ELSEVIER

Journal of Public Economics 91 (2007) 2213–2229

JOURNAL OF PUBLIC ECONOMICS

www.elsevier.com/locate/econbase

Do dropouts drop out too soon? Wealth, health and happiness from compulsory schooling ☆

Philip Oreopoulos

University of Toronto, National Bureau of Economic Research, Canadian Institute for Advanced Research, Canada

Received 11 February 2006; received in revised form 4 February 2007; accepted 5 February 2007
Available online 13 February 2007

Abstract

This paper uses compulsory schooling laws to evaluate high school dropout decisions. The main empirical result is that lifetime wealth increases by about 15% with an extra year of compulsory schooling. Students compelled to stay in school are also less likely to report being in poor health, unemployed, and unhappy. The main conclusion is that high school aversion alone is unlikely to explain why dropouts forgo substantial gains to lifetime wealth. The results are more consistent with the possibility that adolescents ignore or heavily discount future consequences when deciding to drop out of school. If teenagers are myopic, making school compulsory or offering incentives to stay in school may help improve lifetime outcomes.

JEL classification: I20; I21; I28

1. Introduction

Policymakers, educators, and parents typically view dropping out of high school as undesirable and spend considerable time and money in an effort to prevent this outcome. This view is no more apparent than from the motivation behind compulsory schooling laws. Such laws have been

☆ Conference participants at the NBER Summer Institute, IZA/SOLE Transatlantic meetings, and seminar participants at Berkeley, LSE, the Chicago Federal Reserve, Royal Holloway, Duke, McGill, Queens, Wharton, and the Universities of Toronto, British Columbia and Guelph provided very helpful discussion. I am especially thankful to George Akerlof, Alan Auerbach, David Autor, Gregory Besharov, David Card, Liz Cascio, Stacey Chen, Peter Diamond, David Laibson, Botond Koszegi, John Quigley, Marco Manacorda, Enrico Moretti, Rob McMillan, Justin McCrary, Costas Meghir, Mathew Rabin, Jesse Rothstein, Emmanuel Saez, Aloysius Siow, Alois Stutzer, Jo Van Biesebroeck, Ian Walker, and two anonymous referees for many helpful comments and discussions. I am solely responsible for this paper's contents.

E-mail address: oreo@economics.utoronto.ca.

0047-2727/$ - see front matter
doi:10.1016/j.jpubeco.2007.02.002

around for more than a hundred years, and continue to exist in virtually every industrialized country. Motivation for introducing them, or for updating them, often relates to assumptions that children who would have left school earlier are, in fact, better off from staying on.

Many social scientists view education as an investment decision. For high school students, an investment decision would involve weighing the expected rewards from obtaining a degree to the effort required in getting it. Those that dropout drop out because they detest school, lack motivation, or anticipate little reward from graduation (Eckstein and Wolpin, 1999). In this case, in the absence of positive externalities, compulsory schooling restricts choice and lowers lifetime welfare (e.g. Rickenbacker, 1974, Gatto, 2002, Machan, 2000).[1]

This paper uses compulsory schooling laws to evaluate dropout behavior. I estimate lifetime opportunity costs from leaving high school. Quantifying the overall consequences from dropping out offers important perspective for evaluating theories of school attainment. Knowing what dropouts give up is essential for understanding why they do it. I compare whether models that imply efficiency in early school-leaving decisions can adequately explain estimates for the total gains from staying in school, or whether alternative models that imply inefficient outcomes are better suited.

Compulsory laws are ideal instruments to analyze the efficiency of the school-choice decision because they prevent some students from leaving school early. Several previous papers have consistently documented gains to adult outcomes from compulsory schooling. Angrist and Krueger (1991) and Acemoglu and Angrist (2001) estimate (using very different methodologies) that annual adult earnings are about 10% higher for students compelled to stay a year longer in school. Harmon and Walker (1995) and Oreopoulos (2006) find about 14% higher earnings from school compulsion in the UK. Other studies have examined the impact of compulsory schooling on non-pecuniary outcomes. Lochner and Moretti (2004) estimate that compulsory schooling lowers the likelihood of committing crime or ending up in jail. Lleras-Muney (2005) estimates an additional year of compulsory schooling substantially lowers the probability of dying among elderly people. And Black, Devereux, and Salvanes (2004) find compulsory schooling reduces the chances of teen pregnancy in the U.S. and Norway.

None of these papers focus on what their results imply about dropout behavior. What I aim to do here is to discuss how compulsory schooling laws can be used to learn more about school attainment. I demonstrate consistency across countries in finding similar effects of compulsory schooling for the U.S., Canada, and the UK. The cross-country comparison provides an opportunity to examine estimates under different circumstances, different institutions, and for different time periods.

The main empirical finding suggests that one year of compulsory schooling increases average lifetime spending by 15%. Students with additional schooling are also less likely to report poor health, being depressed, looking for work, being in a low-skilled manual occupation, and being unemployed. Adults with more compulsory schooling are also more likely to report being satisfied overall with the life they lead.

The main conclusion of this paper is that it is very difficult to reconcile substantial returns to compulsory schooling with an investment model of school attainment. The results are more consistent with the possibility that many adolescents ignore or heavily discount future

[1] While not advocating support for or against compulsory schooling, Chiswick (1969) notes, '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".

consequences when deciding to drop out of school. This explanation is also consistent with recent studies in neurology and psychology that suggest adolescents are particularly predisposed to myopic behavior. If teenagers are myopic, making school compulsory or offering incentives to stay in school may improve lifetime welfare.

2. A simple model for describing dropout decisions

In this section, I explore a simple model for describing high school attainment. The model provides a useful backdrop to the findings and subsequent discussion.

2.1. The base model

In considering whether to drop out of high school or not, suppose an individual may tend to discount future consumption or may face non-pecuniary attendance costs. In year 0, the individual chooses whether to stay in high school ($S=1$), or drop out ($S=0$). Her lifecycle utility, extending to year T and conditional on school attainment and a given consumption profile is:

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

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 high school.[2] 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. Intertemporal models usually allow individuals to discount future utility geometrically at a rate δ. A higher time preference rate (a low δ) raises the weight on effort costs and lowers the present value of non-pecuniary education gains. With a high enough rate of time preference, a student virtually ignores future utility. A student with a δ of 0.9, for example, considers immediate utility 5 times more important than utility 15 years later.

