The compelling effects of compulsory schooling: evidence from Canada

Philip Oreopoulos *Department of Economics, University of Toronto*

Abstract. Compulsory school laws have existed for more than a hundred years, and policies to mandate further education continue to be discussed. The implications of these laws, however, are not well understood. Historical changes to compulsory schooling in Canada permit an examination of their effects on would-be-dropouts under very different circumstances than those during changes in other countries. Mandating education substantially increased adult income and substantially decreased the likelihood of being below the low-income cut-off unemployed, and in a manual occupation. These findings suggest significant gains from this legislation, which seem unlikely offset by the costs incurred while having to remain in school. JEL classification: I20, I28

Les effets incontournables de l'école obligatoire: résultats pour le Canada. Des lois sur l'école obligatoire existent depuis plus de cent ans et on continue à discuter la possibilité d'en allonger le mandat. Les impacts de ces lois ne sont cependant pas très bien compris. Des changements à cette législation à divers moments dans l'histoire au Canada permettent d'examiner les effets de ces lois sur le décrochage scolaire dans des situations très différentes de celles observées dans d'autres pays. L'instruction obligatoire augmente substantiellement le niveau de revenu à l'âge adulte et réduit de manière substantielle la probabilité d'avoir un Revenu très faible, d'être en chômage et d'être un travailleur manuel. Ces résultats suggèrent que cette législation a des effets bénéfiques significatifs qui ne sont vraisemblablement pas compensés par les coûts encourus en restant à l'école.

This paper was completed as part of the research program of the Family and Labour Studies (FLS) Division of Statistics Canada while the author was a Statistics Canada research fellow. Support from FLS and from SSCHRC, Grant No. 410-2003-0189, is greatly appreciated. I am also very grateful to Miles Corak, Arthur Sweetman, Adriana Lleras-Muney, Angelo Melino, Michael Baker, and two anonymous referees for their discussions and to participants at the Canadian Employment Research Forum's 10th Anniversary Conference. Sonya Gulati and Tarek Hossain provided outstanding research assistance. Any errors and conclusions are my own. Email: oreo@economics.utoronto.ca; oreo@mit.edu

Canadian Journal of Economics / Revue canadienne d'Economique, Vol. 39, No. 1
February / février 2006. Printed in Canada / Imprimé au Canada

0008-4085 / 06 / 22–52 /

1. Introduction

In analysing why some students leave school earlier than others, researchers commonly treat education as an investment. This approach assumes that students invest time, forgo earnings, and endure stress to attend school, but only if the anticipated gains from doing so are large enough to offset the costs. High school students decide whether to drop out or stay by weighing the expected rewards from obtaining a degree against the effort required to get it. Those who leave early may do so because they detest school, lack motivation, or anticipate little reward from graduation (Eckstein and Wolpin 1999). But whatever the reason, models that treat school attendance as an investment decision tend to presuppose that dropouts choose what's best for them under the circumstances.

Many policymakers, educators, researchers, and certainly parents, would disagree. Efforts to introduce, maintain, or update compulsory school attendance laws reflect a widely held view that the decision to leave secondary school before graduation – far from being ex ante optimal – will lead to sub-optimal lifetime outcomes for the individual dropout. Such laws have existed for more than 100 years and are common to virtually every industrialized country. They are motivated by the assumption that children who would otherwise leave school early are, in fact, better off if they stay, or that society benefits collectively because a higher level of educational attainment promotes good citizenship and economic development. Archibald Macallum, an Ontario teacher, summarized the latter argument vigorously in an 1875 report favouring the introduction of compulsory schooling in Canada: 'Society has suffered so cruelly from ignorance, that its riddance is a matter of necessity, and by the universal diffusion of knowledge alone can ignorance and crime be banished from our midst; in no other way can the best interests of society be conserved and improved than by this one remedy – the compulsory enforcement of this great boon – the right of every Canadian child to receive that education that will make him a good, loyal subject, prepared to serve his country in the various social functions which he may be called on to fill during his life; and prepare him, through grace, for the life to come' (Annual Report of the Ontario Teachers' Association, 1875, as cited in Prentice and Houston 1975, 175–6).

More than a hundred years later, similar rationales are still being invoked to justify the further strengthening of compulsory school attendance laws. In 1998, for example, the deputy minister of education for New Brunswick provided this explanation for the province's decision to raise the minimum school leaving age to 18: 'educators must help students fulfil the Mission of Public Education in New Brunswick to acquire the necessary skills, knowledge, and attributes needed to be a life-long learner, to achieve personal fulfillment and to contribute to a productive just and democratic society' (School Leaving Age Task Force, New Brunswick, 1998). Recently, other provinces have

acted to update and increase the school leaving age. Alberta almost did so in 2003 and Ontario is currently discussing legislation to raise the school leaving age to 18.

Several previous studies use historical changes in compulsory school laws as natural experiments to generate causal estimates of the returns to education. Although these studies generally do not discuss the welfare and policy implications of their results, all point to significant individual and social gains from compulsory school attendance. Angrist and Krueger (1991) use individual birth dates to compare outcomes for youths who entered school earlier because they were born just prior to the school entry cut-off date as opposed to just after. They find that U.S. males who attended one extra year of school because of these entry laws experienced an increase in annual earnings of 10.1%, on average. Acemoglu and Angrist (2002) find more direct evidence that compulsory school attendance raises the earnings of would-be-dropouts by instrumenting educational attainment with school entry and compulsory attendance laws. They conclude that individual returns to compulsory schooling are 8% or more, while additional social returns are negligible. Oreopoulos (2004) uses a more dramatic change in the school leaving age in the United Kingdom to estimate the returns to compulsory schooling by regression discontinuity. Even with a much larger fraction of the student cohort affected by the change in leaving age, the estimated return to individuals is similar.

Other papers find evidence of social returns, but for non-pecuniary outcomes. Lochner and Moretti (2002), for example, find that compulsory schooling lowers crime, while Lleras-Muney (2002) finds a correlation with improved health. In studies of the United States and United Kingdom, Dee (2003) and Milligan, Moretti, and Oreopoulos (2003) estimate that tighter restrictions on leaving school early correspond to increased levels of civic activity (like voting and discussing politics).

My aim in this paper is to provide further evidence for the effects of compulsory education and to suggest an alternative framework for evaluating the policy implications of this evidence beyond that offered by the standard returns–to-schooling literature. Historical changes in Canada provide an opportunity to examine whether school leaving and entry laws in that country have produced effects similar to those found in the U.S. and U.K. contexts.

This paper makes two contributions. First, I measure the overall impact of compulsory schooling laws in Canada between 1920 and 1990. Quantifying the effects from both past and more recent changes to those laws provides essential context for current policy discussions concerning further changes to the school leaving age. My analysis suggests that students compelled to complete an extra grade of school have historically experienced an average increase of 9–15% in annual income. I also find that students with additional schooling are more likely to speak two languages, more likely to work, and are less likely to be low-income, unemployed, and in a manual occupation. My estimates are

similar whether I group the data by different birth-cohorts, different geographic regions. or different periods.

Second, I use changes in compulsory school laws to estimate the lifetime opportunity costs associated with dropping out of high school. Quantifying the benefits that dropouts forego by leaving school early offers important insights for evaluating theories of school attainment. Put another way, knowing what dropouts give up is essential for understanding why they do it. If the returns to schooling are very high, this might imply that the financial constraints or psychological costs associated with going to school must also be very substantial among dropouts. If, on the other hand, financial constraints or psychological costs alone seem unlikely – on the basis of additional evidence – to provide an adequate explanation for dropout behaviour other factors may also play a role. For example, cultural or peer influences may dominate adolescent decision-making, and youths may underestimate the rewards from staying in school or ignore the future consequences of their decisions.

2. A brief history of compulsory schooling laws in Canada

Concerns about school attendance emerged soon after the introduction of the public education system in Canada at the end of the nineteenth century. Even as schooling became more available, school attendance was often sporadic and infrequent. At the time, 70% of the Canadian population still lived in rural areas. The needs of the farm often dictated the frequency and timing of school attendance. Some families sent one child to school for a few weeks and then another (Phillips 1957). In the winter, when children were least needed at home, attendance remained low because leisure was often preferred over sitting in cold schoolhouses. In 1900 the average daily attendance rate (among those enrolled) for the whole of Canada was 61%. Moreover, most children received only a few years of schooling. Both boys and girls often left by age 9 or 10 to work in factories or at home.

Teachers, administrators, and politicians were among the first to advocate for compulsory schooling. They argued that inconsistent attendance disrupted class and impeded meaningful learning. In 1971 an Ontario school superintendent complained that "irregularity of attendance is the bane and curse of the public schools; it is a log and chain upon the progress of instruction for it blasts and withers the noblest purposes of the best of teachers' (Axelrod 1997, 51). Education officials worried that students were being kept home for trifling reasons, or that poor families resisted sending their children to school even though education could help them avoid poverty as adults. In short, authorities were concerned that poor attendance compromised exactly those societal goals that public education was intended to advance.

