at age 16 earn 12.1 percent more, each year, than those who left school at age 15.

The IV earnings profile estimates are virtually the same (shown in Figure 5). The regression used for calculating the profiles is the same as the one used for Figure 4, except minimum school-leaving age indicators instrument age finished full-time education. The implied return to schooling is 12.4 percent.

The final earnings profile estimate allows for the possibility that the return to schooling differs over age. The regression, for this case, includes additional indicator variables for adults aged 35 to 44, 45 to 54, or 55 to 65, who finished school at age 15 or more. The instrumental variables now also include these dummies interacted with the school-leaving age dummies. Figure 6 displays the implied profiles. The log earnings profile for males who left school at 15 has much the same shape as before. Returns to schooling for adults leaving school at 16, relative to those leaving at 15, are larger in earlier than in later years. The estimated return to schooling for 27 to 34 year olds (and projected back to 16 year-olds) is 15.7 percent. The return to schooling estimated for 35 to 44 year-olds is 10.2 percent.

The return to schooling then falls for later ages, to 5.2 percent and 0.4 percent for ages 45 to 54 and 55 to 65 respectively.

Table 5 converts these amounts to present value (to age 15), using discount rates of 3, 5, and 8 percent. The average present value (PV) differences in projected lifetime earnings between adults who left school at 16 and those who left at 15 are shown in columns 3 to 5. The PV gains generated from all three regressions are similar. For the IV estimates assuming a constant rate of return from schooling, men leaving school at 16 earned, on average, 31,907 pounds more than men leaving school at 15, assuming a discount rate of 3 percent.

Compare this amount with the financial opportunity cost of staying in school for an additional year. Column (1) shows the average earnings men who left school at age 15 receive, between age 16 and age 20. Under a 3 percent discount rate, average PV gains from the additional year of school are 6.5 times greater than a student's financial opportunity cost (in row 2). Even with a 5 percent discount rate, PV gains from schooling are still 4.4 times greater than earnings predicted after finishing school. Another way to get a sense of the relative size of the predicted gains from additional education, is to compare them with the maximum annual earnings an individual who left school at age 15 receive. Using the IV projections with a constant return to schooling, the PV financial gains from education for a persons taking one more year of schooling are almost twice as large as the maximum lifetime earnings that person would make if they did not take the extra year, assuming a 5 percent discount rate, and more than 4 times as large assuming a 1 percent discount rate.

ii) Non-financial Returns from Schooling

In the base model from section II, optimal school attainment may depend on pecuniary and non-pecuniary gains. Allowing for non-financial benefits from education (such as being less likely to lose one's job, more likely to be happy with one's occupation, and less likely to commit crime) further raises the total benefits from more schooling. The evidence in Table 6 suggests such benefits may be considerable.

The IV coefficient in column 1 from regressing an indicator for life satisfaction on education captures the increase in probability that education raises utility by an unspecified threshold. If income was the only factor influencing this variable, then, conditional on having the same income (and present value wealth), the coefficient should fall to zero. To check this, column 3 adds a complete set of family income group dummies for the IV regression from the Eurobarometer Surveys. Conditional on reporting being in the same family income bracket, the probability of reporting life satisfaction still rises by 4.3 percentage points. A potential problem with this analysis is that persons with more schooling in the highest income brackets may still have more family income, on average, than persons with less schooling in the highest brackets (and vice versa). Column 4 attempts to address this by removing all individuals from the highest and lowest brackets. Conditional on being in the same family income bracket, the coefficient of education on well-being still falls only by 40.2 percent.

If we assume no remaining omitted variables bias, the result suggests that 40 percent of the gains in life satisfaction from additional schooling are attributable to income, while the other 60 percent to non-pecuniary benefits. If financial and non-financial outcomes were perfectly substitutable, an equivalent total gain from education would be to add 150 percent of the income portion of benefits to total benefits, and reduce non-pecuniary benefits to zero. Perfect substitutability underestimates the amount of income required for equivalent compensation if $u(c(S))$ and $\theta(S)$ are concave. Without it, equivalent compensation would be higher.

Ideally, this exploration should use a second instrument for income or some other means to identify income effects on self-reported well-being independent of education effects. Nevertheless, taken together with the wide range of variables that seem to change with extra schooling, the results are suggestive education has more than just a monetary impact.

Non-pecuniary results simply reinforce the size of the estimates for the gains from schooling. The last three columns of Table 5 convert the total benefit from an additional school year into a compensating differential, measured in present value at age 15 by dividing the financial gains in columns 3 to 5 by 0.4. The total gains from school are, of course, larger. With a 5 percent discount rate, for example, total gains for dropping out 1 year later are more than 10 times larger than predicted earnings the first year out, and more than 4 times larger than a dropout's projected peak annual earnings.

iii) Lower expected returns to schooling

A possible criticism with the above calculations is that expected returns may have been lower at the time school attainment decisions were made. Gottchalk and Smeeding (1997) and others document sizable increases to the college/high school wage premium in the United States and the United Kingdom over the 1980s and 1990s. The premium rose from about 20 percent in the 1980s to 30 percent by 1995 (Brunello, Comi, and Lucifora, 2002). Whether a rise also in the return to education at lower levels of education attainment occurred remains less clear. Least squares estimates for the returns to education on log family income from 1975 to 1996, using the Eurobarometer Surveys, find little variation across years [not shown]. From 1975 to 1984, the estimates ranged between about .10 and .14, and afterwards from about .12 to .16. Estimates from the 1984 to 1996 General Household Surveys range by about 4 percentage points, with no consistent upward or downward trend. Using the school leaving age change in Britain, Chevalier et al. (2002) find similar estimates over time using adult males from the British Family Expenditure Survey. They find estimated returns to education on earnings remained between 13 and 16 percent from 1978 to 1995.

While there appears no significant reason to believe expected returns to education differed at the time individuals made school choice decisions in my data, compared to average actual returns realized later, I cannot rule out the possibility. But even assuming an expected return of 8 percent above the earnings profile of a student dropping out at age 15, the present value gains are substantial. The last row of Table 5 shows estimated present value gains from schooling, assuming a constant 8.0 percent return, instead of the constant 12.1 percent estimated return in row 2. Using a 5 percent discount rate, present value financial returns are 2.7 times greater than the estimated earnings one year out of school, and greater than the average maximum annual earnings for a dropout at age 44. Present value gains are even higher if accounting for any future non-pecuniary benefits.

iv) Heterogeneous returns to schooling

The results estimate average treatment effects from additional schooling. They do not imply every dropout faces high opportunity costs from leaving. But if some fraction of the sample was unaffected by the school-leaving age change, the returns for those who were affected must be higher. Suppose 30 percent of students should expect no gain from addition education. The remaining fraction's average treatment effect is $\hat{\beta}^{IV}/.7$, where $\hat{\beta}^{IV}$ is the total sample instrumental variables estimate for the returns to education on earnings. Using this estimate for the returns to schooling for those who would gain, the present value earnings benefit, with a 5 percent discount rate, is £31,622 instead of £21,540 – now more than 2.5 times a dropout's average annual salary age 44, without accounting for non-pecuniary gains.

VI. Why do School leavers Leave?

A. Efficient Models of School Choice

Without liquidity constraints, an investment model of education, as described in section II, says students should leave if their forgone earnings and effort costs exceed the expected present value of benefits from an extra year. For a likely majority of UK students in the mid-20th Century, Table 5 implies one-year attendance costs would have to exceed at least 3 to 7 times forgone earnings to prefer dropping out. In other words, even before taking into account non-pecuniary returns from schooling, these students would have to value effort costs from attending school by at least £16,633 – more than their expected maximum lifetime annual salaries – in order to prefer dropping out (using a 5 percent discount rate). Including possible non-pecuniary health and lifestyle benefits from schooling, the costs would have to be much larger. With liquidity constraints, as in equation (6), the interpretation is slightly different. The expected present value gains from schooling must be offset by the utility loss from forgone earnings while attending school plus effort costs. As a possible baseline estimate, suppose that 30 percent of UK would-be-dropouts can expect no gain from additional education and financial gains for those that do benefit are half the value of total gains. Using a 5 percent discount rate, utility loses from forgone earnings and effort costs for one year in school must be worth more than £63,244 among students that would gain, in order for them, under the base model, to prefer dropping out.