Using interest rate r to convert income to present value, the intertemporal budget constraint is

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

where $R^t = \frac{1}{(1+r)^t}$, and $y(S, t)$ is school dependent income in year t, and $W(R, S)$ is present value lifetime wealth. An individual's optimal strategy is to drop out if the marginal cost from the additional year exceeds the present value of the marginal benefit. For exposition, assume that when $S=1$, $\phi(S)=\phi$, and $\sum_{t=1}^{T} \delta^t \theta(S,t) = \theta(\delta)$. When $S=0$, $\phi(S)=0$, and $\theta(S, t)=0$. The first-order conditions from maximizing Eq. (1) with respect to S and $c(t)$, given in Eq. (2), imply an individual prefers to drop out if:

$$[y(0,0) - y(1,0)] + \frac{1}{\lambda}\phi > \sum_{t=1}^{T} R^t [y(1,t) - y(0,t)] + \frac{1}{\lambda}\theta(\delta), \quad (3)$$

[2] $\phi(S)$ might be negatively correlated with S, in which case an individual would gain utility from attending additional school.

where $\lambda = \left(\frac{\delta}{R}\right)^t u'(c_0(t))\forall t$, and $c_0(t)$ is the optimal consumption path when the individual drops out ($S=0$). The first term on the left-hand side of Eq. (3), $y(0,0)$–$y(1,0)$, captures the foregone earnings from working full-time relative to that from part-time and summer employment while in school. The second term measures additional costs related to staying in school. The benefits from additional schooling, on the right-hand side of Eq. (4), include the present value earnings gained from more education, plus possible non-pecuniary benefits. A nice feature of Eq. (3) 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 the Lagrange multiplier λ.[3]

If non-pecuniary benefits from staying in school are zero or positive, we can rewrite the inequality in Eq. (3) as:

$$\frac{\phi}{\lambda}/W(R,0) > \sum_{t=1}^{T} R^t[y(1,t)-y(0,t)]/W(R,0). \tag{4}$$

In this paper, I estimate the right-hand side of Eq. (4), which is the percent change in lifetime wealth from an extra year of high school, for individuals who do not take that extra year.[4] The monetary equivalent of non-pecuniary attendance costs from extra schooling, relative to a person's lifetime wealth, must be at least as large as the percent increase in lifetime wealth for Eq. (4) to explain dropout behavior. In other words, if the financial payoff from additional schooling is large, the psychological relief from avoiding more school must be at least as large. Psychological costs increase the more individuals ignore or downplay the future. The possibility that this type of myopia can help explain dropout behavior is discussed in Section 6.

2.2. Accounting for uncertainty

The appropriate financial discount rate to consider 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.

Uncertainty associated with additional schooling could offset the attractiveness of higher returns. Heckman (2003) uses this argument to explain why returns to college estimates often exceed returns to other financial investments by a substantial amount. To see this in the context of this model, suppose that $R=\delta$ so that an individual attempts to smooth consumption over her lifetime. Suppose annual income is $y(S, t)=y^p(S)+\sigma(S)\varepsilon$. If the overall financial change in wealth from schooling is positive, let $y^p(1)>y^p(0)$, and vice versa. The uncertain component, ε, has mean zero and variance one, and is multiplied by a standard deviation factor that depends on school attainment. There is no non-pecuniary component from schooling after period zero.

[3] Note that if an individual can borrow and save at the same interest rate and education gains and costs are only monetary, the decision to continue school becomes purely a financial one. An individual's time preference rate becomes irrelevant, since she can borrow off of future earnings to spend today.

[4] The Local Average Treatment Effect (LATE) identified with compulsory schooling is the average treatment effect on the *non-treated*: that is, the average effect from a one year increase in high school, among those who do not take that extra year [see Imbens and Angrist (1994) for more discussion about the LATE].

Lifetime utility is then:

$$V(S) = \phi(1-S) + \sum_{t=0}^{T} \delta^t u[y^p(S) + \sigma(S)\varepsilon] \tag{5}$$

If the uncertain utility 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 expected lifetime utility function can be reformulated as:

$$EV(S) = \phi(1-S) + \sum_{t=0}^{T} \delta^t u[y^p(S)] + \sum_{t=0}^{T} \delta^t u''[y^p(S)] \frac{\sigma(S)}{2} \tag{6}$$

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

$$\phi > \sum_{t=0}^{T} \delta^t (U' + U'''\sigma(s))[y^p(1) - y^p(0)] + \frac{1}{2}\sum_{t=0}^{T} \delta^t U''[\sigma^2(1) - \sigma^2(0)], \tag{7}$$

where $U' = U'[c_0(t)]$. Using the assumption that $\delta^t = R^t$, defining, $\lambda^* = U' + U'''\sigma(S)$, and dividing by a dropout's lifetime wealth, the condition satisfying a dropout decision can be rearranged as:

$$\frac{\phi}{\lambda^*}/W(R,0) - \left\{\frac{1}{2\lambda^*}\sum_{t=1}^{T} R^t U''[\sigma^2(1) - \sigma^2(0)]\right\}/W(R,0) > \sum_{t=0}^{T} R^t[y^p(1) - y^p(0)]/W(R,0) \tag{8}$$

This equation is comparable to Eq. (4), except for the second component on the left-hand-side. If a student is risk-averse ($U'' < 0$) and additional schooling increases risk ($\sigma^2(1) - \sigma^2(0) > 0$), the decision to drop out becomes more likely than the case when future earnings are certain. Eq. (8) shows that added uncertainty can be seen simply as an additional cost for determining whether additional schooling is a good investment. On the other hand, less uncertainty would instead make additional schooling more attractive.

3. Empirical methodology and data

The main regression model analyzes how compulsory schooling affects subsequent outcomes. Since changes in these laws vary by region (state, province, Britain/N. Ireland) and time, not at the individual level, all initial data extracts, with individual observations, are first aggregated into cell means. This procedure explicitly removes within region heterogeneity. When the sample includes both males and females, the data are also categorized into cells by gender. The U.S. sample also groups cells by race.