Figure 1 summarizes compulsory schooling laws in Canada over the last 100 years, highlighting provincial requirements with respect to the maximum age for beginning school and the minimum age for leaving school. The underlying

details of these laws are complex, and exceptions were made. Ontario, for example, was the first Canadian province to introduce compulsory schooling. Beginning in 1871, parents were obliged by threat of fine to have children attend school for at least four months a year between the ages of 7 and 12. Legislation adopted in 1891 raised the age limits to 8 and 14 and required children to remain at school, even after reaching 14, until the end of term. The new law was more rigorous in stipulating penalties for parents who refused to comply and for employers who hired children who should have been at school. As with many of Canada's early compulsory school laws, however, numerous exceptions were allowed and attendance requirements were often poorly enforced, especially in rural areas. Aside from sickness, the main exception involved children who lived more than two miles away from school if they were under 10, or more than three miles away from school if they were over 10. These children were exempt from compulsory attendance unless transportation to school was provided. In 1921 the Adolescent School Attendance Act increased the age of compulsory school attendance to 16 in urban areas, but any adolescent could be exempted with a home permit or an employment certificate signed by a parent. Employed 14 and 15 year-olds were required to attend part-time evening classes, but only in municipalities that provided such classes. In 1954 the Schools Administration Act imposed a minimum school leaving age of 16 for all children in Ontario, but allowed adolescents over 14 to work on a family farm, at home, or elsewhere if doing so was necessary for subsistence. By 1970 these exemptions were removed.[1]

By this time, all of the Canadian provinces enforced a minimum school leaving age of either 15 or 16. These limits remained for many years. Beginning with Prince Edward Island in 1980, those provinces that had set the minimum leaving age at 15 raised it to 16: Newfoundland did so in 1987, Quebec in 1988, British Columbia in 1990, and Nova Scotia in 1996. New Brunswick was the first province to push the minimum school leaving age above 16, changing it to 18 in 2000.

In addition to compulsory schooling, many provinces also introduced child labour laws near the beginning of the twentieth century. Early versions of these laws were designed primarily to protect children from harsh working conditions, not to promote schooling.[2] Many provinces imposed age restrictions on children working in mines or factories and most strictly prohibited night work for children under the age of 18. Typically, children were allowed to work a maximum of 10 hours a day and 60 hours a week.

Other aspects of employment law were more closely connected to schooling requirements. Employment certificates that exempted children from the minimum school leaving age law could be obtained by passing a seventh or eighth

1 Details of the other provincial laws are provided by Oreopoulos (2005).

2 The Dominion Bureau of Statistics *1925 Survey of Education* provides a useful summary of the details and complexities of early child labour laws by province.

grade equivalence test. In some cases, such certificates required only evidence of reading and writing skills. For certain occupations, mainly mining, employment certificates were required even for children over the minimum school leaving age. Some labour laws also allowed children younger than the minimum school leaving age to work if doing so was deemed necessary for subsistence. By 1933, however, all provinces had removed these exemptions.

In sum, education requirements and child labour laws were designed to work together, with the latter serving both to reinforce and create exceptions to the former. In the first half of the twentieth century, children younger than the minimum school-leaving age were generally still allowed to work if they demonstrated a certain level of educational attainment or if they were from poor households. Later, school authorities came to view these exemptions as loopholes that were being used to avoid attendance requirements without reasonable cause. By 1942 all provinces except Saskatchewan removed exemptions to the minimum school leaving age. Saskatchewan abandoned its exemption for students who passed an eighth grade equivalence test in 1974.

3. Data description and sources

For this analysis, I compiled data on compulsory schooling and child labour laws directly from provincial statutes, including all original acts of relevant legislation and subsequent amendments. I used additional sources to help verify the compilation. In particular, the Dominion Bureau of Statistics (later renamed Statistics Canada) has published since 1921 a near-annual survey of education that details legislative changes and summarizes compulsory school attendance requirements (and occasionally child labour laws) for each province.

I created four variables to summarize compulsory school attendance rules, coded by year of legislation for each province from 1900 to 2000:

1. Minimum exit age of compulsory schooling in towns and cities (town leaving age)
2. Minimum exit age of compulsory schooling in rural areas (rural leaving age)
3. Maximum entry age of compulsory schooling (entry age)
4. Indicator for whether employment certificates provided exemptions to the minimum leaving age.

The school-leaving age for towns and rural areas rarely differed, so I used the town-leaving age only. In addition, I constructed a variable for the difference between the school leaving age and the school entry age – this variable corresponds to the number of years spent in school for an individual who waits to enter school until required to attend and who leaves immediately after reaching the school-leaving age. Acemoglu and Angrist (2002) and Lleras-Muney

(2002) use a similar minimum-number-of-years-in-school variable for their U.S. analyses.

To explore the effects of compulsory schooling on educational attainment and on subsequent socio-economic outcomes, I matched the above-described variables to data from the 33% sample of the 1971 Census and the 20% samples from the 1981, 1986, 1991, 1996, and 2001 Censuses.[3] The census files provide information on gender, province-of-residence, province-of-birth, age, labour market status, last year's annual income and wages, and educational attainment. I included in my sample all individuals aged 20 to 65 who were born in a Canadian province and who were 14 years of age between 1920 and 1990. This resulted in a total sample size of 14,399,186.

This baseline sample includes individuals over a wide age range and over a wide time range. The 25-year-olds in the sample attended school under the compulsory education requirements that obtained in the 1970s and later, whereas school attendance for the 65-year-olds was governed by laws enacted as early as 1925. The mean age of individuals in the sample was 39 and the mean year they turned 14 was 1962. Constraining the sample to include only the same birth cohorts over the 30 years of available census data restricts the analysis to either older cohorts and older compulsory schooling laws or younger cohorts and more recent laws. The results for these alternative sample specifications are similar to those presented here. Alternative specifications that restrict individual ages in the census between 40 and 55 and census years 1991 and less produced very similar results to the ones presented here.

All provinces experienced rapid gains in average educational attainment over the period from 1920 to 1990. These gains are shown in figure 2. Note that, together, the data displayed in figures 1 and 2 indicate similar estimates of the effect of compulsory schooling on average grade attainment, even though discontinuities at the years when attendance laws change are not apparent. We would not, in fact, expect large discontinuities, because the educational attainment variable used here (grade attainment) does not correspond precisely with changes in school attendance requirements. Raising the school leaving age may increase the length of time spent in school, but may not raise educational attainment for students who repeat a grade.

The census data record highest grade attained as well as highest degree completed, and also indicate whether a high school certificate was received. I focused on the grade attainment variable, since school attendance laws prior to 1970 did not require children to finish high school. A child who entered grade 1 at age 6 and advanced one grade per year would have reached grade 11 at age

3 These files are available internally at Statistics Canada. I found no notable difference in the results whether working with these files or the Public Use Data Files. The STATA program codes for working with these files are available on request. The 1976 public use census sample excludes earnings information and was omitted.

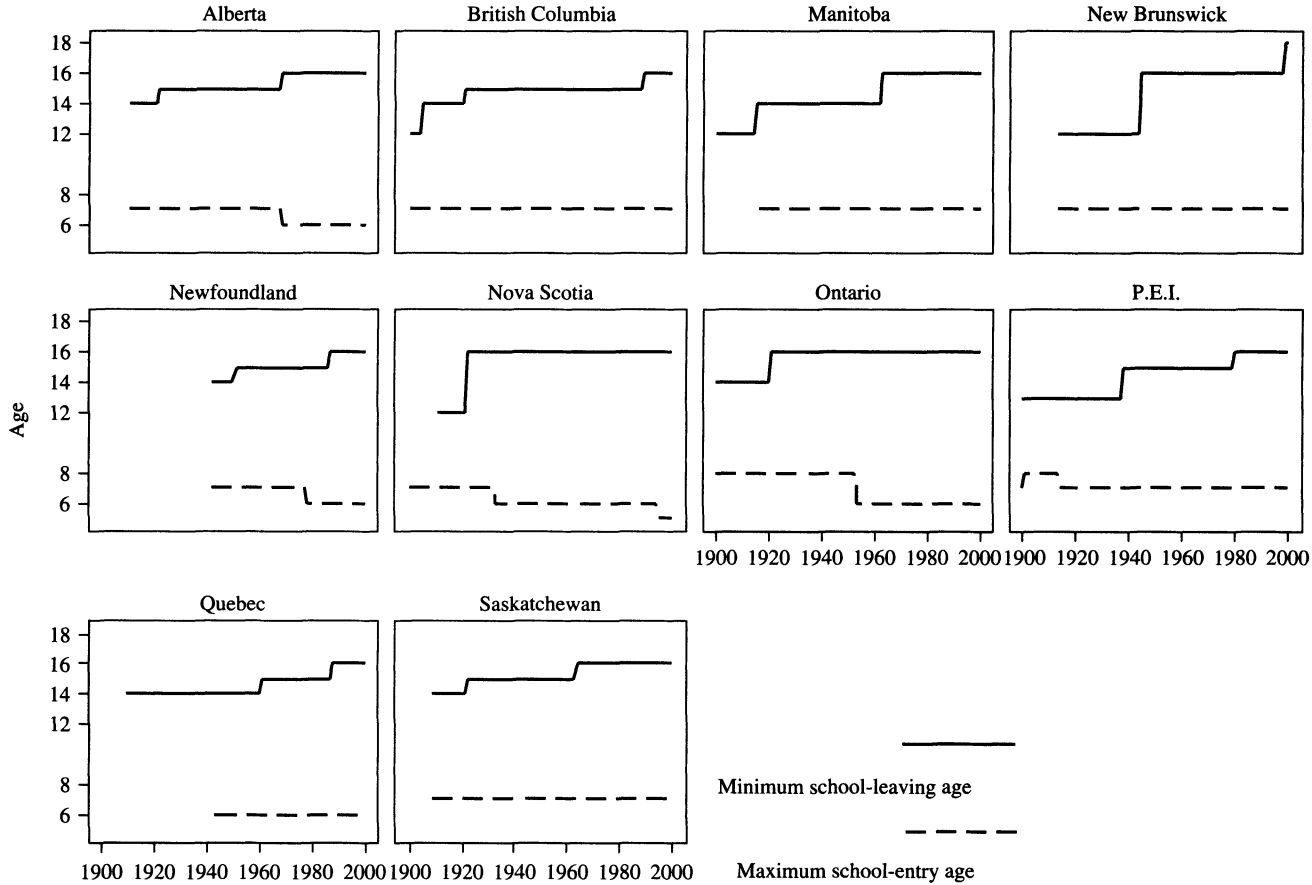

FIGURE 1 Minimum school-leaving ages and maximum school-entry ages by province, 1900–2000
NOTES: See data appendix for details.