If attendance costs were high, reducing borrowing constraints or psychic disutility from attending school would constitute substantially effective and inexpensive policies to benefit students by encouraging them to stay on. But similar results for students that faced a minimum school-leaving age of 15, and for students exposed to different compulsory laws in the U.S. and Canada, no financial cost was imposed to obtain additional school. The 1990 Eurobarometer Youth Survey offers some evidence, for later cohorts, that liquidity constraints or attendance costs play no significant role in school leaving decisions. The survey allows a comparison of 15 year olds in Britain, who report wanting to finish school at age 16 (the earliest age possible) with 16 year olds not in school who report they finished "immediately, after dropout age". Under the base model, period utility should rise for dropouts after leaving school, since effort and liquidity costs fall to zero. We might expect to also observe self-reported well-being higher for youth leaving school immediately after the dropout age than for youth having to wait another year. We do not. In Table 7, average well-being is lower among 16 year old males and females who left school at age 16 in contrast to 15 year olds who report they plan to leave school at age 16. More than 90 percent of 15 year-olds wanting to drop out at 16 report being satisfied overall with life, but only 80 percent are satisfied among 16 year olds who finished school. Average well-being falls for similar aged youth unaffected by the dropout age, but not by as much.

About 26 percent of students in my sample of 15 year olds who say they plan to leave at age 16 report financial difficulty. But finishing school does not appear to improve their situation. The fraction reporting being in a difficult financial position among 16 year olds out of school is 37 percent. Obviously the transition from school to work may affect how individuals respond to these questions. But finding that individuals respond being worse off financially and emotionally after leaving school suggests the costs while constrained to stay in school may not be so high. More than 50 percent of 16 to 25 year olds leaving school immediately at the minimum school leaving age said they left because they did not like it, or saw no point in going on (Table 8). Only 12.6 percent said they needed money, and almost no one said they left because their parents needed money or they had to raise a child. A much higher fraction of youth who left after the minimum age said they had gone on as far as they could.

B. Alternative Models

i. identity

Ethnographic studies show very little evidence that youth make education attainment decisions in a way to maximize their human capital investment. A central theme from the works of Coleman (1961), Cusick (1972), Everhart (1983), Gordon (1957), Hall (1904), Hollingshead (1975), Jackson (1968), Roderick (1993), and Willis (1977) is that adolescent concerns about self-image or peer acceptance predominate adolescent behavior. The importance of a student's attitude towards school, ingrained by their social and cultural background, in influencing her school choice decision, may help explain early school leaving decisions.

Gordon (1957), for example, conducted a study in a mid-western high school in the 1950s. He was interested in the premise that the chief motivation of students in high school was that of being liked and accepted by peers, and that such motivation in turn affected important dimensions of student life. Gordon concluded that the dominant motivation of a student is to maintain a general social status within the organization of the school. Students created their own mechanisms for rewards most important to them. Involvement in academic issues was at the minimally accepted level.

Deviating from behavior common to one's social group may evoke anxiety and discomfort in one's self and in others, even if such behavior, without considering self-image, would raise lifetime utility. To analyze the possible effect of cultural norms, relative to the base model, I incorporate recent models by Akerlof and Kranton (2000,2002). Define the social group a student identifies with in period t as $I(t)$, which may include friends, parents, role models, etc…. Let $\Phi\left(S, E(S \mid I(t))\right)$ be a student's period t utility (or disutility) from attaining school level S, relative to the education attainment she perceives is expected of her by those she identifies with, $E(S \mid I(t))$. Her lifetime utility is:

$$(13)\, V(S,t) = u(c(0)) - \phi(S) + \Phi\left(S, E(S \mid I(0))\right) + \sum_{t=1}^{T} \delta^t \left[u(c(t)) + \theta(S,t) + \Phi\left(S, E(S \mid I(t))\right)\right]$$

Compared to the base model, the costs associated with extending school and going against the opinions of others from one's identity may dwarf any expected independent gains from not dropping out.

Note that I allow for the possibility that a student's identity might change. The possibility is not crucial for the argument that self-image concerns may increase a student's likelihood of dropping out, but it does increase this likelihood. If a student identifies with a group that expects her to dropout, but she does not, she initially receives disutility from not behaving the same way as others in her group. Over time, however, she may associate with a new social group, or those from her initial group may accustom to her decision. In both cases, the disutility from school choice deviating from anticipated school choice, $\Phi(S, E(S \mid I(t)))$, may diminish with time. At period 0, however, the student may not fully anticipate how her self-image might change if she were to take additional schooling. Suppose, for example, she instead projects her current identity when considering her future utility.[16] Then, she prefers to drop out of school when:

$$
(14) \qquad \begin{array}{l} -\dfrac{\partial y(S,0)}{\partial S} + \dfrac{1}{\lambda}\dfrac{\partial\left[\phi(S) + \Phi\left(S, E(S \mid I(0))\right)\right]}{\partial S} > \\ \displaystyle\sum_{t=1}^{T} R^t E\left[\frac{\partial y(S,t)}{\partial S}\right] + \frac{1}{\lambda}\sum_{t=1}^{T}\delta^t E\left[\frac{\left[\partial\theta(S,t) + \Phi\left(S, E(S \mid I(0))\right)\right]}{\partial S}\right] \end{array}.
$$

Comparing this identity model with the base model, a student whose social group considers dropping out acceptable (and even expected) is more likely to drop out in the identity model for two reasons. First, deviating from her social group's expectations and attitudes would likely generate an immediate disutility. Second, she may perceive this disutility to continue in the future.

If the discomfort a student gets from exceeding her social groups' school attainment norm predominates her reason for dropping out, then raising the minimum school leaving age may increase her lifetime utility. She no longer would receive discomfort from her decision, since her social group's school attainment norm would also adjust from the law change. Her peers would also face the new dropout age. Increasing the school leaving age would also prevent her from projecting her current state over her future. A student that would choose to continue schooling, where it not for concerns over how doing so affects her self-image, would be better off under a higher minimum school leaving age policy.

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[16] See Loewenstein, O'Donoghue, and Rabin (2000) for a detailed discussion on projection bias.

ii) hyperbolic discounting

Students value the future, but when making decisions, they value the present temporarily more. Following Laibson (1997) and O'Donoghue and Rabin (1999), one way to incorporate immediate impatience into the school choice model is to add a second discount rate placing more relative weight on the current period versus all other periods:

(15) $$V(S,t) = u(c(0)) - \phi(S) + \beta \sum_{t=1}^{T} \delta^t \left[u(c(t)) + \theta(S,t) \right].$$

In equation (15), a student discounts all consequences beyond the first period from the school choice decision by the factor β. If $\beta < 1$, this quasi-hyperbolic discount factor changes the discounting of this period relative to the entire future. If students could make school choice decisions before facing any imminent opportunity cost, they would place less weight on these costs than when facing them at the time the decision is actually made. Preferences under such behavior are time inconsistent. The condition for dropping out is if:

(16) $$-\frac{\partial y(S,0)}{\partial S} + \frac{\beta}{\lambda}\frac{\partial \phi(S)}{\partial S} > \sum_{t=1}^{T} R^t E\left[\frac{\partial y(S,t)}{\partial S}\right] + \frac{\beta}{\lambda}\sum_{t=1}^{T}\delta^t E\left[\frac{\partial \theta(S,t)}{\partial S}\right].$$

Using the implicit function theorem, it can be shown that $\frac{\partial \lambda}{\partial \beta} > 0$ and $\frac{\partial \frac{\beta}{\lambda}}{\partial \beta} < 0$.[17] The more the individual discounts the future, the larger the weight placed on her disutility from effort at school.

[17] By the chain rule, $\frac{\partial \lambda}{\partial \beta} = \frac{\partial u(c(0))}{\partial c(0)} \frac{\partial c(0)}{\partial \beta}$. The expression, $\frac{\partial u(c(0))}{\partial c(0)}$, is less than zero. Solve implicitly for $c(0))$ using the budget constraint: $c(0) + \sum_{t=1}^{T} R^t g_t \left[\frac{R^t}{\beta \delta^t} u'(c(0)) \right] = k$, where g_t is the inverse function for $y = u'(t)$, and k is positive. The derivative of the inverse function,

Furthermore, a hyperbolic discount rate also lowers the significance placed on the non-pecuniary portion of education's relative benefits. If the student is liquidity constrained the first period, the individual's optimal strategy is very similar to (16), the main exception being that the student's marginal cost from an additional year of school includes her disutility from less consumption compared to that if she worked, with more weight placed on this cost when β is small.[18]

iii) misguided expectations

Another possibility explaining the early school leaving decisions is that students may systematically mispredict expected gains from additional education. Students may not make correct present value calculations of future returns, or may underestimate the real gains from school. Dominitz and Manski (2000) find substantial variation among high school students in earnings expectations conditional on a bachelor degree. While expectations about the returns from a degree were positive, it seems questionable whether would-be-dropouts can anticipate lifetime gains from one more year of school. The annual gains may seem insignificantly small and ignored when comparing them to a large initial burden from staying in school (Rubinstein, 1988). Guidance from parents who themselves dropped out or peers that do not care for school may also lead to misguided expectations of returns to

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$g'(x) = \frac{1}{u''(y)}$, is negative. Finally, using the implicit function theorem, and the fact that $u''(c(t)) < 0$, we find that $\frac{\partial c(0)}{\partial \beta} < 0$. The other expression, $\frac{\partial \frac{\beta}{\lambda}}{\partial \beta}$ can be signed in a similar fashion, using the fact that $\frac{\beta}{\lambda} = \frac{R}{\delta} u'(c(1))$, and computing $\frac{\partial c(1)}{\partial \beta}$.