Define $\bar{y}_{jkl}$ as the average outcome for members among birth cohort j, from high school region k, and surveyed in year l. The equation of interest (weighted by cell group population size) is:

$$\bar{y}_{jkl} = \delta \bar{S}_{jkl} + \beta X_{jkl} + e_j + e_k + e_l + e_{jkl}, \tag{9}$$

where $\bar{S}_{jkl}$ is the average educational attainment for members among birth cohort j, from high school region k, and surveyed in year l, X_{jkl} includes additional birth cohort, region, and survey year controls, e_j, e_k, and e_l represent fixed effects for birth cohort, region, and survey year respectively, and e_{jkl} represents the statistical residual. All regressions in the paper compute robust standard error

estimates using Huber–White correction methods, clustering by region.[5] In addition to region specific controls for economic and demographic conditions at the time birth cohorts were age 14, X_{jkl} includes quartic age controls for each birth cohort (from different survey years) to estimate age-earnings profiles. Multiple years of cross-sectional data allow for simultaneous age, birth cohort, and survey year effects by assuming two birth cohort effects are the same. Alternative age effects, or dropping the age controls all together does not affect estimates of δ by very much.

The underlying baseline first stage of the instrumental variable regression is:

$$\bar{S}_{jkl} = \gamma_{jk} + \alpha X_{jkl} + v_j + v_k + v_l + v_{jkl}, \tag{10}$$

where γ_{jk} is the minimum school-leaving age faced by birth cohort j from high school region k, v_j, v_k, and v_l are fixed effects for birth cohort, region, and survey year respectively, and v_{jkl} represents the statistical residual. Eq. (10) 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 region fixed effects. Identifying the effects from school-leaving laws comes from differences in the timing of these laws across regions. The analysis is therefore similar to difference-in-difference estimation, but with more than one intervention and more than one treatment group. The schooling effect, δ, is not identified if unobserved region specific factors that affect the outcome variable also change at the same time school-leaving laws change.[6]

The estimates are also used to generate annual income profiles for individuals that dropout at age 15 and individuals compelled to stay one year longer in school. The profiles are used to estimate lifetime changes in wealth from compulsory schooling, measured in present value.

Details of the data extracts used in this paper are provided in Oreopoulos (2003, 2006).[7] Wherever possible, I tried to maintain consistency in sample selection, school laws, and variable definitions across countries. The samples generally include all 25 to 64-year old males and females who were aged 14 in the years that major school-leaving age changes occurred (1915 to 1970 for the US, 1925 to 1970 for Canada, and 1935 to 1965 for the UK). The US data is from the six decennial Census microdata samples from 1950 through 2000. The Canadian data is from the 33% sample of the 1971 Census, and the five 20% samples of the 1981 through 2001 censuses. The UK analysis combines the General Household Surveys from 1983 to 1998 with the Northern Ireland Continuous Household Surveys, from 1985 to 1998. For all countries, individuals are matched to the minimum school-leaving age in their state or province of birth the year that they were age 14. I also matched to each individual a number of regional controls.

4. The effect of compulsory schooling laws on school attainment

Table 1 presents the first-stage effects of the school-leaving age changes on educational attainment, specified as in Eq. (10), and the corresponding reduced form effects of the school-

[5] Clustering by region and not region-by-cohort leads to higher standard errors. It is not clear-cut whether one should do this since identification comes from changes in compulsory schooling laws and differences in the timing of these changes. In their original study, Acemoglu and Angrist (2001) clustered by state and cohort. Another advantage of doing this is that fewer clusters, as in the state-only case, generate worse asymptotic results. Nevertheless, I cluster by region because the resulting standard error estimates are the most conservative.

[6] The main results hold up against a wide array of robustness checks (e.g. Oreopoulos, 2003, 2007; Lleras-Muney, 2002).

[7] Specific details are also available on my homepage at: http://www.economics.utoronto.ca/oreo/research/main.htm.

Table 1
First-stage effects of compulsory schooling on educational attainment and earnings for the U.S., Canada, and the UK

Dependent variable	(1)	(2)	(3)	(4)	(5)	(6)
	1st stage effects of dropout ages on schooling			Reduced form coefficients on earnings		
	Full sample	Sample with <high school	Sample with >high school	Full sample	Sample with <high school	Sample with >high school
U.S. [1901 — 61 birth cohorts aged 25–64 in the 1950–2000 censuses]						
	Number of years of schooling			Log weekly wage		
School-leaving age=14	0.236	0.253	−0.014	0.033	0.027	−0.013
	[0.0705]***	[0.0702]***	[0.0152]	[0.0230]	[0.0164]	[0.0103]
School-leaving age=15	0.260	0.168	−0.023	0.054	0.022	−0.005
	[0.0739]***	[0.1026]	[0.0188]	[0.0183]***	[0.0223]	[0.0093]
School-leaving age=16	0.458	0.451	−0.003	0.060	0.045	−0.007
	[0.1090]***	[0.1108]***	[0.0195]	[0.0262]**	[0.0195]**	[0.0122]
Initial sample size	2,814,203	727,789	1,173,880			
F-test: coefficients on laws are zero	6.7	5.8	2.0			
Canada [1911 — 61 birth cohorts aged 25–64 in the 1971–2001 censuses]						
	Highest grade attended			Log annual wage		
School-leaving age=14	0.405	0.345	0.033	0.037	0.044	−0.012
	[0.1337]**	[0.2214]	[0.0767]	[0.0191]*	[0.0476]	[0.0155]
School-leaving age>=15	0.643	0.657	−0.004	0.054	0.086	−0.007
	[0.1956]***	[0.2705]**	[0.0603]	[0.0190]**	[0.0481]	[0.0183]
Initial sample size	8,208,030	4,177,800	4,030,230			
F-test: coefficients on laws are zero	5.4	4.4	1.0			
UK [1921 — 51 birth cohorts aged 32–64 in the 1983–98 GHHS]						
	Age left full-time education			Log annual wage		
School-leaving age=15	0.425	0.487	0.062	0.058	0.052	0.005
	[0.0313]***	[0.0309]***	[0.0785]	[0.0198]***	[0.0242]**	[0.0369]
Initial sample size	66,185	47,584	13,760			
F-test: coefficients on laws are zero	184.9	358.5	0.6			