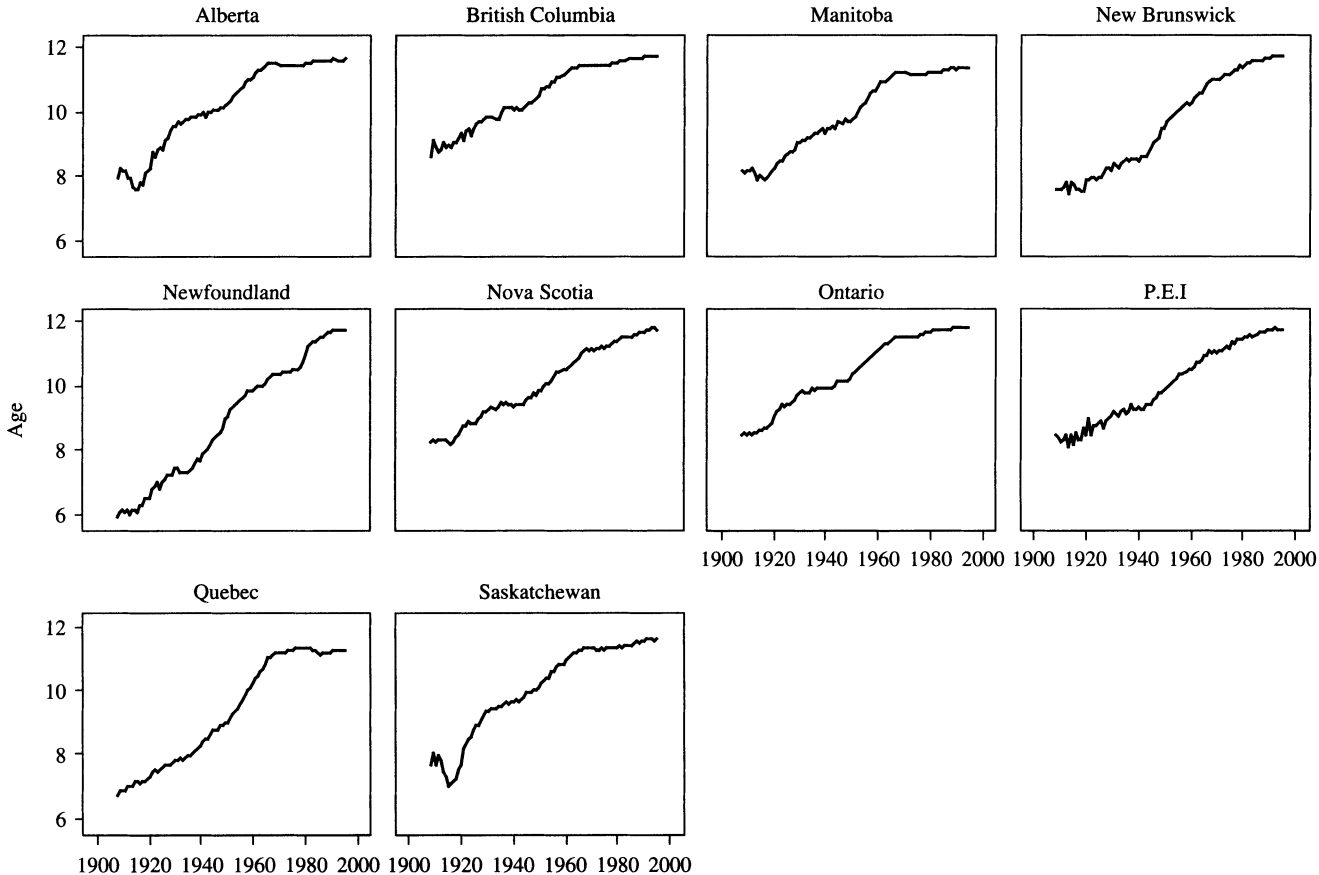

FIGURE 2 Average grade attainment by year turned 14 years old and province, 1900–2000
NOTES: See data appendix for details.

16. I examined whether compulsory schooling affected high school graduation or ultimate educational attainment.[4]

Different provincial grade requirements for high school graduation complicate the use of grade attainment variables to examine the effects of compulsory schooling on earnings. By 1960, for example, Nova Scotia, Quebec, and Newfoundland allowed graduation after grade 11. Newfoundland did not offer schooling beyond this grade until 1984.[5] The other provinces allowed graduation after grade 12. Ontario and British Columbia offered a grade 13 senior matriculation year that generally reduced by one year the time required to obtain a university degree. Almost 50% of 14-year-olds in 1960 attended this additional grade. Thus, compelling children to stay in school through grade 11 likely had different implications for high school graduation in different provinces.

I matched individuals to the compulsory school attendance laws that were in place in their province of birth when they were 14 years old, except when matching to school entry laws, where I used the age requirements that applied when individuals were 6 years old.[6] Acemoglu and Angrist (2002), Lleras-Muney (2002), Schmidt (1996), and Goldin and Katz (2003) follow the same procedure for the United States. Schmidt (1996) examined this approach and found that the effects of compulsory school laws in the United States were largest when matched to individuals at age 14.

Finally, I also matched individuals with other characteristics of their province of birth when they were 14 years old, including: number of schools per student, number of teachers per student, per capita education expenditures, fraction of population in a rural area, and fraction of workers in the manufacturing sector. The appendix describes in more detail how these variables were compiled and presents means and standard deviations for the variables used in this paper.

4 Children compelled to take additional years of school as the result of a higher leaving age may also be more likely to graduate, since the remaining number of years required to complete a high school degree – once they have the option to drop out – declines. If this has the effect of lowering the perceived cost of graduating, students who would have dropped out under more permissive school attendance laws may choose to continue going to school even after they reach the minimum leaving age. Changes in compulsory school attendance requirements might also affect children who would otherwise choose to drop out before graduation but after the school leaving age. Lang and Kropp (1986) suggest that children in this category might choose to complete additional years of schooling following an increase in the minimum leaving age so as to signal to potential employers that they are different from those students who opt to drop out as soon as possible.

5 See Sweetman (2001) for a discussion of the effects of adding one year to the high school curriculum required for graduation in Newfoundland.

6 Individuals who moved from one province to another before reaching high school were mismatched. Because changes in compulsory school laws were unlikely to cause people to move, this is not likely to be a source of significant error in my estimates for the sample as a whole.

4. Methodology for estimating the effects of compulsory school attendance on educational attainment and adult outcomes

I first generated cell means for all variables by census year, birth cohort, and province. This improves the manageability of the dataset and avoids heteroscedasticity at the individual level. I estimated the following equation:

$$EDUC_{pcy} = \gamma CL_{pc} + \beta X_{pc} + e_p + e_c + e_y + e_{pcy}, \quad (1)$$

where $EDUC_{pcy}$ is the average educational attainment level for the group born in province p from birth cohort c and census year y; CL_{pc} is a vector of provincial compulsory schooling laws and child labour laws; X_{pc} is a vector of provincial controls; e_p, e_c, and e_y are fixed effects for province, birth cohort, and census year respectively; and e_{pcy} is the error term. The errors are clustered by province and birth cohort.

To identify effects from compulsory schooling laws I used differences in the timing of changes to those laws across provinces. The effects on education attainment from the laws in equation (1) are estimated from comparing the relative difference in education attainment across provinces before and after more restrictive laws are enacted for some provinces. The analysis is therefore similar to difference-in-difference estimation, but with more than one intervention and more than one 'treatment group.' The methodology does not identify the true impact of compulsory schooling laws on enrolment if other provincial factors that influence school attendance change coincidentally at the same time as the laws themselves. I conducted several specification checks to examine this possibility.

I estimated the returns to compulsory schooling on earnings and other socio-economic outcomes by substituting actual educational attainment with predicted educational attainment using differences in school attendance requirements across provinces and time periods. The baseline instrumental variables equation is

$$Y_{pcgya} = \delta \overline{EDUC}_{pcy} + \beta X_{pc} + u_p + u_c + u_y + u_{pcy}, \quad (2)$$

where Y_{pcy} is the average outcome for the group born in province p from birth cohort c and census year y, and where $\overline{EDUC}_{pcy}$ is the group's predicted educational attainment after estimating equation (1).