[18] If a student cannot borrow in the first period, she prefers to drop out if

$$-\frac{1}{\lambda^*}\frac{\partial u(y(S,0))}{\partial S} + \frac{1}{\lambda^*}\frac{\partial \phi(S)}{\partial S} > \sum_{t=1}^{T} R^t E\left[\frac{\partial y(S,t)}{\partial S}\right] + \frac{\beta}{\lambda^*}\sum_{t=1}^{T} \delta^t E\left[\frac{\partial \theta(S,t)}{\partial S}\right].$$

school. With actual expectations below true expectations, $\tilde{E}[.] < E[.]$, the decision to drop out becomes more likely. A student prefers to drop out if:

$$(17) \qquad -\frac{\partial y(S,0)}{\partial S} + \frac{1}{\lambda}\frac{\partial \phi(S)}{\partial S} > \sum_{t=1}^{T} R^t \tilde{E}\left[\frac{\partial y(S,t)}{\partial S}\right] + \frac{1}{\lambda}\sum_{t=1}^{T} \delta^t \tilde{E}\left[\frac{\partial \theta(S,t)}{\partial S}\right].$$

iv) school attainment decisions made by parents

Since few students in secondary school have access to income, parents likely incur a significant portion of the costs associated with children remaining in school. The decision whether to continue past the minimum school leaving age may thus depend on parents' willingness to provide if their children do stay on. Parents may fail to internalize the socially efficient gains from additional schooling. The welfare implications of school compulsion and early school leaving decisions become complicated by the possibility that children gain substantially from additional education while parents do not. The analysis here is analogous to the welfare discussion on the implementation of child labor laws. Baland and Robinson [2000], for example, point out, "if children could borrow when they were young, they could transfer resources to their parents and compensate them for reduced child labor, even if parents subsequently planned to leave no bequests. Alternatively, children could enter into a contract with their parents involving a transfer of future income in exchange for a current reduction in child labor. However, such contracts are in general neither self-enforcing nor legally enforceable". Institutional arrangements that compensate parents for their investment with future resources from children may make all better off.

VI. Discussion and Conclusion

The purpose of this paper is to examine whether early school-leaving decisions are inefficient. I use changes in minimum school leaving laws in England and Ireland, which were extremely influential, to identify financial and non-financial returns to education. Minimum school leaving age changes provide ideal experiments to examine school choice decisions because they compel some students to continue school beyond the level they would choose on their own. I find from this analysis significant lifetime rewards to wealth, health, and overall happiness from having to take another year of school. These results collectively summarize and reinforce earlier studies that also estimate substantial benefits from education through changes in compulsory schooling.

The estimates of the returns from compulsory schooling appear inconsistent with efficient models of school choice. Although this paper's empirical analysis cannot measure precisely liquidity costs and psychological costs incurred from additional school, such costs seem unlikely to exceed the estimated present value gains from an extra year of school: 2 to 7 times the maximum annual wage for the average dropout. Survey responses among school leavers asking why they left as soon as they could do not indicate an urgent desire for income. The alternative explanations considered involve some form of inefficiency. That is, for at least some early school leavers, perhaps a majority, the decision appears sub-optimal.

One explanation points to the importance of a student's social group in determining their active involvement in school. The central theme from ethnographic and psychological research on school life is that seeking peer acceptance and self-identity dominate adolescent concerns, even though such social pressures dissipate with time. If the desire to fit in socially prevents a student from otherwise preferring more schooling, policies that provide incentives or encourage individuals to pursue additional education may not be effective. Raising the minimum school leaving age may be one way to eliminate the disutility from deviating from one's peers, since all of them face the same constraint.

Another explanation to explain dropout behaviour is that students' expectations of what they gain from taking more school are not in line with true expected gains. For example, an 8 percent annual return seems small and insignificant relative to the one-year opportunity cost from not working, which is felt immediately. Rubenstein (1988) proposes individuals ignore small differences like these when making decisions and focus on the largest difference when choosing between one option and another. For this reason, perhaps students' do not make correct present value calculations when making school attainment decisions.

Students might also discount the future hyperbolically. If students could make school choice decisions before facing any imminent opportunity cost, they would place less weight on these costs than when facing them at the time the decision is actually made. Hyperbolic students value the future, but when making decisions, they value the present temporarily more.

A final possibility considered arises from an inability to credibly enforce long-term arrangements between parents and children. Parents that bear costs from accommodating additional schooling for children may not be willing to do so if compensation cannot be guaranteed.

Each explanation carries different policy implications. The ones that imply inefficiency are often not considered. On balance, however, the empirical evidence points away from models of optimal school choice. Historical changes in compulsory school laws were extremely effective in improving overall lifetime welfare. Whether further changes could provide similar gains to early school leavers depends on which explanation underlies the results. The potential to improve such a large set of social and economic outcomes certainly seems to merit further investigation.

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Appendix A: Discounting Ex-Post Future Earnings

This appendix provides evidence that future earnings associated with an additional year of high school are no more risky than future earnings without the extra year. I compare variances of log earnings among groups of students who finished school as early as possible under alternative minimum school leaving laws. The findings provide support to prefer using a risk free discount rate in computing the stream of earnings differentials from additional schooling to present value.

To evaluate the high school drop out decision using the school choice models presented in the paper, a discount rate is used to convert the flow of earnings differentials into present value. If the flow, conditional on schooling, is certain, then the appropriate rate of return is the risk free rate. The discount rate is chosen so that a one-time monetary amount, paid up front, is equivalent to a student's annual income stream over her lifetime. Since the one time amount involves saving for future consumption, rather than borrowing, the rate to use is independent of whether an individual is liquidity constrained.

If a person is risk-averse and future earnings uncertain, we may wish to adjust the discount rate to reflect concern about the potential risk involved in the school investment decision. A higher variance associated with future earnings from additional education will lower the relative expected utility from it compared to the utility with future earnings certain.

To see this more clearly, consider the base school-choice model in section II when the time preference discount factor, δ, equals the financial discount factor, R. This assumption leads to the well-known result that a student attempts to smooth consumption over her lifetime. Suppose also that the student is liquidity constrained at the time the school choice is made. Then the student chooses schooling to maximize the following lifetime utility function:

(A1) $$\Omega^{**}(S) = u(y(S,0)) - \phi(S) + \sum_{t=1}^{T} \delta^t E\{u[y^p(S) + \sigma(s)\varepsilon_i]\},$$

where $y^p(S)$ is the non-stochastic component of lifetime earnings after period 0, conditional on S: $y^p(S) = \frac{1}{T}\sum_{t=1}^{T}\rho^t y^p(S,t)$. Since annual earnings for school attainment S at time t are known, they are discounted using the risk-free factor, ρ. The uncertain component, ε_i, has mean zero and variance 1, and is multiplied by a standard deviation factor that depends on school attainment.

Assuming the function, $u[y^p(S) + \sigma(s)\varepsilon_i]$, may be approximated by a second-order Taylor series around the point, $\varepsilon_i = E(\varepsilon_i) = 0$, the lifetime utility function can be reformulated as:

(A2) $$\Omega^{**}(S) = u(y(S,0)) - \phi(S) + \sum_{t=1}^{T}\delta^t u[y^p(S)] + \sum_{t=1}^{T}\delta^t u''[y^p(S)]\frac{\sigma^2(s)}{2}.$$

Maximizing with respect to S, the condition for preferring not to continue school is:

(A3) $$-\frac{\partial u(y(S,0))}{\partial S} + \frac{\partial\phi(S)}{\partial S} > \sum_{t=1}^{T}\delta^t(U' + U'''\sigma(s))\frac{\partial y^p(S)}{\partial S} + \frac{1}{2}\sum_{t=1}^{T}\delta^t U''\frac{\partial\sigma^2(s)}{\partial S}.$$

Using the assumption that $\delta^t = R^t$, and the definition of the shadow price of consumption, $\lambda^* = \frac{\partial EU(c(t))}{\partial c(t)} = U' + U'''\sigma(s)$, the condition satisfying a drop out decision can be rearranged as:

(A4) $$-\frac{1}{\lambda^*}\frac{\partial u(y(S,0))}{\partial S} + \frac{1}{\lambda^*}\frac{\partial\phi(S)}{\partial S} > \sum_{t=1}^{T}R^t\frac{\partial y^p(S)}{\partial S} + \frac{1}{2\lambda^*}\sum_{t=1}^{T}R^t U''\frac{\partial\sigma^2(s)}{\partial S}.$$

Equation A4 is comparable to equation 6, except for the second component on the right-hand-side. If a student is risk-averse ($U''<0$) and additional schooling increases risk ($\frac{\partial\sigma(s)}{\partial S}>0$), the decision to drop out becomes more likely than the case when future earnings are certain. When using ex-post future earnings to convert income-streams into present value, researchers often correct for uncertainty with a discount rate higher than the risk-free rate. This correction method motivated the use of alternative discount rates in this paper. But an adjustment is necessary only if the variance of outcomes that affect utility rise with schooling.