Notes: All regressions include fixed effects for birth year, region (state, province, Britain/N. Ireland), survey year, sex, and a quartic in age. The U.S. results also include a dummy variable for race and state controls for fraction living in urban areas, fraction black, in the labor force, in the manufacturing sector, female, and average age based on when a birth cohort was age 14. Similar province controls for Canada include fraction in urban areas, fraction in the manufacturing sector, female, and average age. Data are grouped into means by birth year, nation, sex, race (for the U.S.) and survey year and weighted by cell population size. Huber–White standard errors are shown from clustering by region. Single, double, and triple asterisks indicate significant coefficients at the 10%, 5%, and 1% levels respectively. The omitted variable indicates whether able to drop out at age 13 or less for the U.S. and Canada, and 14 or less for the UK. Samples include all adults aged 25 to 64. Dependent variable in Column 3 for Canada is 1=some post-secondary schooling, 0 otherwise. See text for more data specifics.

leaving age on earnings. Column 1 shows raising the school-leaving age increases the average number of years of completed schooling. For the full US sample, years of schooling is 0.24 years higher for those that faced a dropout age of 14 compared to those that faced a smaller dropout age, or none at all. Average school attainment increases by 0.02 years from raising the dropout age to 15, and 0.20 years from raising it to 16. Column 2 shows similar estimated effects if we restrict the sample to only those with less than 12 years of completed schooling

(and then collapse the data into cell means). Focussing on this sample zeros in on the individuals most likely to be affected by the dropout age changes.

Compulsory schooling laws affect those wanting to leave high school as soon as possible. Individuals that go on to college are not likely to fall into this category. Therefore, as a check to the interpretation of the results in Table 1, we can look to see if compulsory schooling laws have no estimated effect on those with college.[8] If we do estimate an effect, it could indicate that changes to other policies or economic conditions are going on and that these changes are the real reasons behind the results. Column 3 and 6 show this is not the case, and the specification check holds. For the sample with more than 12 years of schooling, none of the changes to the school-leaving age relate to their educational attainment or earnings.

Table 2 also presents parallel results for Canada. The results are similar to those from the U.S. extract. High school grade attainment is 0.41 grades higher, on average, for those that faced a dropout age of 14, compared to those that faced a lower age limit. Grade attainment is 0.23 years higher on top of that, for the group of Canadian youths that faced a dropout age of 15 or 16. The dependent variable in column 3 for the Canadian data is an indicator for post-secondary schooling. Similar to the U.S. results, I find no evidence that changes in dropout ages in Canada affected post-secondary educational attainment among the sample that completed Grade 11 or more. The reduced form results from the Canadian extract in columns 4 to 6 also show no effect from dropout age changes on annual wages among the higher educated sample.

The increase in the minimum school-leaving age from 14 to 15 in Britain and in Northern Ireland has the largest estimated effect on educational attainment. Raising the school-leaving age from 14 to 15 increased the average age students left full-time school by more than half a year for the sample that left when less than 17 years old. I find no significant evidence that the higher school-leaving age affected those that left school at age 18 or more.

5. The effect of compulsory schooling on wealth, health, and happiness

5.1. Earnings

The estimates for the effects of compulsory schooling on earnings are shown in Table 2. The instrumental variable results corresponding to the first and second stages in columns 1 and 2 of Table 1 are shown here in column 2. All regressions include fixed effects for birth cohort, region, survey year, gender, and a quartic in age. The U.S. results also include a dummy variable for race and state controls for fraction of state living in urban areas, fraction black, in the labor force, in the manufacturing sector, female, and average age based on when a birth cohort was age 14. Similar province controls for Canada include fraction in urban areas, fraction in the manufacturing sector, female, and average age. Data are grouped into means by birth year, region, gender, race (for the U.S.) and survey year. Huber–White standard errors are shown from clustering by region.

I estimate that adolescents compelled to take an additional year of high school earn about 10 to 14% more than dropouts without the additional year. The returns to compulsory schooling are similar across all countries, whether restricting the initial sample by gender or race (for the U.S.). Column 3 shows the results are generally robust to including linear cohort trends that are region specific.

[8] Lang and Kropp (1986) suggest that individuals intending to complete one or two additional years of schooling after the minimum age required may obtain additional education after the dropout age is changed to avoid signalling to employers they are in the same category as those who leave school as soon as possible. If this influence caused a significant number to obtain post-secondary schooling, we might expect the coefficients to be positive.

Table 2
OLS and IV estimates of the returns to compulsory schooling for the U.S., Canada, and the UK

Dependent variable	(1)	(2)	(3)
	OLS (Full sample)	IV	IV with regional trends
U.S. [1901 — 61 birth cohorts aged 25–64 in the 1950–2000 censuses]			
Log weekly earnings (all workers)	0.079 [0.0005]***	0.133 [0.0118]***	0.144 [0.0270]***
Log weekly earnings (males)	0.070 [0.0007]***	0.122 [0.0274]***	0.145 [0.0613]**
Log weekly earnings (black males)	0.074 [0.0008]***	0.158 [0.0281]***	0.151 [0.0528]***
Canada [1911 — 61 birth cohorts aged 25–64 in the 1971–2001 censuses]			
Log annual earnings (all workers)	0.088 [0.0027]***	0.084 [0.0267]**	0.147 [0.1304]
Log annual earnings (males)	0.107 [0.0032]***	0.106 [0.0264]***	0.136 [0.1123]
UK [1921 — 51 birth cohorts aged 32–64in the 1983–1998 GHHS]			
Log annual earnings (all workers)	0.078 [0.0024]***	0.158 [0.0491]***	0.195 [0.0446]***
Log annual earnings (males)	0.055 [0.0017]***	0.094 [0.0568]	0.066 [0.0561]

Notes: All regressions include fixed effects for birth year, region (state, province, Britain/N. Ireland), survey year, sex (for the full sample only), and a quartic in age. The U.S. results also include a dummy variable for race (except for the regression for black males) and state controls for fraction of state living in urban areas, fraction black, in the labor force, in the manufacturing sector, female, and average age based on when a birth cohort was age 14. Similar province controls for Canada include fraction in urban areas, fraction in the manufacturing sector, female, and average age. There are no UK regional controls. Data are grouped into means by birth year, nation, sex, race (for the U.S.) and survey year. Huber–White standard errors are shown from clustering by region and birth cohort. Single, double, and triple asterisks indicate significant coefficients at the 10%, 5%, and 1% levels respectively. See text for more data specifics.