5. Results

5.1. The impact of compulsory schooling on school enrolment and educational attainment

Table 1 presents the predicted effects of the compulsory schooling on grade attainment as estimated using from estimating equation (1) and after weighting

by cell mean sample size.[7] The estimates use the full sample of Canadian-born individuals who were 14 years old between 1920 and 1990 and who were between 20 and 65 years old when they were surveyed for the census. Column 1 shows the coefficients for the effects from different school leaving ages. The omitted dropout age is age 12 or less. Average grade attainment is 0.27 points higher with a minimum school leaving age of 14 compared with 12 or less, after controlling for average province, birth cohort, and census year fixed effects. Raising the minimum school leaving age from 14 to 15 generates an increase in average grade attainment of 0.63 points, while raising the leaving age from 14 to 16 generates an increase of 0.35 points.

Table 1 also shows a negative association between grade attainment and the indicator for whether employment certificates provided exemptions to the minimum leaving age. Allowing for exemptions from the school leaving age by means of work-permit or proof of necessity lowers average grade attainment by about 0.15 points. Extending compulsory school requirements to younger children by lowering the age of entry is associated with higher grade attainment. Adding control variables does not alter estimated coefficients for these effects by much. Provincial school expenditures matched to students when age 14 are strongly associated with higher grade attainment (while including province and birth cohort fixed effects). A positive correlation also exists between grade attainment and fraction of workers in the manufacturing sector. By contrast, fraction of population in rural areas is negatively correlated with grade attainment.

Column (4) allows for separate quadratic cohort trends for each province over the 70-year period instead of the provincial background controls in column (3). Specifically, each provincial dummy variable is interacted with a year of birth variable and year of birth squared. The background controls are dropped because the trend variables are trying to do the same job as these control variables: accounting for other province-specific influences over time.[8] Estimated coefficients for the effects of compulsory school laws are similar. The main set of instrumental variables results use column (3) as the first stage. Results using the provincial/cohort-specific trends are also shown, but these specifications generate estimates that are less precise. This is not surprising, since de-trending province-specific cohort effects may absorb some of the compulsory schooling effects and make them more difficult to identify.

The first-stage results suggest the marginal effect of raising the leaving age to 16 is negligible. In some cases, the point estimates imply raising the school leaving age from 15 to 16 lowers education attainment. This anomaly may arise for two reasons. First, for the provinces that raised their leaving age

7 Weighting by sample size leads to identical coefficient estimates comparing the cell-mean regressions and those from using the non-aggregated micro sample. Only the standard errors differ. The aggregated regressions remove within-cell heteroscedasticity.

8 The inclusion of both provincial background controls and quadratic trends leads to larger standard errors on the coefficient estimates, but the second-stage IV estimates of the returns to compulsory schooling are almost exactly the same as the base specifications in table 3.

TABLE 1
Effects of compulsory schooling and child labour laws on education attainment (dependent variable = grade attainment)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Full sample: (grade attainment mean = 10.27)						
School-leaving age = 14	0.266	0.224	0.198	0.301			
	[0.060]***	[0.062]***	[0.065]***	[0.070]***			
School-leaving age = 15	0.934	0.875	0.641	0.561			
	[0.052]***	[0.059]***	[0.084]***	[0.073]***			
School-leaving age = 16	0.606	0.614	0.333	0.507			
	[0.055]***	[0.060]***	[0.078]***	[0.072]***			
Exemptions to leaving age allowed		−0.126	−0.237	−0.197			
		[0.023]***	[0.032]***	[0.026]***			
School entry age = 7		0.126	0.318	0.292			
		[0.037]***	[0.057]***	[0.050]***			
School entry age = 6		0.149	0.100	0.211			
		[0.028]***	[0.026]***	[0.038]***			
Number of mandatory school years					0.183	0.133	0.134
					[0.014]***	[0.013]***	[0.016]***
Log provincial school expenditure			0.166			0.301	
			[0.033]***			[0.045]***	

Fraction in province in rural area			−0.081			−0.956	
			[0.189]			[0.336]***	
Fraction in province in manufacturing			3.9			3.5	
			[1.4]***			[2.3]	
Number of schools in province per student			3.3			5.1	
			[2.41]			[2.5]**	
Number of teachers in province per student			−26.7			−19.3	
			[6.12]***			[9.3]**	
With (province) *(linear cohort) trends	No	No	No	Yes	No	No	Yes
Initial sample size	14,399,186	14,399,186	14,399,186	14,399,186	14,399,186	14,399,186	14,399,186
Grouped observations	2710	2710	2710	2710	2710	2710	2710
R-squared	0.96	0.96	0.97	0.97	0.93	0.95	0.95

NOTES: Regressions are on cell means from census data, grouped by birth cohort, province, and census year. All regressions are weighted by cell sample size and include fixed effects for province, birth cohort, and census year. Province* linear-cohort trends are provincial dummy variables interacted with year of birth and year of birth squared. Huber-White standard errors are shown, clustered by province. One, two, and three asterixes indicate coefficient is significantly different from zero at a 10%, 5%, and 1% confidence levels.

requirement to 15 and then to 16 (i.e., Newfoundland, Prince Edward Island, Quebec, and Saskatchewan), many fewer students were leaving as soon as possible once the higher age requirement was instituted. If the same specification used in column (1) is applied only to these four provinces, changing the leaving age from 14 to 15 is predicted to increase grade attainment by 0.31 points, while raising it from 15 to 16 increases grade attainment by 0.08 points. Second, gains in educational attainment for provinces that directly increased the minimum school leaving age from 12 to 16 or from 14 to 16 are not substantially larger than gains for those for provinces that increased the leaving age to 15. This may be the case because the fraction of students that dropped out as early as age 14 was smaller when provinces increased the leaving age to 16 than when provinces increased the leaving age to 15. So estimating the effects from raising the school leaving age at different levels is complicated by the fact that some provinces raised their leaving age by more than one year at a time, and some changed their laws much earlier than others. This does not invalidate using the laws as instruments since the laws still influence education attainment, albeit in a less systematic way across provinces and time. To address this, I estimate the returns to compulsory schooling over a wide range of alternative region and time period specifications.

The coefficient on the summary variable for compulsory schooling is shown in column (5). It indicates that a one-year increase in the number of mandatory school years is associated with a 0.18 increase in average grade attainment, on average. The estimate falls to 0.13 when the provincial control variables (in column (6)) are added and when quadratic cohort trend controls are included for each province (in column (7)). This result implies that if a change in law compels all would-be dropouts to stay for one additional year of school, the fraction of students who – absent that change – would have left one year earlier is 13%. The fraction would be lower if some students compelled to continue attending school also end up staying on for more than one additional year. This upper-bound estimate of the fraction of students affected by a change in compulsory school requirements compares with the fraction of students in my sample (12.6 to 17.5%) whose highest grade attainment is less than or equal to the mandatory number of school years.[9] Oreopoulos (2004) finds similar effects from compulsory school laws in the United States: a one-year increase in the school leaving age raises total years of schooling by 0.10, on average. Lleras-Muney (2002) estimates smaller U.S. effects using an earlier time period (1914 to 1940) and a different set of regional controls. Specifically, she finds that a one-year increase in compulsory school attendance increases average years of schooling by 0.05 years.

9 The fraction that attained grade 7 or less among those who faced seven years of mandatory schooling or less is 0.126; the fraction that attained grade 8 or less among those who faced eight years of compulsory schooling is 0.174; the fraction that attained grade 9 or less among those who faced nine years of compulsory schooling is 0.135; and the fraction that attained grade 10 or less among those who faced at least ten years of mandatory schooling is 0.165.

Table 2 compares estimated effects from compulsory school laws on different levels of educational attainment. All estimates continue to include fixed effects for province, census year, and birth cohort, as well as other controls for provincial background. The table reports regression coefficients using dummy variables for whether an individual has completed the level of schooling indicated by the column heading. The bottom row shows results obtained by separately regressing mandatory number of school years on various levels of educational attainment. These coefficients generally peak for attainment at the grade 8 level, and fall sharply after grade 11. Column (7) shows that students subject to a school-leaving age of 16 are 1.0% more likely to attend a trade or vocational college compared with a leaving age of 15. According to these results, compulsory schooling requirements other than leaving age are not significantly related to post-secondary educational attainment. If raising the school-leaving age merely compels would-be dropouts to stay in school for an additional year or two, the primary impact of this change will be to shift the distribution of schooling in middle and high school grades. On the other hand, evolving requirements for compulsory education themselves may reflect omitted factors related to macroeconomic conditions, tastes for schooling, or family background. In that case it might be reasonable to expect that more demanding laws would be correlated with a higher fraction of the population obtaining a post-secondary education.

Since the effects of compulsory school attendance appear to be concentrated on early grade attainment without significantly affecting high school graduation, it may be preferable to restrict the analysis to early high school leavers. Table 3 shows the first stage results for both the full census sample and the sample of individuals that attained eleventh grade or less. Census surveys query both an individual's highest grade attainment and his/her highest degree, so while most individuals in the smaller sample did not complete high school, some of them could have obtained community college or bachelor degrees. Overall, constraining the sample in this way produces only small changes in the estimated effects coefficients for compulsory schooling. The effect of imposing a minimum school leaving age of 14 is somewhat smaller for the dropout sample compared with the full sample, while the effect of imposing a school entry age of 6 is somewhat higher.