Levhari and Weiss (1974) suggest that, from the point of the individual, investment in human capital is likely a risky decision. The main reason is that education attainment cannot be bought or sold, which limits the possibility for diversification. As human capital accumulation becomes more specialized, the possibility for avoiding career specific shocks diminishes. The previous literature that investigates these issues focuses on the decision whether to extend schooling beyond high school. But this paper is concerned with extending the minimum education attainment by one year – a consideration that seems unlikely to increase uncertainty since the additional year seems unlikely to contribute to specialization.

To measure the change in uncertainty associated with an extra year of high school, I adopt the methodology most often used from previous studies, which is to compare the variances of log earnings among different education groups for students with similar characteristics. Table A1 shows the variances of log earnings among working British males who finished their full-time education the same age as the minimum school-leaving age. The top half of the table compares 52 to 61 year-olds that left school in 1943 to 45 at age 14 to those that left in 1949 to 51 at age 15. The advantage of looking at these two groups is that the reason for the difference in education attainment is plausibly exogenous, ensuring that the distribution of other background characteristics between them are likely similar (see Figure 1).

After controlling for survey year and age fixed effects, the annual earnings are about 14.6 percent higher, on average, for the group that finished full time education one year later. The difference is similar to that found under the more detailed estimate of the return to schooling in the paper. The log earnings variance for the group that finished school at age 15 is considerably smaller than that for the group that finished at age 14. The second half of Table A1 shows a similar analysis, but for 29 to 37 year-olds that left school in 1968 to 1970 at age 15 and those that left in 1974 to 76 at age 16. The variances between the first group, that faced a drop out age of 15, and the second group, that faced a drop out age of 16, are about the same.

The findings indicate those who obtained additional schooling from compulsory school legislation changes face less uncertainty associated with their earnings outcomes. Table 3 also finds those with additional education are less likely to say they are unemployed. More high school may thus provide a hedge against risk, rather than increase it. A risk-free discount rate (or possibly a lower rate) seems appropriate when converting the estimated stream of ex-post annual earnings into present value.

Appendix A: Robustness Checks

Section V finds adults who attained more education because of minimum school-leaving law changes experienced not only increases in earnings, but lower unemployment, better health, job satisfaction, and higher rates of happiness and life satisfaction. Identification of these influences comes from differences in the timing of the school-leaving laws across nations. If nation-specific outcome variables trend coincidently with the school-leaving age changes, the coefficient estimates may not correspond with an education effect. To examine this possibility, I run several specification checks in this appendix on the three main variables I use to analyze a student's optimal dropout decision: family income and life satisfaction from the Eurobarometers, and individual earnings from the GHHS.

The Eurobarometer Surveys contain data from 3 nations. Dropping any one nation leaves the other two for a difference-in-difference analysis. Table A1 shows OLS and IV estimates for the returns to education on family income with different country-comparison groups. Column (1) shows the baseline results with all nations included, the same ones displayed in Table 2. Dropping any one country still leaves positive and significant estimates of the returns to schooling. This means a coincidental trend in average family income over time by a single nation is not driving the significant results. The estimates are less precise, but all within a similar range as the full sample ones.

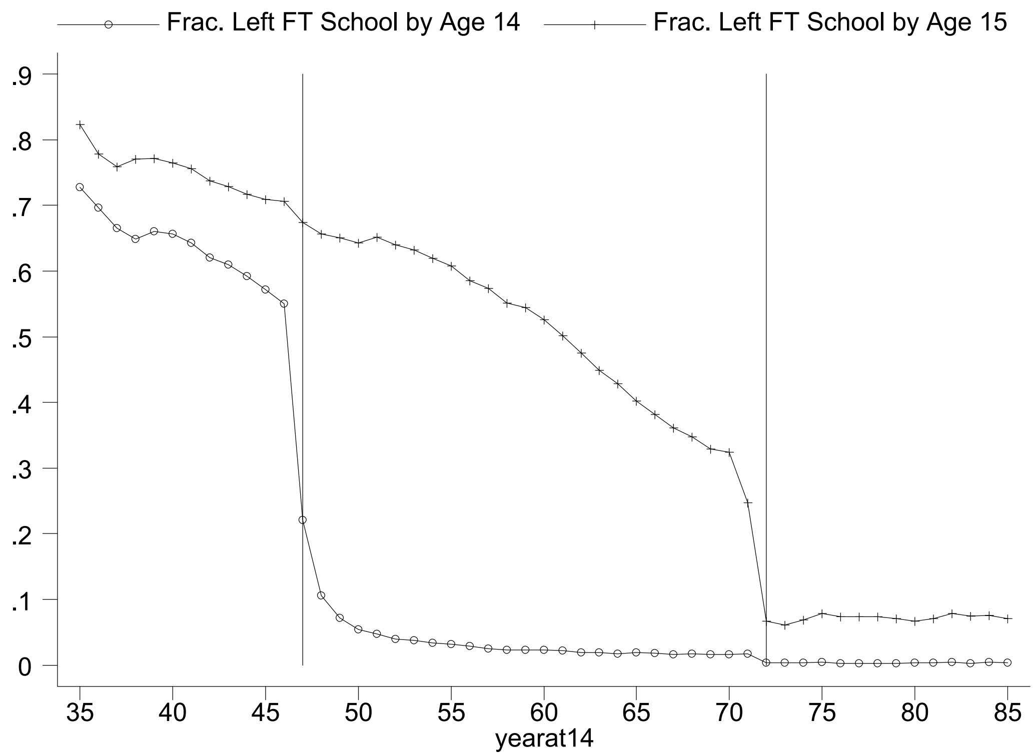
Table A2 shows the same analysis, but for subjective well-being. I use the indicator variable for whether a person reports being satisfied overall with life as the dependent variable. This was the variable where education had the most significant effect in Table 4. As with the earnings variable, dropping any one nation leaves a significantly positive IV estimate from the effect of additional schooling on adult life satisfaction. The point estimates are all similar.

Another check is to see whether the results hold up after restricting the analysis to a smaller time period. Table A3 shows results from examining the sample of adults aged 14 between 1925 and 1955, and the sample aged 14 between 1950 and 1960. In the first sample, only the school-leaving age change in Britain, from 14 to 15, affected education attainment levels. The IV returns to education estimates on earnings are higher than the baseline results and previous estimates, but these are measured somewhat imprecisely. The effect of education on life satisfaction is similar for this sample as for the basecase.

Only Northern Irish from the sample of adults who were 14 between 1950 and 1970 experienced a change in their minimum school-leaving laws. The bottom of Table 7 shows still similar estimates of the effects from education on this sample. The IV returns to schooling on earnings is again fairly high relative to the baseline estimates. The effect of education on life satisfaction remains robustly positive.