The comparable full sample OLS results are shown in Column 1. I aggregated the country data also by level of schooling to calculate these results (still weighted by cell sample size). For the U.S. in particular, OLS point estimates are lower than IV. This result is common in earlier studies. Card (2001) and others suggest the relative difference could be due to the effect of high school education among would-be dropouts being larger than the average treatment effect of a typical year of education among the whole population.

5.2. Health, employment, and poverty

The results in Table 3 show other outcome effects from compulsory schooling. Health outcomes are strongly associated from the minimum school-leaving age changes, consistent with Lleras-Muney's (2005) finding that compulsory schooling increases life expectancy. The 1990 and 2000 U.S. Censuses ask questions about physical and mental health limitations. Among all individuals in the sample aged 25 to 74, 9.2% claim a physical or mental health disability that limits personal care. I estimate an additional year of compulsory schooling lowers the likelihood of reporting such disability by 1.7% points, similar to the OLS estimate. A year of compulsory schooling also lowers the likelihood of reporting a disability that limits daily activity by 2.5% points. For the UK, 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 3.2% points, and raises the chances of reporting being in good health by 6.0% points.

Schooling also affects many labor market outcomes in addition to earnings. In all three countries, I find compulsory schooling lowers the likelihood of respondents being in the labor force and looking for work. The magnitude of the effect is similar across countries, and similar

Table 3
OLS and IV estimates for effects of compulsory schooling on health and other social-economic outcomes

Country (schooling variable)	(1)	(2)	(3)	(4)
	Mean (<HS sample)	OLS (<HS sample)	IV (<Full sample)	IV (<HS sample)
Health outcomes (ages 25–84)				
U.S. (total years of schooling)				
Physical or mental health disability that limits personal care	0.092	−0.014 [0.0008]***	−0.025 [0.0088]***	−0.029 [0.0160]*
Disability that limits mobility	0.128	−0.020 [0.0012]***	−0.043 [0.0118]***	−0.031 [0.0183]
UK (age left full-time education)				
Self-reported poor health	0.150	−0.037 [0.0016]***	−0.032 [0.0113]***	−0.019 [0.0085]**
Self-reported good health	0.564	0.065 [0.0021]***	0.060 [0.0155]***	0.025 [0.0115]**
Other social-economic outcomes (ages 25–64)				
U.S. (schooling variable: total years of schooling)				
Unemployed	0.064	−0.004 [0.0003]***	−0.005 [0.0050]	−0.026 [0.0153]
Receiving welfare	0.067	−0.013 [0.0005]***	−0.011 [0.0046]**	−0.020 [0.0102]*
Below poverty line	0.220	−0.023 [0.0015]***	−0.064 [0.0190]***	−0.085 [0.0312]***
Canada (highest grade attended)				
Unemployed; looking for work	0.062	−0.009 [0.0004]***	−0.010 [0.003]***	−0.013 [0.004]***
Below low-income cut-off	0.227	−0.038 [0.0004]***	−0.026 [0.0038]***	−0.019 [0.0068]***
UK (age left full-time education)				
In labor force; looking for work	0.110	−0.030 [0.0044]***	−0.032 [0.0150]**	−0.020 [0.0166]
Receiving income support	0.066	−0.025 [0.0024]***	−0.059 [0.0259]**	−0.031 [0.0150]**

Notes: All regressions include fixed effects for birth year, region (state, province, Britain/N. Ireland), survey year, sex, and a quartic in age. The U.S. results also include a dummy variable for race and state controls for fraction of state living in urban areas, fraction black, in the labor force, in the manufacturing sector, female, and average age based on when a birth cohort was age 14. Similar province controls for Canada include fraction in urban areas, fraction in the manufacturing sector, female, and average age. Data are grouped into means by birth year, nation, sex, race (for the U.S.) and survey year. Huber–White standard errors are shown from clustering by region and birth cohort. Single, double, and triple asterisks indicate significant coefficients at the 10%, 5%, and 1% levels respectively. See text for more data specifics.

compared to corresponding OLS estimates. Compulsory schooling also lowers the likelihood of receiving welfare and being classified as poor. Remaining in school one year longer reduces the likelihood of falling below the US poverty line by 6% points and falling below Canada's low-income-cut-off by 3% points.[9]

[9] A household falls below the low-income cut-off if they spend more than 20% points above the average comparative household on food, clothing, and shelter.

Table 4
The effect of schooling on subjective well-being least squares and IV estimates using UK and Irish changes in school-leaving age

	(1)	(2)	(3)	(4)
	Mean	OLS	IV	Initial observations
Life satisfaction (1 = not at all satisfied, 4 = very satisfied)	3.14	0.073	0.059	89279
		(0.0093)***	(0.0073)***	
Satisfied with life (1 = very or fairly satisfied, 0 = not satisfied or not at all satisfied)	0.86	0.040	0.0516	89279
		(0.0046)***	(0.0033)***	
Very satisfied (1 = very satisfied)	0.325	0.027	0.0235	89279
		(0.0023)***	(0.0135)*	
Happy (1 = not so happy, 2 = fairly happy, 3 = very happy)	2.14	0.044	0.0667	24565
		(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 asterisks indicate significant coefficients at the 10%, 5%, and 1% levels respectively. Samples include all adults aged 18 to 65. See text for more data specifics.

5.3. Happiness

Table 4 shows estimated effects of compulsory schooling on self-reported life satisfaction using a sample of 18 to 65-year olds from the UK and Northern Ireland in the 1973 to 1998 Eurobarometer Surveys. The outcome variable in the first row takes on a value 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. The IV results in column 3 indicate that a year of compulsory schooling increases the likelihood of being overall satisfied with life by 5.2% points, and increases the likelihood of being very satisfied by 2.4% points. The IV coefficient estimates are similar to the OLS ones. Some of the Eurobarometer Surveys also record self-reported happiness. The results indicate that the likelihood of being very happy or fairly happy also increases with compulsory schooling.[10]

5.4. Wealth

The return to compulsory schooling and quartic age coefficients from the U.S. male regression results are used to predict annual income over time for an individual who leaves school at age 15 and the annual income the individual would have received from leaving instead at age 16.[11] The amounts are converted to present value (to age 15), using discount rates of 3, 5, and 8%, and assuming that while in school or older than 64 years, income is zero. The percent increase in lifetime income from staying on another year is shown in Table 5.[12]

[10] These estimates are robust to regressing over any two-nation sample instead of three, or restricting the data over 20 birth cohorts and estimating returns to compulsory schooling solely from the 1947, 1957, or 1973 change in the school-leaving age.