Since these estimates are weighted by cell mean sample sizes, they are more strongly influenced by what happened in Quebec and Ontario, where more than 50% of Canada's population resides, than by outcomes in the other provinces. The cell mean sample sizes for each province are sufficiently large to allow for an alternative calculation in which equal weight is placed on all provinces (and all birth cohorts). The second set of columns in table 3 excludes the cell weights, thus treating law changes that happened in smaller provinces as equal in significance to changes that happened in larger ones. This approach results in a larger estimated effects coefficient on the school-leaving age variable, a smaller coefficient on the leaving age exemption

TABLE 2
Effects of compulsory schooling and child labour laws on various education attainment levels

	(1) Gr. 7 attained	(2) Gr. 8 attained	(3) Gr. 9 attained	(4) Gr. 10 attained	(5) Gr. 11 attained	(6) High school cert.	(7) College	(8) College or more	(9) University degree
				Detailed specification					
School Dropout Age = 14	0.049 [0.012]***	0.015 [0.014]	0.007 [0.009]	−0.006 [0.010]	−0.013 [0.008]	−0.002 [0.006]	0.002 [0.006]	0.001 [0.006]	0.000 [0.004]
School Dropout Age = 15	0.097 [0.015]***	0.117 [0.020]***	0.073 [0.012]***	0.068 [0.013]***	0.031 [0.010]***	−0.004 [0.007]	0.003 [0.006]	0.002 [0.007]	0.002 [0.004]
School Dropout Age = 16	0.056 [0.014]***	0.046 [0.018]**	0.028 [0.011]**	0.015 [0.012]	−0.014 [0.009]	−0.004 [0.006]	0.011 [0.005]**	−0.006 [0.006]	−0.009 [0.003]**
Exemptions to Leaving Age Allowed	−0.046 [0.005]***	−0.066 [0.008]***	−0.033 [0.005]***	−0.028 [0.005]***	−0.022 [0.004]***	0.005 [0.002]**	−0.002 [0.002]	−0.003 [0.002]	−0.001 [0.001]
School Entry Age = 7	0.059 [0.009]***	0.046 [0.012]***	0.051 [0.009]***	0.009 [0.010]	−0.001 [0.010]	0.002 [0.008]	−0.001 [0.005]	−0.001 [0.005]	0.002 [0.003]
School Entry Age = 6	0.024 [0.004]***	0.023 [0.006]***	0.010 [0.004]**	−0.004 [0.005]	−0.006 [0.004]	0.003 [0.003]	−0.001 [0.002]	−0.013 [0.002]***	−0.005 [0.002]***
				Summary specification					
Mandatory Number of School Years (separate regression)	0.026 [0.001]***	0.027 [0.002]***	0.019 [0.001]***	0.012 [0.001]***	0.004 [0.001]***	0.001 [0.001]	0.000 [0.001]	−0.001 [0.001]	−0.001 [0.001]

NOTES: Regressions are on cell means from Census data, grouped by birth cohort, province, and census year. All regressions are weighted by cell sample size. The regressions include controls for log provincial public school expenditure, fraction by province in rural area, fraction by province in manufacturing sector, number of schools in province, number of teachers in province, and fixed effects for province, birth cohort, and census year. Huber-White standard errors are shown, clustered by province. One, two, and three asterixes indicate coefficient is significantly different from zero at a 10%, 5%, and 1% confidence levels.

TABLE 3
OLS and IV estimates for the effect of grade attainment on earnings and income

	(1) OLS	(2) IV	(3) IV	(4) IV: with trends	(5) IV: with trends
	Full sample	Population weights	Equal prov/ cohort weights	Population weights	Equal prov/ cohort weights
Log income	0.127 [0.004]***	0.121 [0.013]***	0.114 [0.027]***	0.153 [0.081]*	0.104 [0.058]
Log earnings	0.115 [0.007]***	0.070 [0.008]***	0.070 [0.018]***	0.193 [0.095]*	0.131 [0.064]*
Log income males	0.118 [0.005]***	0.079 [0.016]***	0.113 [0.028]***	0.110 [0.098]	0.083 [0.061]
Log earnings males	0.088 [0.004]***	0.044 [0.011]***	0.063 [0.022]**	0.062 [0.102]	0.094 [0.030]**
Log household income	0.095 [0.006]***	0.051 [0.019]**	0.104 [0.024]***	0.162 [0.076]*	0.150 [0.073]*

NOTES: OLS results in column 1 include fixed effects for birth cohort, province, census year, and provincial controls for log provincial public school expenditure, fraction by province in rural area, fraction by province in manufacturing sector, number of schools in province, number of teachers in province. IV results in columns 2 and 5 use the same specification used in column 3 of table 1 for the first stage. Grade attainment is instrumented with school-leaving-age indicators, an employment certificate exemption indicator, and school-entry laws. The IV regressions use cell means from census data, aggregated by birth cohort, province, and census year. The regressions include controls for log provincial public school expenditure, fraction by province in rural area, fraction by province in manfacturing sector, number of schools in province, number of teachers in province, and fixed effects for province, birth cohort, and census year. Huber-White standard errors are shown, clustered by province. Columns 2 and 4 are weighted by cell mean sample sizes. Columns 3 and 5 use equal weights for cell means across province and cohorts. The last two columns substitute the provincial controls and cohort fixed effects for second-order polynomial cohort trends for each province. One, two, and three asterixes indicate coefficient is significantly different from zero at a 10%, 5%, and 1% confidence levels.

variable, and a larger coefficient on the entry age variable. More generally, all of these results – whether derived from the full, weighted sample, the smaller dropout sample, or the unweighted sample – indicate that changes to compulsory school laws in Canada had a significant impact on average grade attainment.

5.2. Returns to compulsory schooling: earnings and other outcomes

In subsection 5.1 I examined how changes to compulsory schooling legislation from 1920 to 1990 impacted average educational attainment. Here, I investigate impacts on the students affected by these changes by instrumenting individual grade attainment with the compulsory school laws discussed in the last section. Table 3 shows results from estimating equation (2). Columns (1) and (2) compare least squares estimates of the returns to grade attainment with the instrumental variables estimates. The first stage for these instrumental

variables estimates is given in column (3) of table 1. The Ordinary Least Squares (OLS) and Instrumental Variables (IV) returns-to-schooling measures are similar: 12.7% and 12.1%, respectively. The IV coefficients fall by more than a third when only males are considered or when earnings are used instead of income in the regression. While there is no obvious explanation for this result, the smaller effects are estimated for the larger provinces. When changes in compulsory school requirements are weighted equally by province and birth cohort (column (3)), returns to schooling in terms of income are about 11.3% for both men and women. Effects on earnings, however, are still lower than those on income. As noted in the previous section, weighting the regressions by cell mean sample size places substantially more emphasis on what happened in Quebec and Ontario, the two provinces with the largest populations. Because the combined census sample is so large, it is also possible to weight the cell means equally in the IV regressions without being overly concerned about less accurate point estimates for the smaller provinces. This approach assigns equal significance to the effects of compulsory schooling across provinces and birth cohorts. In the discussion that follows, I present both population-weighted and unweighted results.

The last two columns in table 3 include second-order polynomial cohort trends for each province instead of background controls and cohort fixed effects that are constant across provinces. The trends are intended to absorb regional fluctuations in the outcome variables that are not caused by changes in compulsory schooling laws but that are nevertheless related to those changes. Use of cohort trends also removes degrees of freedom, which make the identification of compulsory schooling effects more difficult. If causal effects from changes to compulsory schooling laws are realized gradually over time, these effects are more likely to be absorbed when allowing for trends. The coefficients in column (4) range from 6.2–16.2%, similar to the earlier IV results. The large standard errors leave a wide confidence region, but four of the five estimated effects on income and earnings are significantly different from zero at the 10% confidence level. The unweighted results in column (5) generate point estimates similar to those without trend controls. The standard error falls considerably when earning effects for males only are considered.

Figure 3 illustrates the discontinuity in average educational attainment and log income at different school leaving ages. The figure shows estimated coefficients on lead and lag indicators for changes in the leaving age. To generate these coefficients, I aggregated data by province and birth cohort groups. The dependent variables are grade attainment and log income. Lags include years -10 to -2. Leads include years $+2$ to $+10$. The regression also includes province and birth cohort fixed effects.