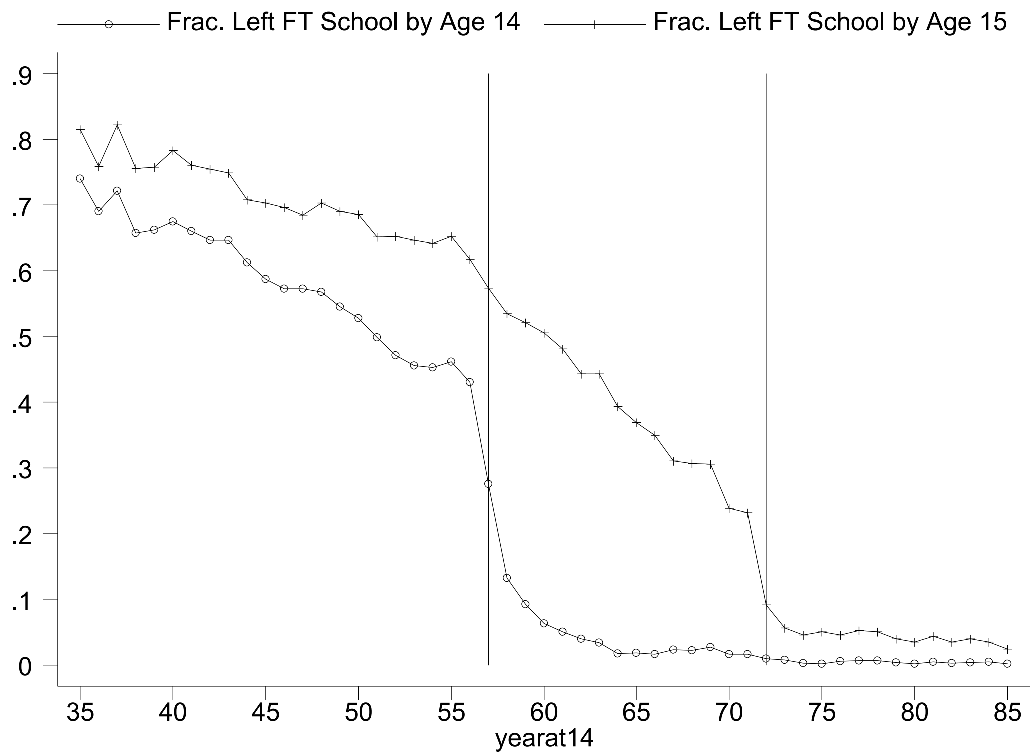
School-leaving law changes should not influence education attainment decisions for those not intending to drop out as soon as they can. If increasing school-leaving age laws improves earnings and life satisfaction through additional education, then increasing the school-leaving age should not affect earnings and well-being of adults never intending to drop out early. Table A4 shows reduced form estimates of school-leaving age indicators on the three outcome variables of interest. As predicted, columns 2 and 3 show adults who finished full-time school before age 17 experience higher earnings from facing a greater school-leaving age, but adults who finished school after this period are not affected. If some would-be-dropouts facing later school-leaving ages decide to attain even more schooling after being compelled to take an extra year, these persons may end up in the second sample of adults with higher education attainment. Then these persons, with lower relative earnings than the rest of the sample, should push average earnings <u>lower</u>. This is what I find from the Eurobarometer surveys. School-leaving age laws raise family income for the group who finished schooling before age 17, but lower family income for the group with education completed beyond age 16. Life satisfaction is also unaffected by changing school-leaving ages for the sample with higher education. The finding that unconstrained cohorts are unaffected by the law changes also provides support that the results are not driven by coincidental changes in economic circumstances, legislation changes, or changes in school quality that would also have affected everyone.

Figure 1
Fraction Left Full-Time Education by Year Aged 14 and 15
Great Britain



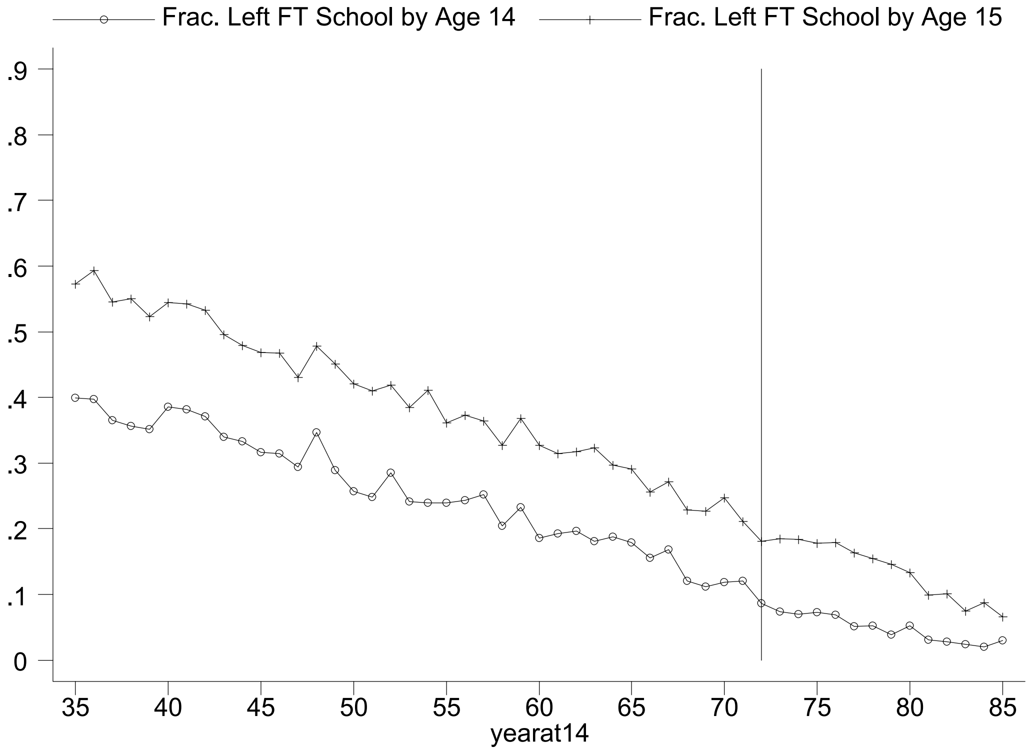
Notes: The lower line shows the proportion of British-born adults aged 16 to 65 from the 1983 to 1998 General Household Surveys who report leaving full-time education at, or before, age 14. The upper line shows the same, but for age 15.

Figure 2
Fraction Left Full-Time Education by Year Aged 14 and 15
Northern Ireland



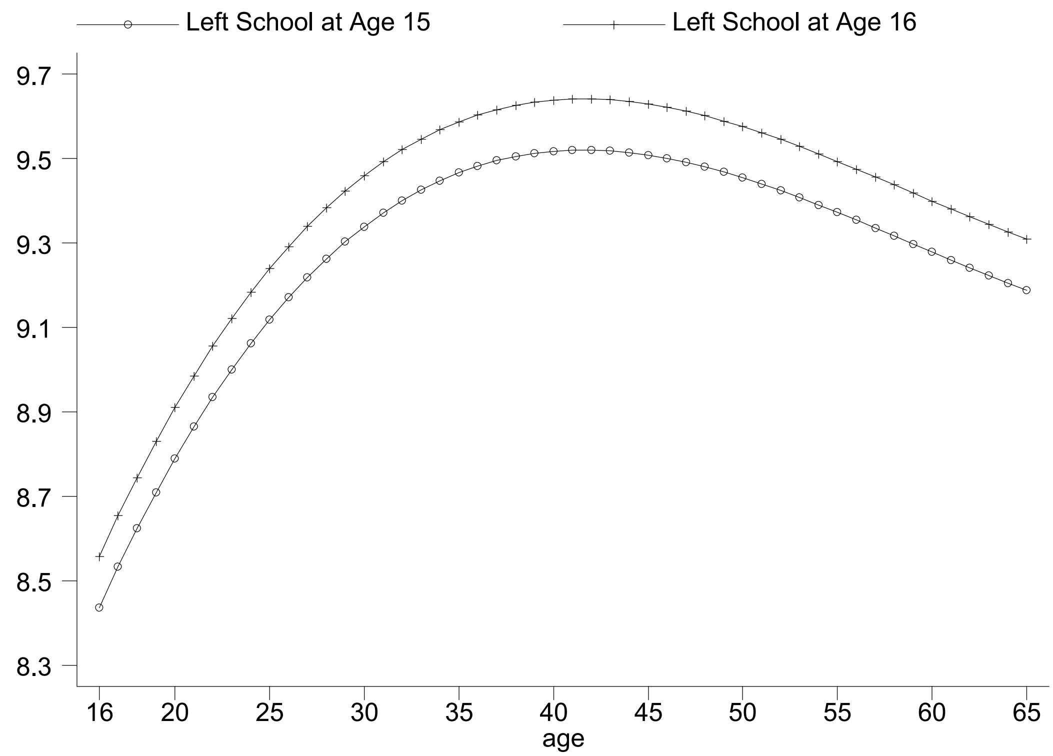
Notes: The lower line shows the proportion of Northern Irish adults aged 16 to 65 from the 1985 to 1998 Continuous Household Surveys who report leaving full-time education at, or before, age 14. The upper line shows the same, but for age 15.