[11] To check whether the return to compulsory schooling differs over the lifecycle, I estimated the same IV regression in Table 2, column 2, but allowing the compulsory schooling effect to vary between ages 15–24, 25–44, and 45–64. The estimated returns are within 1% point of each other for all three age groups.

[12] The estimates are from using the sample of U.S. males (row 2, column 2, in Table 2). Results are similar using samples from the other countries.

Table 5
Percent increase in present value wealth from one year of compulsory schooling

	(1)	(2)	(3)
	Discount rate		
	0.03	0.05	0.08
Percent change in present value wealth, OLS estimate	11.0%	10.8%	8.5%
Percent change in present value wealth, IV estimate	17.6%	16.9%	16.0%
Percent change in present value wealth, assuming 8% return	7.1%	6.4%	5.6%
Hurdle rate	1.20%	1.80%	2.60%

Notes: The regression specification follows Table 3 for the sample of U.S. males and with log annual income as the dependent variable. Estimated income profiles from ages 15 to 65 and estimated annual returns to compulsory schooling (17.4% for the IV estimate and 9.5% for the OLS estimate) are used to calculate present value changes in wealth using the discount rate indicated in the table. The overall change in wealth includes the expected income loss from attending school an additional year. The hurdle rate is the minimum annual return required to make an individual financially better off from taking one year of school instead of one year of work. It is based on the projected earnings profile for a 15-year old high school dropouts and uses the discount rate indicated in the table.

Lifetime wealth increases substantially, despite forgoing a year of income at age 15. Under the IV estimates, lifetime buying power would increase by 16 to 17% by staying on an extra year for individuals that dropout at age 15. The percent increase is about the same regardless of the discount rate used, because the discount rate adjusts both the numerator gains from schooling and the denominator lifetime wealth from leaving at age 15. Even with a lower return to compulsory schooling of 8%, lifetime buying power still increases by 6 to 7%. Table 5 also shows the hurdle rate, which is the minimum annual return required to make an individual financially better off from taking one year of school instead of one year of work. The estimated actual return, shown in Table 2, is more than 8% points higher.

6. Discussion

Changes to compulsory schooling laws help identify what dropouts would have earned had they stayed in school longer. This paper finds that the typical dropout born in the middle of the 20th century in the U.S., Canada, or the UK, missed out on an opportunity to increase lifetime spending by more than 10%.[13,14] Faced with such high returns, it would be difficult to describe staying in school as a poor financial investment. Dropouts may also have missed out on non-pecuniary effects, such as utility gains from higher life expectancy or lower chances of unemployment. Non-monetary returns reinforce the conclusion that the overall benefits from staying in high school were substantial.

[13] Some of these gains might be attributable to positive externalities generated from increasing a regions' enrolment and we should not include these gains when considering an individual's dropout decision. But Acemoglu and Angrist (2001), and Iranzo and Peri (2006) conclude that social returns from compulsory schooling are negligible. I also find no evidence of externalities from compulsory schooling. Changes to the minimum school-leaving age had no effect on schooling or earnings for individuals that dropped out or completed high school just prior to the change (Oreopoulos, 2003). Moretti (2004) finds positive earnings externalities from increases to a city's supply of college educated workers. Even assuming the same effect from more high school educated workers, the implied externality would not be large because the overall increase in education attainment from compulsory schooling changes during the period examined is relatively small.

[14] Oreopoulos (2007) estimates raising the minimum school-leaving age to 18 in the U.S., increased average earnings and decreased unemployment incidence for young adults in high school between 1970 and 2000.

With expected wealth higher from staying in school, the model presented in Section 2 suggests we should consider corresponding non-pecuniary costs to explain dropout behavior. One possible cost is added uncertainty. If a student is risk-averse, higher expected returns from additional schooling may be offset by greater outcome uncertainty. Some previous research finds greater earnings variance for college graduates than for high school graduates (e.g. Levhari and Weiss, 1974). Chen (2006), on the other hand, concludes that virtually all of the increased variance can be attributed to non-random selection.[15] Selection issues aside, there is little evidence that earnings variance increases with more high school. For example, while earnings vary more among college educated individuals compared to high school graduates in the 2000 U.S. census, earnings vary about the same among high school graduates compared to high school dropouts.[16]

Several other, potentially offsetting, costs occur while attending school. Stress from taking tests or from condescending attitudes by teachers may make some students want to leave as soon as possible. Friends and peers may also play a role. A central theme from the works of Akerlof and Kranton (2002), Coleman (1961), Gordon (1957), Hall (1904), Jackson (1968), Roderick (1993), and Willis (1977) is that that the chief motivation of students in high school is to be liked and accepted by peers. Lack of support for continuing may diminish a student's interest in staying. Removing these types of reasons for school distaste could reduce dropout outcomes (Lee and Burkam, 2003).

However, most dropouts do not describe school as stressful, but instead uninteresting. Asked to explain why they left, most dropouts say they were bored or unmotivated (Bridgeland et al., 2006). Table 6, for example, reports the frequency of reasons given for leaving school from the 1990 Eurobarometer Youth Survey.[17] More than 50% 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. Only 12.6% said they needed money, and almost no one said they left because their parents needed money or they had to raise a child.[18]

Attendance costs on their own are unlikely to offset an immediate offer of cash in the amount of the present value gains from attending another year.[19] However, attendance costs increase the more an individual focuses on the present and ignores the future. An individual's emphasis on the present may help explain why dropouts miss out on large returns. A large body of research documents a tendency for individuals to focus on the present when faced with immediate costs or uncertain gains (Frederick, Loewenstein, and O'Donoghue, 2002). Separate neural systems in the human brain value immediate and delayed rewards differently (McClure et al., 2004), which may explain why this tendency occurs. Adolescents are particularly predisposed to this myopic

[15] Judd (2000) concludes that the risk associated from an education investment is lower than the risk associated with other assets with similar expected returns.