Figure 3 shows that effects on grade attainment and income occur immediately, or soon after, an increase in the school leaving age and not before. Grade attainment and average log income show no noticeable trend leading up to a

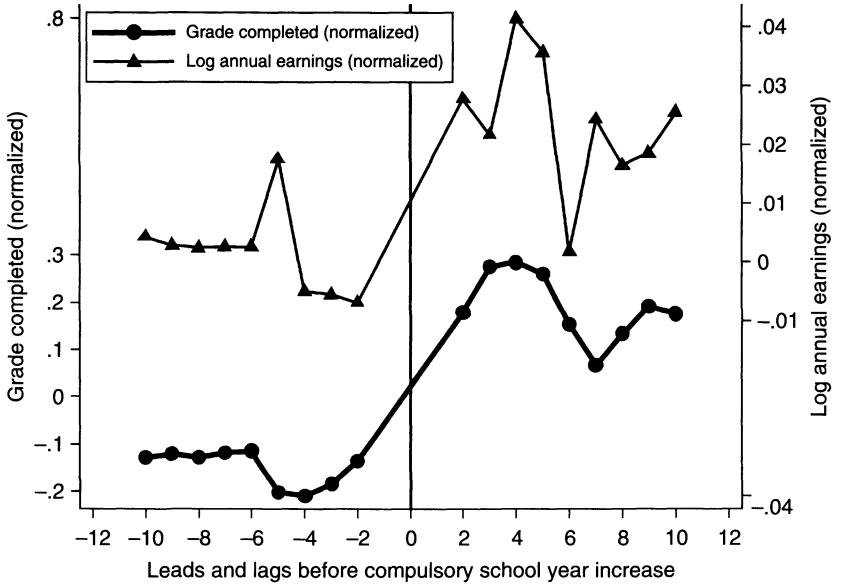

FIGURE 3 Adult education attainment and earnings for cohorts aged 14 before and after increases in the minimum school-leaving age
NOTES: The Canadian high school dropout data extract was aggregated into province and birth cohort cell means, weighted by population size. Average high school grade attainment and log annual earnings were regressed on indicators for the number of years between an increase in a province's minimum school leaving age and the year a cohort was 14, plus province and birth cohort fixed effects. The time indicator coefficients are shown, normalized to zero for the group that was 14 years old one year before and one year after the increase.

change in the leaving age. For birth cohorts two years after an increase in the leaving age, average grade attainment is about 0.314 points higher than for cohorts two years before. Log income rises over the same period by 0.035 points. If I divide the change in income by the change in grade attainment, I arrive at an estimate of 11.1% for the average return to compulsory schooling. This result is remarkably similar to the result I obtained for the full sample. It is important because it suggests that raising the leaving age leads to higher educational attainment and subsequent income, not that they respond to underlying trends in schooling.

Table 4 shows the IV estimates for older and younger birth cohorts using log income as the dependent variable. Column (1) repeats the same model specifications used to generate the regression results in columns (2) and (3) of table 3. Column (2) presents coefficients using only those birth cohorts that reached age 14 between 1920 and 1950. The population-weighted results show an average return to compulsory schooling of 9.4%. Weighting the provinces and cohorts equally results in an estimated average return of 7.9%. Different changes in compulsory schooling laws under different circumstances generate

TABLE 4
IV estimates for the effect of grade attainment on income for different birth cohorts

	(1)	(2)	(3)	(4)	(5)	(6)
			Dependent variable: log income			
Grade attainment population weights	0.121 [0.013]***	0.094 [0.015]***	0.089 [0.011]***	0.131 [0.013]***	0.165 [0.015]***	0.153 [0.078]*
Grade attainment equal prov/cohort weights	0.114 [0.027]***	0.079 [0.029]**	0.075 [0.015]***	0.110 [0.030]***	0.104 [0.036]**	0.164 [0.074]*
Year when cohort 14	All years	1920–50	1930–60	1940–70	1950–80	1960–90

NOTES: Instrumental variables regressions instrument grade attainment on school leaving ages, an employment certificate exemption indicator, and school entry laws. Regressions are on cell means from census data, grouped by birth cohort, province, and census year. The top row is weighted by cell mean sample size, while the second row weights province and cohort cells equally. The regressions include controls for log provincial public school expenditure, fraction by province in rural area, fraction by province in manufacturing sector, number of schools in province, number of teachers in province, and fixed effects for province, birth cohort, and census year. Huber-White standard errors are shown, clustered by province. One, two, and three asterixes indicate coefficient is significantly different from zero at a 10%, 5%, and 1% confidence level.

consistently significant effects across birth cohorts. These effects generally increase for later cohorts. For the most recent cohorts examined – that is, individuals who reached 14 years of age between 1960 and 1990 – an additional year of compulsory schooling results, on average, in a 15.3% increase in income. The trend towards larger effects for later cohorts suggests that the returns to compulsory schooling were increasing over time.

To examine potential differences across regions, table 5 presents estimates of the returns to compulsory schooling if certain provinces are excluded. Column (1) again repeats the baseline estimates for one-year returns on log income. Column (2) shows coefficients generated by the same regression model when data from the maritime provinces of Prince Edward Island, Newfoundland, Nova Scotia, and New Brunswick are omitted. The resulting effects estimates hold steady between 11.3 and 12.7%. Eliminating Quebec in column (3) leads to higher returns for the case where cell means are weighted by cell sample size. The general consistency of results across columns suggests that no one province or region is driving the overall findings from this analysis.

In table 6, I explore socioeconomic outcomes other than income and earnings by presenting estimated coefficients for the effects of compulsory schooling on unemployment, occupation, and bilingualism. Column (1) displays the mean of each dependent variable. Least squares estimates are given in column (2). The IV estimates in columns (3) and (4) imply that compulsory schooling reduces the likelihood that affected individuals later report not working or looking for work, while raising the likelihood that they report working

TABLE 5
OLS and IV estimates for the effect of grade attainment on earnings and income for different regions

	(1)	(2)	(3)	(4)	(5)	(6)
	Dependent variable: log income					
Grade Attainment Population Weights	0.121 [0.013]***	0.127 [0.006]***	0.166 [0.052]**	0.117 [0.036]**	0.163 [0.029]***	0.102 [0.015]***
Grade Attainment Equal Prov/Cohort Weights	0.114 [0.027]***	0.113 [0.009]***	0.110 [0.033]**	0.118 [0.025]***	0.111 [0.029]***	0.088 [0.022]**
Provinces excluded	None	Maritimes	Quebec	Ontario	Quebec & Ontario	Western provinces

NOTES: Instrumental variables regressions instrument grade attainment on school-leaving ages, an employment certificate exemption indicator, and school-entry laws. Regressions are on cell means from census data, grouped by birth cohort, province, and census year. The top row is weighted by cell mean sample size, while the second row weights province and cohort cells equally. The regressions include controls for log provincial public school expenditure, fraction by province in rural area, fraction by province in manufacturing sector, number of schools in province, number of teachers in province, and fixed effects for province, birth cohort, and census year. Huber-White standard errors are shown, clustered by province. One, two, and three asterixes indicate coefficient is significantly different from zero at a 10%, 5%, and 1% confidence levels.

fulltime. The IV results also indicate that additional schooling lowers the probability of later working in a manual occupation and raises the likelihood of working in a clerical occupation. Those compelled to attend an extra grade of school are 4.0 percentage points less likely to fall below Statistics Canada's Low Income Cut-off, and are more likely to report being fluent in both English and French.[10] These results seem to indicate that additional time spent in school results in the acquisition of real additional skills.

6. Discussion

The IV results from the last section estimate annual gains in earnings and non-pecuniary outcomes from compulsory schooling, after schooling is completed. To assess the magnitude of these gains over an individual's lifetime, I re-estimated the regressions in table 4, column (2), using the sample of male dropouts, designating log income as the dependent variable, and adding quartic age controls. I then used age coefficients and estimated returns to compulsory schooling to plot predicted income profiles for individuals who dropped out of high school at ages 15 and 16, assuming a baseline annual wage of $6,927 at age 16 for individuals who dropped out when they were 15 (this figure corresponds to the average wage reported in the 2001 Canadian

10 A household falls below the Low Income Cut-off if it spends more than 20 percentage points above the average comparative household on food, clothing, and shelter.

TABLE 6
OLS and IV estimates for the effect of grade attainment on various outcomes

	(1)	(2)	(3)	(4)
	Mean	OLS	IV	
			Population weights	Equal prov/ cohort weights
Unemployed; looking for work	0.044	−0.008 [0.001]***	−0.003 [0.002]	−0.010 [0.003]***
Working	0.478	0.033 [0.003]***	0.040 [0.0067]***	0.034 [0.0088]***
Manual occupation	0.237	−0.012 [0.001]***	−0.019 [0.0074]**	−0.002 [0.0089]
Clerical service occupation	0.410	0.010 [0.001]***	0.034 [0.0061]***	0.024 [0.0103]**
prof manager	0.363	0.033 [0.003]***	−0.010 [0.0063]	−0.008 [0.0143]
Bilingual	0.201	0.030 [0.016]	0.041 [0.0115]***	0.029 [0.0228]
Below low income level	0.131	−0.038 [0.002]***	−0.0395 [0.0030]***	−0.0271 [0.0062]***
Unemployment insurance benefits	0.118	−0.01 [0.001]***	−0.0117 [0.0057]*	−0.0091 [0.0098]

NOTES: OLS results in column 2 include fixed effects for birth cohort, province, census year, and province controls for log provincial public school expenditure, fraction by province in rural area, fraction by province in manufacturing sector, number of schools in province, number of teachers in province. IV results in columns 2 and 4 use the same specification used in column 3 of table 1 for the first stage. Grade attainment is instrumented with school-leaving-age indicators, an employment certificate exemption indicator, and school entry laws. The IV regressions use cell means from census data, aggregated by birth cohort, province, and census year. The regressions include controls for log provincial public school expenditure, fraction by province in rural area, fraction by province in manufacturing sector, number of schools in province, number of teachers in province, and fixed effects for province, birth cohort, and census year. Huber-White standard errors are shown, clustered by province. Columns 3 weights by cell mean sample sizes. Column 4 uses equal weights for cell means across province and cohorts. One, two, and three asterixes indicate coefficient is significantly different from zero at a 10%, 5%, and 1% confidence levels.

census for 17-year-old male dropouts who were working 50 hours or more per week).[11] Table 7 converts the annual earnings differences to a present value figure (at age 15), using discount rates of 3, 5, and 7%. Column (1) shows that with an annual log earnings gain of 0.12, the average present value gain from staying in school for an extra year is $45,560, assuming a 3% discount rate. On

11 Allowing the effects of compulsory schooling to vary over the average individual's lifetime income profile (e.g., at ages 15 to 35, 35 to 45, 45 to 55, and 55 to 65) does not alter these results significantly. The base value is arbitrary, as long as present value gains are compared relative to the wage profiles used to calculate them (e.g., the maximum or initial wage). Average earnings at age 15 are low because many dropouts do not work immediately after leaving school. The wage profile is steep at the outset as more dropouts become employed in the years following their departure from school.