Figure 3
Fraction Left Full-Time Education by Year Aged 14 and 15
Republic of Ireland



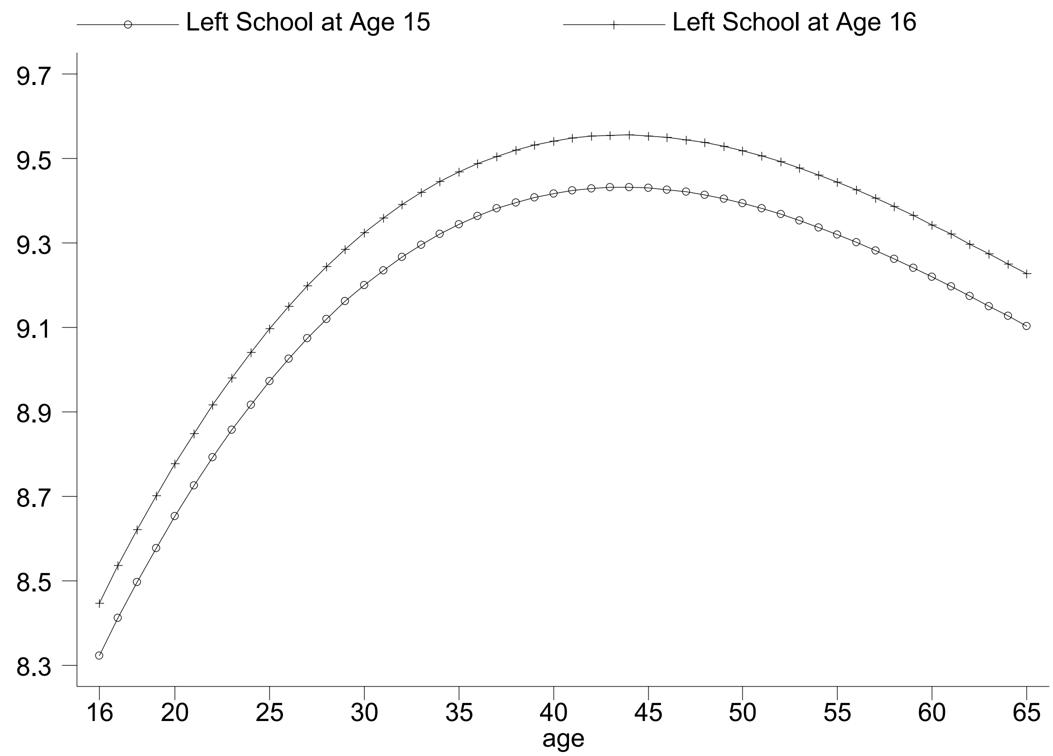
Notes: The lower line shows the proportion of Republic of Ireland adults aged 16 to 65 from the 1973 to 1998 Eurobarometer Surveys who report leaving full-time education at, or before, age 14. The upper line shows the same, but for age 15.

Figure 4
Projected Log Earnings for Males with 15 and 16 Years of Education, Least Squares Estimates



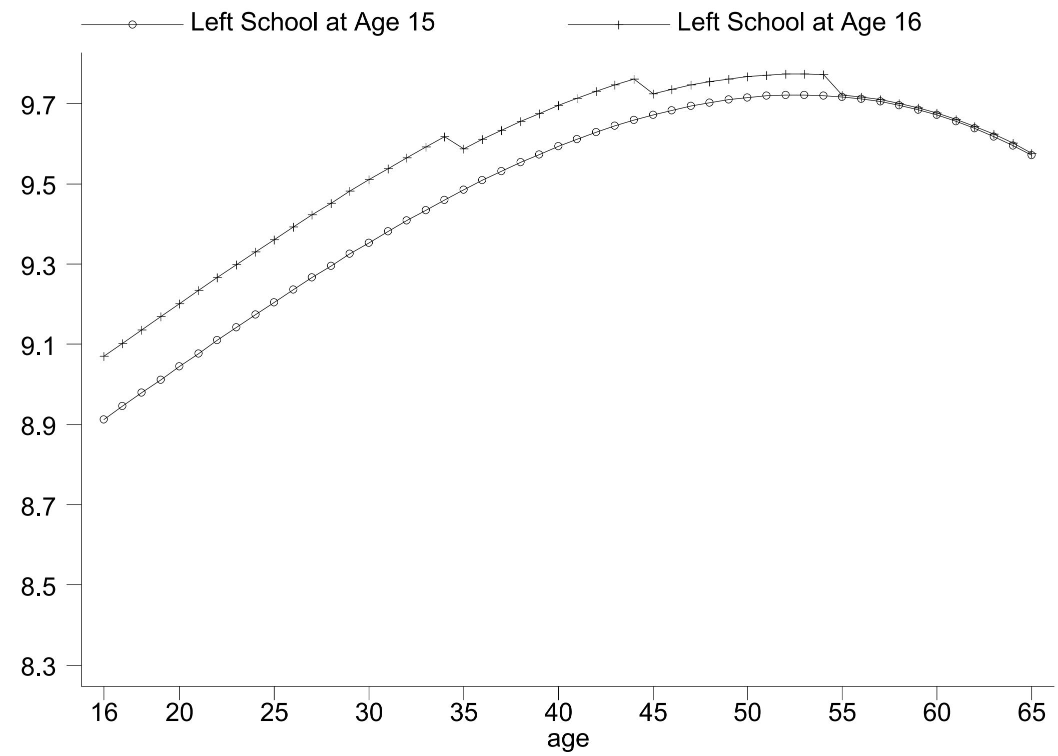
Notes: Projections are based from regression log annual earnings for British adults aged 16 to 65 in the General Household Surveys with fixed effects for age and survey year. A constant rate of return from schooling is assumed.

Figure 5
Projected Log Earnings for Males with 15 and 16 Years of Education, Instrumental Variable Estimates



Notes: Projections are based from regression log annual earnings for British adults aged 16 to 65 in the General Household Surveys with fixed effects for age and survey year. Age left school is instrumented on indicator variables for whether able to drop out at age 15 or at 16. A constant rate of return from schooling is assumed.

Figure 6
Projected Log Earnings for Males with 15 and 16 Years of Education, IV Estimates, Variable Returns to School



Notes: Projections are based from regression log annual earnings for British adults aged 16 to 65 in the General Household Surveys with fixed effects for age and survey year. Age left school is instrumented on indicator variables for whether able to drop out at age 15 or at 16. The returns to education estimates vary between ages 25 to 35, 35 to 45, and 55 to 65.

Table 1
Minimum Well-Being Cost-to-Annual-Gains Ratio
Required for Decision to Decline Additional Schooling,
Assuming Gains are Constant Each Period, and Schooling Choice in Period 0

(1) Geometric Discount Factor R	(2) Period Schooling Gains Begin	(3) Period Schooling Gains End	(4) Minimum Cost-to-Annual-Benefit Ratio Required to Prefer Dropping Out
0.99	1	50	38.5
0.95	1	50	17.5
0.9	1	50	8.5
0.99	10	50	24.2
0.95	10	50	9.5
0.9	10	50	3.4

Notes: Calculations of column 4 follow equation (7) in the text, and assumptions given in columns 1 to 3.

Table 2
The Effect of Schooling on Income and Earnings
Least Sqaures and IV Estimates using UK and Irish Changes in School Leaving Ages

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Reduced Form Coefficients		Returns to Schooling				
Dependent Variable	School Leaving Age: 15	School Leaving Age: 16	OLS	OLS: Age Left School<17	IV	Initial Observations	Number of Groups
Log Family Income (From Eurobarometers)	0.0775 (0.0124)***	0.1021 (0.0176)***	0.0868 (0.0077)***	0.13 (0.009)***	0.1353 (0.0241)***	61192	25545
Log Individual Earnings (From General Household Surveys)	0.0628 (0.0210)**		0.1352 (0.0126)***	0.155 (0.0086)***	0.1375 (0.0411)***	145060	4184
Log Individual Income (From Labour Force Surveys)	0.0606 (0.0067)***		0.1558 (0.0204)***	0.138 (.0117)***	0.1241 (0.0142)***	206551	6482

Notes: All regressions include fixed effects for age, sex, birth year, and nation interacted with survey year. Data are grouped into means by age, sex, birth year, nation, and survey year. Huber-White standard errors are shown from clustering by nation. Single, double, and triple asterix indicate significant coefficients at the 10 percent, 5 percent, and 1 percent levels respectively. The two instruments are indicator variables for whether able to drop out at age 15 or age 16. The ommited variable indicates whether able to drop out at age 14. Samples include all adults aged 18 to 65. Income and earnings are reported in the Eurobarometers, the GHHS, and the LFS annually, weekly, and annually respectively. See text for more data specifics.