[16] In the 2000 U.S. census, the standard deviations in annual income among 40 to 49-year olds with less than 12 years of education, 12 years of education, and more than 12 years are $23,300, $24,700, and $48,400 respectively.

[17] The sample includes those from Britain and Northern Ireland. Bridgeland, Diluio, and Morison (2006), report similar findings from a survey of young dropouts from Philadelphia and Baltimore in the U.S.

[18] Less than a third of dropouts surveyed in Bridgeland, Diluio, and Morison (2006) say they left because of personal constraints, such as from having to work, becoming a parent, or taking care of a family member. Another argument against explaining dropout behavior with a need to work is that many dropouts do not work. Among 17-year olds not in school according to the 2000 U.S. Census, for example, 90.4% were living with their parents, 5.6% were parents themselves, and 45% were not in the labor force.

[19] Students may underestimate the expected returns from staying in school. Dominitz and Manski (2000) find substantial variation among high school students in earnings expectations conditional on a bachelor degree. Rouse (2004), however, finds little evidence that the income expectations of lower-income disadvantaged students are different from those of higher-income students.

Table 6
Reasons for leaving school among 16 to 25-year olds

	Fraction mentioning reason		
	Finished school immediately at minimum school-leaving age	Finished school 1–2 years after minimum school-leaving age	Finished school 3+ years after minimum school-leaving age
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 money	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.

behavior. Spear (2000) summarizes from a review of evidence that maturational changes in the brain during adolescence contribute to many characteristic differences relative to individuals of other ages, including an increase in propensity to use drugs and partake in other risky behavior. Adolescence is associated with a major transformation of cognitive thought and abstract reasoning (Graber and Petersen, 1991). Decisions made before or during this transformation may likely differ from decisions made after. A tendency to downplay or ignore future consequences (as considered by Laibson, 1997; O'Donoghue and Rabin, 1999) may make adolescents prefer dropping out to staying on but later prefer staying on to dropping out. Consistent with this possibility, in the survey of 16 to 25-year old dropouts by Bridgeland, Diluio, and Morison (2006), 74% said that if they were able to relive the experience, they would have stayed in school.

As a final thought for this discussion, a recent group of papers that incorporate insights from neurology offer an interesting approach for interpreting myopic dropout behavior (e.g. Loewenstein and O'Donoghue, 2005; Fudenberg and Levine, 2005). These papers model an individual with two selves: an *affective* self that encompasses emotions and motivational drives and generally does not consider future consequences when maximizing present welfare, and a *deliberative* self that assesses options with a long-term, goal based perspective. The deliberative self cannot act, but can discourage the affect self from making decisions that lead to undesirable long-term outcomes. This influence, however, requires willpower which may in turn depend on an individual's level of stress or circumstance. The willpower needed to deter an angst ridden teenager's immediate desire to leave school may offset subsequent gains from staying on, but experienced in the future. Compulsory schooling removes the need for willpower to stay in school. In this case, welfare increases.

7. Conclusion

In this paper I discuss welfare implications for the empirical finding that the opportunity costs of dropping out are substantial. I use influential changes in minimum school-leaving laws in the U.S., Canada, Britain and Ireland to estimate lifetime gains to would-be dropouts from staying on. These changes provide ideal natural experiments to explore dropout behavior because they compel some students to continue school beyond the level they would choose on

their own. I find significant lifetime rewards to wealth, health, and overall happiness from having to stay in school. These results collectively summarize and reinforce earlier studies that estimate similar gains.

Lifetime wealth increases by about 15% with an extra year of compulsory schooling. Non-pecuniary school attendance costs must exceed these gains to justify dropping out. I find little evidence, however, that high school aversion on its own can offset these gains. One cannot rule out this possibility, since non-monetary costs are difficult to quantify, but it seems important and worthwhile to consider alternatives.

The discussion presented in this paper suggests that a better default explanation for dropout behavior is that dropouts are myopic. Immediate costs from schooling are more important for adolescents that tend to focus on the present. Forgoing substantial gains from additional schooling is more consistent with a model where adolescents ignore or heavily discount consequences of their decisions. This possibility is also more in line with recent studies in neurology and psychology that suggest adolescents lack abstract reasoning skills and are predisposed to risky behavior.

Several policy options exist to improve students' future outcomes if myopic behavior explains dropout decisions. Not all of them involve restricting choice, as in the case of compulsory schooling. Engaging students and providing more interesting curricula are some possibilities for making school attendance more attractive, based on self-reported reasons for dropping out. But identifying what specific changes would matter is difficult. Offering immediate financial incentives to stay in school is another method educators have considered to offset immediate costs. The Education Maintenance Allowance program (EMA) in the UK, for example, provides financial stipends to children from low-income families for every week of high school they stay beyond the minimum leaving age. Dearden et al. (2005) evaluate a pilot study of the EMA and estimate significant program effects on enrolment and graduation. Other researchers have offered incentives for performing well in school, with mixed success (e.g. Angrist and Lavy, 2002; Angrist et al., 2006; Kremer et al., 2007). Exploring these issues further through innovative field experiments or by gathering data on students' experiences may shed further light on understanding dropout behavior and, more generally, on the educational attainment decision process.

References

Acemoglu, Daren, Angrist, Joshua, 2001. How large are human capital externalities? Evidence from compulsory schooling laws. NBER Macroannual 9–59.

Akerlof, George, Kranton, Rachael, 2002. Identity and schooling: some lessons for the economics of education. Journal of Economic Literature 4 (40), 1167–1201 (December).

Angrist, Joshua D., Krueger, Alan, 1991. Does compulsory school attendance affect schooling and earnings? Quarterly Journal of Economics 106 (4), 979–1014.

Angrist, J., V. Lavy. "The Effect of High School Matriculation Awards: Evidence from Randomized Trials." NBER Working Paper #9389, 2002.

Angrist, Joshua, Daniel Lang, Philip Oreopoulos. "Lead them to Water and Pay them to Drink: An Experiment with Services and Incentives for College Achievement", NBER WP#12790, 2006.

Black, Sandra E., Paul J. Devereux, Kjell G. Salvanes. "Fast Times at Ridgemont High? The Effect of Compulsory Schooling Laws on Teenage Births, " NBER Working Paper #10911, November 2004.