TABLE 7
Estimated average present value gain from additonal year of compulsory schooling (in 2001 Canadian dollars)

(1) Discount rate	(2) Constant annual return from an extra grade of high school 0.118	(3) 0.09	(4) 0.08	(5) Income at age 16	(6) Peak income (at age 47)
0.03	45,560	34,560	27,551	6,927	17,943
0.05	30,603	23,521	19,008	6,927	17,943
0.07	21,923	17,097	14,022	6,927	17,943

NOTES: Income profiles were created from estimating the returns to compulsory schooling IV regressions in table 3, column 2, using log income as the dependent variable and including quartic age controls for the sample of male dropouts aged 15 to 64. Present value gains were calculated from the predicted income profiles for 15- and 16-year-old high school dropouts using returns to compulsory schooling assumptions given in columns 2, 3, and 4, and a baseline wage of $6,927 for 15-year-old dropouts at age 16 (the average wage among 17-year-old male dropouts working 50 hours or more in the 2001 Canadian census. Predicted income peaks at age 47 at $17,943. The discount rates used to calculate the present value amounts are shown in column 1.

average, that amount exceeds earnings forgone as a result of staying in school by a factor of 6.6 and exceeds the peak annual wage that dropouts can expect to earn over their lifetime by a factor of 2.5. If forgone earnings were the only costs incurred while attending school, the implicit net rate of return from an additional year of school would be 18.5%.

Higher discount rates or lower annual rates of return from compulsory schooling lead to smaller but still significant gains. With a 7% discount rate, the present value gain for an additional year of schooling in column (1) exceeds forgone earnings by a factor of 3.2 and peak annual wages by a factor of 1.2. If one assumes smaller gains in annual earnings, the present value lifetime gain, assuming a 7% discount rate, is still 2.7 times forgone earnings, and it still exceeds a year of peak annual wages if one assumes a 5% discount rate.

The results from table 7 suggest that the average gains from additional schooling, among would-be dropouts, are very large. Some of these gains may be attributable to positive externalities resulting from an overall increase in school enrolment for a given region and should therefore be excluded when evaluating the decision to drop out from an individual perspective. But table 2 suggests that gains from an increase in the school leaving age for cohorts born a few years later did not lead to significant differences in the gains estimated for earlier cohorts. Even assuming that as much as one-third of the financial gains to compulsory schooling come from externalities, the remaining gains – according to the results shown in table 5 – still substantially exceed forgone earnings. Accounting for possible non-pecuniary benefits from education (such as utility gains from higher life expectancy or lower chances of displacement) simply reinforces this conclusion.

If average gains from an additional year of high school exceed forgone earnings many times over, why do some students nevertheless choose to leave school early? From the standpoint of the investment model discussed in the introduction to this paper, individual students make optimal decisions in weighing the costs of school attendance against the expected gains. This assumption, besides raising the question of why compulsory school attendance laws should be necessary in the first place, implies that other factors must account for dropout behaviour. Below, I present several suppositions. One possibility is that dropouts are credit constrained. Students usually cannot borrow from expected future earnings to attend school. If they come from impoverished households, they may choose work over school to provide near-term financial support for parents and siblings. In such cases, policies that provide monetary incentives to youths at risk of dropping out may help them to stay in school and realize much larger lifetime gains. For example, Dearden et al. (2003) examine a pilot program in Britain that paid 16 to 18 year-olds from low-income families £30 per week, plus retention bonuses, for remaining in school past grade 11. Compared with a randomized control group, the program reduced early dropout rates by 5.9 percentage points, from 34.5% to 28.7%. The program also demonstrated, however, that credit constraints were not the only factor driving school attendance decisions, since more than half of those who dropped out were not working. Similarly, among 17-year-olds who were not in school at the time of the 2001 Canadian census, 90.4% lived with parents and 45% were not in the labour force.

A second possible explanation for dropout behaviour is that the risk of miscalculating future gains from schooling is too high for some students. Deciding how long to attend school involves comparing alternative earnings distributions, not only means. If a student is risk averse, the expected long-term returns from additional schooling may not be enough to offset the higher probability of earning particularly low wages (Levhari and Weiss 1974; Chen 2002). Judd (2002) applies the Capital Asset Pricing Model to determine whether the risk-return relationship for education is similar to that for comparable assets. He concludes that the risk associated with an education investment is much lower than the risk associated with other assets that have similar expected returns. Judd's analysis may be more relevant for decisions concerning college enrolment, but it still implies that the risk of ending up significantly worse off as a result of staying in high school rather than dropping out is quite low.

A third possibility is that dropouts abhor school. Students who experience condescending attitudes from teachers and other students as a result of their poor classroom performance or who are otherwise unhappy at school, may want to leave as soon as possible even if that means forgoing large monetary gains later in life. In these cases, addressing the reasons for some students' dislike of school could go a long way in reducing dropout rates (Lee and Burkam 2003).

A fourth explanation for dropout behaviour is that some youths simply ignore the future consequences of present decisions. A high time preference rate may lead some students to place more weight on the immediate attendance costs of school and less weight on future outcomes – such as health and earnings – that cannot be transferred to the present.[12] Discounting future consequences from immediate actions does not necessarily imply myopic behaviour, unless such discounting occurs only temporarily. Students who temporarily downplay future consequences (see Laibson 1997 and O'Donoghue and Rabin 1999) may prefer dropping out to staying in school at one point in time, but may later wish they had stayed on instead of dropping out.

A fifth explanation considers social or cultural influences on school attendance. A central theme in Akerlof and Kranton (2002), Coleman (1961), Cusick (1972), Gordon (1957), Jackson (1968), and Willis (1977) is that concerns about self-image or peer acceptance dominate adolescent behaviour. Cultural norms and a lack of emotional support or acceptance for higher education may exacerbate students' distaste for remaining in school beyond the minimum age.

A final possibility is that dropouts simply make wrong predictions. They may calculate the present value of future returns incorrectly, or underestimate the real gains from school. Dominitz and Manski (2000) find substantial variation in the earnings expectations of high school students conditional on receiving a bachelor's degree. Guidance from parents who themselves dropped out or from peers who do not care for school may also lead to students' being misinformed.

The analysis described in this paper does not allow for an evaluation of which of these explanations for dropout behaviour might matter most, since the effects of compulsory schooling considered here occur only after leaving school and since costs (pecuniary and non-pecuniary) are not examined. The finding that expected gains from compulsory schooling are large and cannot be easily explained by the existence of credit constraints suggests that alternative explanations for dropout behaviour may be worth exploring.

7. Conclusion

This paper uses changes in Canadian law to explore the effects of compulsory schooling and to measure the lifetime opportunity costs of dropping out of

12 A high time preference rate would not affect dropout behaviour without the presence of credit constraints or non-pecuniary costs or benefits from schooling. If none of these factors is present, students who prefer to consume more in the present can simply borrow from future earnings (see Oreopoulos 2003).

school early. I find that the introduction of tighter provincial restrictions on leaving school between 1920 and 1990 raised average grade attainment and incomes. Students compelled to attend an extra year of school experienced an average increase in annual income of about 12%. I also find that compulsory schooling is associated with significant benefits in terms of other socio-economic outcome measures ranging from bilinguillism, employment, and poverty status. These results hold up against many specifications checks and are entirely consistent with previous studies.

The main conclusion of this paper is that the opportunity cost of dropping out of high school is very high. My estimates of the earnings forgone as a result of leaving school early range from about one to two times the average dropout's lifetime peak annual wage or three to six times the earnings forgone by staying in school. These results provide an important context for evaluating school-leaving decisions. They help to quantify the dropout decision from a cost-benefit perspective and are useful in identifying possible reasons why some students nevertheless choose to leave school early.

In the absence of significant positive externalities, the view that students approach education as an investment and make optimal decisions about when to leave suggests that compulsory schooling laws are not only unnecessary but counterproductive, since they constrain individuals from choosing the level of educational investment that is best for them. Within this framework, school attendance costs would have to be extremely high to justify leaving school early, and addressing these costs would be an effective means of mitigating dropout behaviour.

On the other hand, it seems unlikely, given the results of this analysis, that attendance costs alone would be sufficient to outweigh the significant gains associated with staying in school. In that case, other factors may be important in explaining dropout behaviour, and alternative frameworks may be better suited to analysing schooling decisions. There is no a priori reason to prefer an investment model of school attainment over any number of other possibilities – cultural or peer pressures may dominate adolescent decision-making; youths may underestimate the rewards from staying in school and/or may temporarily ignore the longer-term consequences of their decisions. Each explanation carries different policy implications, but all merit further investigation, given the potential to improve a large set of social and economic outcomes by keeping would-be dropouts in school.