Table 3
The Effect of Schooling on Health, Labor Market Outcomes, and Occupation Composition
Least Sqaures and IV Estimates using UK and Irish Changes in School Leaving Ages

	Mean	(1) School Leaving Age: 15	(2) OLS: Age Left School<17	(3) IV	(4) Number of Initial Observations
			Health Outcomes		
General Household Survey					
In Poor Health (Self-Reported)	0.097	-0.0177 (0.0067)**	-0.0446 (0.0029)***	-0.0373 (0.0153)**	262231
In Good Health (Self-Reported)	0.660	0.0386 (0.0111)***	0.0753 (0.0004)***	0.0814 (0.0260)***	262231
Has Long-Standing Illness (Self-Reported)	0.303	-0.0101 (0.005)**	-0.0444 (0.0031)***	-0.0209 (0.0111)*	277372
Labour Force Survey					
Has a Health Problem or Disability	0.190	-0.0352 (0.0034)***	-0.0491 (0.0017)***	-0.0796 (0.0076)***	1732879
Health Problem is Depression	0.009	-0.0027 (0.0003)***	-0.0026 (0.0005)***	-0.0061 (0.0006)***	1213266
			Labor Market Outcomes		
General Household Survey					
In Labor Force and Looking for Work	0.064	-0.0084 (0.005)*	-0.0217 (0.0056)***	-0.01892 (0.003)***	207778
Labour Force Survey					
Looking for Different or Additional Job	0.034	-0.0071 (0.0013)***	-0.0143 (0.0022)***	-0.0159 (0.0030)***	1762982
Receiving Unempoyment Benefits	0.017	-0.0038 (0.0002)***	-0.0034 (0.0007)***	-0.0045 (0.0006)***	2630818
Receiving Income Support	0.024	0.0003 (0.001)	-0.0087 (0.0020)***	-0.0107 (0.0174)	1199065
Eurobarometer Survey					
Unemployed (Self-Reported)	0.042	-0.0307 (0.0084)***	-0.0079 (0.0010)**	-0.0187 (0.0057)***	89279
			Occupation Composition Outcomes		
General Household Survey					
Unskilled Manual Occupation	0.058	-0.0315 (0.0039)***	-0.0373 (0.0042)***	-0.0603 (0.0069)***	263886
Junior Non-Manual Occupation	0.207	0.0242 (0.0080)*	0.0594 (0.0023)***	0.0463 (0.0155)*	263886
Skilled Manual Occupation	0.113	0.0152 (0.0048)**	-0.0329 (0.0079)***	0.0291 (0.0092)*	263886
Manager or Employer Occupation	0.192	0.0079 (0.0007)***	0.0675 (0.0088)***	0.0152 (0.0016)***	263886
Labour Force Survey					
Unskilled Occupation	0.030	-0.013 (0.0005)***	-0.018 (0.0020)***	-0.0115 (0.0005)***	1338958
Partly Skilled Occupation	0.081	-0.0201 (0.0005)***	-0.0134 (0.0052)***	-0.0147 (0.0065)**	1338958
Intermediate Occupation	0.445	0.013 (0.0030)**	0.0225 (0.0027)***	-0.001 (0.026)	1338958
Skilled Occupation	0.444	0.02 (0.0021)***	0.0089 (0.0021)***	0.0272 (0.020)	1338958

Notes: All regressions include fixed effects for age, sex, birth year, and nation interacted with survey year. Data are grouped into means by age, sex, birth year, nation, and survey year. Huber-White standard errors are shown from clustering by nation. Single, double, and triple asterix indicate significant coefficients at the 10 percent, 5 percent, and 1 percent levels respectively. Samples include all adults aged 18 to 65. See text for more data specifics.

Table 4
The Effect of Schooling on Subjective Well-being
Least Sqaures and IV Estimates using UK and Irish Changes in School Leaving Ages

		(1)	(2)	(3)	(4)	(5)
	Mean	School Leaving Age: 15	School Leaving Age: 16	OLS: Age Left School<17	IV	Initial Observations
Life Satisfaction	3.14	0.03	0.0508	0.073	0.059	89279
(1 = not at all satisfied, 4 = very satisfied)		(0.0028)***	(0.0058)***	(0.0093)***	(0.0073)***	
Satisfied with Life	0.86	0.0245	0.0555	0.040	0.0516	89279
(1 = Very or Fairly Satisfied,0 = Not Satisfied or not at all satisfed)		(0.0028)***	(0.0059)***	(0.0046)***	(0.0033)***	
Very Satisfied	0.325	0.006	0.0373	0.027	0.0235	89279
(1 = Very Satisfied)		(0.0071)	(0.0158)***	(0.0023)***	(0.0135)*	
Happy	2.14	0.0379	0.1096	0.044	0.0667	24565
(1 = Not So Happy, 2 = Fairly Happy, 3 = Very Happy)		(0.0023)***	(0.0069)***	(0.013)***	(0.0093)***	

Notes: All regressions include fixed effects for age, sex, birth year, and nation interacted with survey year. Data are grouped into means by age, sex, birth year, nation, and survey year. Huber-White standard errors are shown from clustering by nation. Single, double, and triple asterix indicate significant coefficients at the 10 percent, 5 percent, and 1 percent levels respectively. Samples include all adults aged 18 to 65. See text for more data specifics.

Table 5
Estimated Present Value Gains from Additional Year of School
Evaluated at age 15, Measured in 1998 UK Pounds

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Average Projected Annual Earnings After Leaving School at Age 15 (between age 16 to 20)	Maximum Projeced Annual Earnings after Leaving School at Age 15 [age max. achieved]	Financial Gains 100% of Total Gains			Financial Gains 40% of Total Gains		
			Discount Rate			Discount Rate		
			0.03	0.05	0.08	0.03	0.05	0.08
Present Value Gains from OLS Estimates	5,573	13,599 [43]	34,555	23,490	14,651	86,388	58,726	36,627
Present Value Gains from IV Estimates	4,907	12,475 [44]	31,907	21,540	13,323	79,768	53,851	33,308
PV Gains from IV Estimates, Allowing Different Returns to Education over Age	7,941	16,678 [53]	34,411	26,150	18,477	86,029	65,374	46,192
Assuming 8 percent return	4,907	12,475 [44]	20,123	13,585	8,403	50,308	33,962	21,006

Notes: Projected earnings between ages 16 to 65 from Figures 4, 5, and 6 are converted to present value (with base period beginning at age 15), with assumed discount rates shown.

Table 6
Instrumental Variable Estimates of Education on Subjective Well-Being and Other Variables, with and without Income Controls

	(1) IV No Controls	(2) IV with Individual Earnings Controls	(3) IV with Household Income Controls	(4) IV with Household Income Controls, Truncated
Satisfied with Life (from Eurobarometers)	0.0522 (0.0027)***	NA	0.0426 (0.0045)***	0.0311 (0.0029)***
Good Health (from General Household Surveys)	0.0763 (0.0253)***	0.0603 (0.0079)***	0.0591 (0.0185)***	NA
Bad Health (from General Household Surveys)	-0.0346 (0.0147)**	-0.0287 (0.0032)***	0.0013 (0.0135)	NA
Watch TV (from General Household Surveys)	-0.0195 (0.0088)**	0.0161 (0.0014)***	-0.0202 (0.0107)*	NA

Notes: All regressions include fixed effects for age, sex, birth year, and nation interacted with survey year. Huber-White standard errors are shown from clustering by nation. Single, double, and triple asterix indicate significant coefficients at the 10 percent, 5 percent, and 1 percent levels respectively. Samples include all adults aged 18 to 65. The log of usual annual earnings was included in the General Household Surveys in column 2 as a control variable. The regression used in column 3 includes log annual household income for the General Household Surveys, and family income group indicators for the Eurobarometers. Column 4 truncates the analysis to adults not reporting the highest or lowest family income group. See text for more data specifics.

Table 7
British 15 to 16 Year-Old Students
With Constrained and Non-Constrained School Choices

	Mean			
	Age 15 Want to Drop Out at Age 16	**Age 16 Dropped Out Age 16**	**Age 15 Want to Drop Out at Age 17 or 18**	**Age 16 Want to Drop Out at Age 17 or 18**
Life Satisfaction (1 = not at all satisfied, 4 = very satisfied)	3.30	2.97	3.39	3.24
Satisfied with Life (1 = Very or Fairly Satisfied,0 = Not Satisfied or not at all satisfed)	0.91	0.80	0.94	0.94
Very Satisfied (1 = Very Satisfied)	0.39	0.20	0.44	0.29
Monthly Funds Available (1990 pounds)	65.87	223.79	51.94	63.33
In Difficult Financial Situation?	0.26	0.37	0.14	0.16
Household Head?	0.00	0.06	0.00	0.00
N	28	30	38	51

Notes: Sample includes 16 to 25 year-olds in Britain from the 1990 Eurobarometer Youth Survey. The minimum school-leaving age among these cohorts was 16.