Bridgeland, John M., Dilulio Jr., Jon J., Morison, Karen Burke, 2006. The Silent Epidemic: Perspectives of High School Dropouts. A report by Civic Enterprises in association with Peter D. Hart Research Associates for the Bill and Melinda Gates Foundation. March.

Card, David, 2001. Estimating the return to schooling: progress on some persistent econometric problems. Econometrica 69 (5), 1127–1160.

Chen, Stacey H. "Estimating the Variance of Wages in the Presence of Selection and Unobservable Heterogeneity", mimeo, Department of Economics, State University of New York at Albany, 2006.

Chiswick, Barry R., 1969. Minimum schooling legislation and the cross-sectional distribution of income. Economic Journal 79 (315), 495–507 (Sep.).
Coleman, James S., 1961. The Adolescent Society. The Free Press, New York.
Dearden, Lorraine, Carl Emmerson, Christine Frayne, Costas Meghir. "Education Subsidies and School Drop-Out Rates," Institute for Fiscal Studies Working Paper Number 05/11, 2005.
Dominitz, Jeff, Manski, Charles F., 2000. Using expectations data to study subjective income expectations. Journal of the American Statistical Association 92 (439), 855–867.
Eckstein, Zvi, Wolpin, Kenneth I., 1999. Why youths drop out of high school: the impact of preferences, opportunities, and abilities. Econometrica 67 (6), 1295–1339.
Frederick, Shane, Loewenstein, George, O'Donoghue, Ted, 2002. Time discounting and time preference: a critical review. Journal of Economic Literature 40 (2), 351–401.
Fudenberg, Drew, David K. Levine. "A Dual Self Model of Impulse Control," Mimeo, 2005.
Gatto, John Taylor, 2002. Dumbing Us Down: The Hidden Curriculum of Compulsory Schooling.
Gordon, Wayne C., 1957. The Social System of the High School. The Free Press, Chicago.
Graber, J.A., Petersen, A.C., 1991. In: Gibson, K.R., Petersen, A.C. (Eds.), Cognitive changes in adolescence: biological perspectives. Brain maturation and cognitive development: comparative and cross-cultural perspectives. Aldine de Gruyter, New York, NY, pp. 253–279.
Hall, Stanley G., 1904. Adolescence. Appleton, New York.
Harmon, Colm, Walker, Ian, 1995. Estimates of the economic return to schooling for the United Kingdom. American Economic Review 1278–1286 (December).
Heckman, James J., 2003. Human capital policy. In: Friedman, Benjamin (Ed.), Inequality in America. MIT Press, Cambridge, MA.
Imbens, Guido W., Angrist, Joshua D., 1994. Identification and estimation of local average treatment effects. Econometerica 62 (2), 467–475.
Iranzo, Susana, Giovanni Peri. "Schooling Externalities, Technology and Productivity: Theory and Evidence from U.S. States," University of California, Davis, mimeo, July, 2006.
Jackson, Philip, 1968. Life in Classrooms. Holt, Rinehart, and Winston, New York.
Judd, Kenneth L. "Is Education as Good as Gold? A Portfolio Analysis of Human Capital Investment," Stanford Economics Department Mimeo, 2000.
Kremer, Michael, Edward Miguel, Rebecca Thorton. "Incentives to Learn," mimeo, January 2007.
Laibson, David, 1997. Golden eggs and hyperbolic discounting. Quarterly Journal of Economics 112 (2), 443–477.
Lang, Kevin, Kropp, David, 1986. Human capital versus sorting: the effects of compulsory attendance laws. Quarterly Journal of Economics 101 (3), 609–624.
Lee, Valerie E., Burkam, David T., 2003. Dropping out of high school: the role of school organization and structure. American Educational Research Journal 40 (2), 353–393 (Summer).
Levhari, David, Weiss, Yoram, 1974. The effect of risk on the investment in human capital. American Economic Review 64 (6), 950–963.
Lleras-Muney, Adriana, 2002. Were compulsory attendance and child labor laws effective? An analysis from 1915 to 1939. Journal of Law and Economics 45, 401–435 (2,Oct).
Lleras-Muney, Adriana, 2005. The relationship between education and adult mortality in the United States. Review of Economic Studies 72 (1), 189–221.
Lochner, Lance, Moretti, Enrico, 2004. The effect of education on crime: evidence from prison inmates, arrests, and self-reports. American Economic Review 94 (1), 155–189.
Loewenstein, George, Ted O'Donoghue. "Animal Spirits: Affective and Deliberative Processes in Economic Behavior," Mimeo, 2005.
Machan, Tibor R., 2000. Education in a Free Society. Hoover Institution Press, Stanford University, Stanford, CA.
McClure, Samuel M., Laibson, David I., Loewenstein, Goerge, Cohen, Jonathan D., 2004. Separate neural systems value immediate and delayed monetary rewards. Science 306 (15), 503–507 (October).
Moretti, Enrico, 2004. Estimating the social return to higher education: evidence from longitudinal and repeated cross-sectional data. Journal of Econometrics 121 (1–2), 175–212.
O'Donoghue, Ted, Rabin, Matthew, 1999. Doing it now or later. American Economic Review 89 (1), 103–124.
Oreopoulos, Philip. "Do Dropouts Drop Out Too Soon? International Evidence From Changes in School-Leaving Laws," NBER Working Paper No. 10155, 2003.
Oreopoulos, Philip, 2006. Estimating average and local average treatment effects of education when compulsory schooling laws really matter. American Economic Review 96 (1), 152–175 (March).

Oreopoulos, Philip. "Should We Raise the Minimum School Leaving Age to Help Disadvantaged Youth? Evidence from Recent Changes to Compulsory Schooling in the United States," University of Toronto mimeo, 2007.
Rickenbacker, Willian F. (Ed.), 1974. The Twelve-year Sentence. Open Court, LaSalle, III.
Roderick, Melissa, 1993. The Path to Dropping Out. Auburn House, Westport MA.
Rouse, Cecilia, 2004. Low-income students and college attendance: an exploration of income expectations. Social Science Quarterly 85, 1299–1317 (Number 5, December).
Spear, L.P., 2000. The adolescent brain and age-related behavioral manifestations. Neuroscience and Biobehavioral Reviews 24, 417–463.
Willis, Paul, 1977. Learning to Labour. Saxon House, Westmead.