Data Appendix

A. Constructing the compulsory school law variables

The three compulsory school law variables used in this paper summarize a complex set of policies. For most of the provinces, changes in the minimum school-leaving age since 1900 could be readily identified by accessing historical

provincial legislation and the Dominion Bureau of Statistics' annual survey of education.[13] During the first half of the last century, some provinces had two school-leaving ages: one for towns and one for rural areas. There were not enough of these cases to accurately identify separate effects. In these cases, I used the town-leaving age.

Some provinces exempted some students from compulsory school requirements. These exemptions varied widely from province to province and year to year. I set the exemptions indicator variable equal to one if any of the following conditions obtained: (1) home permits or work certificates were allowed in any form; (2) parents could claim their children had to work for reasons of subsistence; or (3) attendance was mandatory for six months or less in a year. The variable equals zero otherwise. In 1920, 36% of 14-year-olds had access to some type of exemption. By 1970 only 14% of 14-year-olds had this option.

The mandatory-number-of-school-years variable was calculated by subtracting the school entry age that applied when an individual was 6 from the school leaving age that applied when an individual was 14. If no minimum leaving age was specified, a dropout age of 10 was assumed, and if no school entry age existed, an entry age of 8 was assumed. If youths had to remain until the end of the school year even after reaching the school-leaving age, the mandatory number of school years was increased by 0.5.

B. Constructing the provincial controls

The regressions in the paper include five controls for province-specific economic and social trends: log education expenditure per student, number of schools per student, number of teachers per student, fraction of population in a rural area, and fraction of workers in the manufacturing sector. Aggregates of the first three variables come from the Dominion Bureau of Statistics' *Annual Surveys of Education*. Values exist for most years between 1920 and 1970. The Consumer Price Index was used to convert total education expenditures by province and year into real 1991 dollars. All variables were smoothed using STATA's ksm function, with a bandwidth of 0.1. I imputed values for missing years by linear interpolation and divided the aggregate values by the population of 5- to 16-year-olds by province and year. The population data come from Statistics Canada's social-economic database, CANSIM.

The rural and manufacturing variables were created using tables published from the 1921, 1926, 1931, 1936, 1941, 1946, 1951, 1956, 1961, 1966, and 1971 censuses. I divided the number of individuals in rural areas (for each province) by the total provincial population and the total number of workers (again, in each province) by the number of workers in the manufacturing sector. Missing values were imputed by linear interpolation.

13 Please see Oreopoulos (2005) for a list of the Statutes and legislative references.

APPENDIX TABLE
Descriptive Statistics for Native Canadians born 1911 to 1961 aged 25 to 64 in the 1971 to 2001 Canadian Censuses

	Population Weighted		Equal Province/Cohort Weights	
	Mean	Standard Deviation	Mean	Standard Deviation
Exposed to School Leaving Age $\leq$ 13	0.010	0.098	0.037	0.189
Exposed to School Leaving Age = 14	0.159	0.365	0.141	0.348
Exposed to School Leaving Age = 15	0.353	0.478	0.416	0.493
Exposed to School Leaving Age = 16	0.479	0.500	0.406	0.491
Exemptions to Leaving Age Allowed	0.273	0.446	0.258	0.437
Exposed to School Entry Age = 8	0.189	0.392	0.120	0.325
Exposed to School Entry Age = 7	0.337	0.473	0.663	0.473
Exposed to School Entry Age = 6	0.474	0.473	0.217	0.412
Grade attainment	10.084	0.795	9.883	0.815
Grade 7 Attained	0.954	0.066	0.943	0.073
Grade 8 Attained	0.900	0.129	0.880	0.126
Grade 9 Attained	0.851	0.151	0.813	0.152
Grade 10 Attained	0.783	0.184	0.735	0.181
Grade 11 Attained	0.674	0.202	0.609	0.204
High School Certificate	0.512	0.161	0.163	0.083
Highest Educ. Attainment = College	0.190	0.118	0.184	0.116
Some Post Secondary Schooling	0.322	0.162	0.302	0.156
University Degree	0.170	0.087	0.157	0.086
Log Income	9.536	0.606	9.466	0.584
Log Earnings	9.527	0.625	9.447	0.594
Log Income Males	9.663	0.712	9.692	0.645
Log Earnings Males	9.654	0.730	9.670	0.652
Log Household Income	9.663	0.712	9.692	0.645

References

Acemoglu, Daren, and Joshua Angrist. (2000) 'How large are human capital externalities? Evidence from compulsory schooling laws,' NBER Macroannual, 9–59

Akerlof, George, and Rachael Kranton (2002) 'Identity and schooling: some lessons for the economics of education,' *Journal of Economic Literature* 40, 1167–201

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

Becker, Gary S. (1975) *Human Capital: A Theoretical and Empirical Analysis, with Special Reference to Education.* 2nd ed. (New York: Columbia University Press for NBER).

Bound, John, David A. Jaeger, and Regina M. Baker (1995) "Problems with instrumental variables estimation when the correlation between the instruments and the endogenous explanatory variable is weak," *Journal of the American Statistical Association* 90, 443–50

Chen, Stacey H. (2002) 'Is investing in college education risky?' Mimeo, Department of Economics, State University of New York at Albany
Chiswick, Barry R. (1969) 'Minimum schooling legislation and the cross-sectional distribution of income,' *Economic Journal* 79, 495–507
Coleman, James S (1961) 'The adolescent society,' (New York: Free Press)
Cusick, Philip (1972) 'Inside high school,' (New York: Holt, Rinehart, and Winston)
Dearden, Lorraine, Carl Emmerson, Christine Frayne, and Costas Meghir (2002) 'The impact of financial incentives on educational choice,' mimeo, Institute for Fiscal Studies
Dee, Thomas (2004) 'Are there civic returns to education?' *Journal of Public Economics* 88, 1697–1720
Dominitz, Jeff, and Charles F. Manski (2000) 'Using expectations data to study subjective income expectations,' *Journal of the American Statistical Association* 92, 855–67
Eckstein, Zvi, and Kenneth I. Wolpin (1999) 'Why youths drop out of high school: the impact of preferences, opportunities, and abilities,' *Econometrica* 67, 1295–339
Goldin, Claudia, and Lawrence F. Katz (2003) 'Mass secondary schooling and the state: the role of state compulsion in the high school movement,' mimeo
Gordon, Wayne C. (1957) *The Social System of the High School*, (Chicago: Free Press)
Jackson, Philip. *Life in Classrooms* (New York: Holt, Rinehart, and Winston)
Judd, Kenneth L. (2000) 'Is education as good as gold? A portfolio analysis of human capital investment,' mimeo, Stanford Economics Department
Laibson, David (1997) 'Golden eggs and hyperbolic discounting,' *Quarterly Journal of Economics* 112, 443–77
Lang, K., and D. Kropp (1986) 'Human capital vs. sorting: the effect of compulsory attendance laws,' *Quarterly Journal of Economics* 101, 609–24
Lee, Valerie E., and David T. Burkam (2003) 'Dropping out of high school: the role of school organization and structure,' *American Educational Research Journal* 40, 353–93
Levhari, David, and Yoram Weiss (1974) 'The effect of risk on the investment in human capital,' *American Economic Review* 64, 950–63
Lleras-Muney, Adriana (2002) 'Were compulsory attendance and child labor laws effective? An analysis from 1915 to 1930,' *Journal of Law and Economics* 45, 401–35
— (2005) 'The relationship between education and adult mortality in the U.S.,' *Review of Economic Studies* 72, 189–221
Lochner, Lance, and Enrico Moretti (2004) 'The effect of education on crime: evidence from prison inmates, arrests, and self-reports,' *American Economic Review* 94, 155–89
Milligan, Kevin, Enrico Moretti, and Philip Oreopoulos (2003) 'Does education improve citizenship? Evidence from the U.S. and the U.K.,' NBER Working Paper No. 9584
O'Donoghue, Ted, and Matthew Rabin (2001) 'Risky behavior among youths: some issues from behavioral economics,' in *Risky Behavior Among Youths*, ed. Jonathan Gruber (Chicago: University of Chicago Press)
Oreopoulos, Philip (2003) 'Do dropouts drop out too soon? Evidence from changes in school-leaving laws,' mimeo
— (2004) 'Average treatment effects of education when compulsory schooling laws really matter,' mimeo
— (2005) 'Canadian compulsory school laws and their impact on educational attainment and future earnings,' Analytical Studies Branch Research Paper No. 251, Statistics Canada
Phillips, Charles E. (1957) *The Development of Education in Canada* (Toronto: Gage)

Prentice, Alison L., and Susan E. Houston (1975) *Family School and Society in Nineteenth Century Canada* (Toronto: Oxford University Press)
Schmidt, Stefanie (1996) 'School quality, compulsory education laws, and the growth of American high school attendance, 1915–1935,' PhD dissertation, MIT
School Leaving Age Task Force, New Brunswick (1998) 'High school graduation: the new school leaving age: findings and recommendations of the School Leaving Age Task Force,' mimeo, Province of New Brunswick
Sweetman, Arthur (2000) 'What if high school were a year longer? Evidence from Newfoundland,' mimeo
Willis, Paul (1977) 'Learning to Labour,' Saxon House, Westmead