Table 8
Reasons for Leaving School Among 16 to 25 Year-Olds

	Fraction Mentioning Reason		
	Finished School Immediately at Min. Schl. Leaving Age	**Finished School 1 or 2 Years After Dropout**	**Finished School More Than 2 Years After**
Had Gone as Far as I Could	0.148	0.332	0.540
I Saw No Point in Going On	0.295	0.172	0.193
I Did Not Like It	0.243	0.114	0.040
I Needed Money	0.126	0.095	0.053
I Wanted to Work	0.445	0.437	0.293
Family Needed Mondey	0.039	0.034	0.013
Couldn’t Afford Course	0.009	0.019	0.013
Had to Bring Up Children	0.015	0.009	0.067
N	461	325	150

Notes: Sample includes 16 to 25 year-olds in Britain from the 1990 Eurobarometer Youth Survey.

Table A1
Variances of Log Annual Earnings
Among Working British Males who Finished School at Earliest Possible Age
(1998 UK pounds)

1983-98 GHHS: Respondent Age 52-61	**Left School 1943-45 at Age 14**	**Left School 1949-51 at Age 15**	**Difference**
Predicted mean with survey year and age FE	9.394	9.540	0.146
1998, age 52 (se in parenthesis)			(0.075)
Residual Variance	0.145	0.073	-0.072
F-test; P-Value			(0.001)
Var(Dropout at 15) > Var(Dropout at 14)			
Number of Respondents	1456	1024	
(full sample)			
1983-98 GHHS: Respondent Age 29-37	**Left School 1968-70 at Age 15**	**Left School 1974-76 at Age 16**	**Difference**
Predicted mean with survey year and age FE	9.346	9.405	0.058
1998, age 29 (se in parenthesis)			(0.043)
Residual Variance	0.112	0.107	-0.005
F-test; P-Value			(0.136)
Var(Dropout at 16) > Var(Dropout at 15)			
Number of Respondents	2260	2614	
(full sample)			

Notes: All data are from the 1983-98 British General Household Surveys. Log weekly earnings are regressed on age, survey year fixed effects, and age finished full time schooling. The variances of the residual earnings from these estimates are shown. See text for details.

Table A2
Reduced Form and Returns to Schooling Estimates on Family Log Income, Different Country Control Groups

	Dependent Variable: Log Family Income			
	(1)	(2)	(3)	(4)
	All Nations	**Rep. Of Ireland, Grt. Britain**	**Grt. Britain, N. Ireland**	**Rep. Of Ireland, N. Ireland**
School Leaving Age: 16	0.0897 (0.0232)***	0.1213 (0.0264)***		0.0389 (0.0376)
School Leaving Age: 15	0.0792 (0.0113)***	0.094 (0.0128)***	0.099 (0.0219)***	0.0317 (0.0192)*
OLS coefficient for Age left School (left School<17)	0.13 (0.009)***	0.1227856 (0.0209)***	0.1458 (0.0054)***	0.0998 (0.0057)***
IV coefficient for Age left School	0.1403 (0.0213)***	0.14696 (0.0043)***	0.2088 (0.0036)***	0.0658 (0.0374)*
Initial Observations	61192	50645	34842	27895

Notes: All regressions include fixed effects for age, sex, birth year, and nation interacted with survey year. Data are grouped into means by age, sex, birth year, nation, and survey year. Huber-White standard errors are shown from clustering by nation. Single, double, and triple asterix indicate significant coefficients at the 10 percent, 5 percent, and 1 percent levels respectively. Samples include all adults aged 18 to 65. See text for more data specifics.

Table A3
Reduced Form and Returns to Schooling Estimates on Life Satisfaction, Different Country Control Groups

	Dependent Variable: Satisfed with Life (1 = very or fairly satisfied, 0 = not very or not at all satisfied)			
	(1)	(2)	(3)	(4)
	All Nations	**Rep. Of Ireland, Grt. Britain**	**Grt. Britain, N. Ireland**	**Rep. Of Ireland, N. Ireland**
School Leaving Age: 16	0.0549	0.0609		0.0405
	(0.0105)***	(0.0122)***		(0.0155)***
School Leaving Age: 15	0.0241	0.027	0.0217	0.0164
	(0.0052)***	(0.0061)***	(0.0101)**	(0.0087)*
OLS coefficient for Age left School	0.040	0.0339	0.026	0.036
(left School<17)	(0.0046)***	(0.0054)***	(0.0025)***	(0.0025)***
IV coefficient for Age left School	0.0516	0.0549	0.0487	0.0424
	(0.0105)***	(0.0119)***	(0.0229)**	(0.0178)**
Initial Observations	89279	72592	48579	42497

Notes: All regressions include fixed effects for age, sex, birth year, and nation interacted with survey year. Data are grouped into means by age, sex, birth year, nation, and survey year. Huber-White standard errors are shown from clustering by nation. Single, double, and triple asterix indicate significant coefficients at the 10 percent, 5 percent, and 1 percent levels respectively. Samples include all adults aged 18 to 65. See text for more data specifics.

Table A4
Reduced Form and Returns to Schooling Estimates on Life Satisfaction, over different time periods

	(1)	(2)	(3)
	Adult Log Earnings (from GHHS)	Family Log Inome (from Eurobarometers)	Satisfied with Life
Year at 14: 1935 - 1955 (identification from Grt. Britain's change in School Leaving Law)			
School Leaving Age: 15	0.1005	0.0535	0.0124
	(0.0071)***	(0.0173)***	(0.0079)
OLS coefficient for Age left School	0.1556	0.1292	0.0277
(left School<17)	(0.0216)***	(0.0125)***	(0.0063)***
IV coefficient for Age left School	0.2035	0.1437	0.0322
	(0.0157)***	(0.0461)***	(0.0205)
Initial Observations	31063	28648	39950
Year at 14: 1950 - 1970 (identification from N. Ireland's change in School Leaving Law)			
School Leaving Age: 15	0.0448	0.0463	0.0349
	(0.0044)***	(0.0257)*	(0.0126)***
OLS coefficient for Age left School	0.1663	0.1199	0.0386
(left School<17)	(0.0159)***	(0.0210)***	(0.0057)***
IV coefficient for Age left School	0.1635	0.1109	0.0827
	(0.0103)***	(0.0605)*	(0.0322)**
Observations	30942	24338	35066
Year at 14: 1965 - 1985 (identification from 1972-73 changes in School Leaving Laws)			
School Leaving Age: 16	0.0220	0.0404	-0.0082
	(0.0086)**	(0.0131)***	0.0071
OLS coefficient for Age left School	0.1342	0.1559	0.0341
(left School<17)	(0.0134)***	(0.0083)***	(0.0023)***
IV coefficient for Age left School	0.1048	0.1455	-0.0360
	(0.0412)**	(0.0717)**	0.039
Observations	43976	12833	16661

Notes: All regressions include fixed effects for age, sex, birth year, and nation interacted with survey year. Data are grouped into means by age, sex, birth year, nation, and survey year. Huber-White standard errors are shown from clustering by nation. Single, double, and triple asterix indicate significant coefficients at the 10 percent, 5 percent, and 1 percent levels respectively. Samples include all adults aged 18 to 65. See text for more data specifics. GHHS = General Household Surveys.

Table A5
Reduced Form Estimates of Minimum Schooling Law Effects
on Life Satisfaction for Alternative Education Attainment Groups

	Adult Log Earnings (From GHHS)			Family Log Income (from Eurobarometers)			Satisfed with Life		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Full Sample	Finished Schooling Age < 17	Finished Schooling Age >= 17	Full Sample	Finished Schooling Age < 17	Finished Schooling Age >= 17	Full Sample	Finished Schooling Age < 17	Finished Schooling Age >= 17
School Leaving Age: 16				0.1059	0.1169	-0.046	0.0549	0.0873	0.0089
				(0.0179)***	(0.0252)***	(0.0565)	(0.0062)***	(0.0125)***	(0.0215)
School Leaving Age: 15	0.0625	0.1481	0.005	0.0842	0.0933	-0.041	0.0241	0.0325	0.0075
	(0.0244)**	(0.0310)***	(0.0073)	(0.0131)***	(0.0117)***	(0.0277)	(0.0028)***	(0.0060)***	(0.011)
Observations	145060	87825	57235	61192	47621	13571	89279	67416	21863

Notes: All regressions include fixed effects for age, sex, birth year, and nation interacted with survey year. Data are grouped into means by age, sex, birth year, nation, and survey year. Huber-White standard errors are shown from clustering for by nation. Single, double, and triple asterix indicate significant coefficients at the 10 percent, 5 percent, and 1 percent levels respectively. Samples include all adults aged 18 to 65. See text for more data specifics. GHHS = General Household Surveys.