

# Estimating the Value of Community College: Evidence from Quebec's CÉGEPs

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This paper exploits the creation of a formal college system in Quebec in the late 1960's as a quasi-experiment to estimate the value of community college. Focusing on the effect of the policy on English-speaking Quebecois, the creation of the CÉGEPs (Colleges of General and Vocational Education) is shown to increase schooling by about a third of a year for both men and women, without diverting students from university. Despite increasing educational attainment, estimates of the impact of CÉGEP on wages are negative. Analysis suggests the negative estimates can be understood as a combination of lost labor market experience, a decrease in the return to university, and an insignificant return to CÉGEP. The results are robust to the inclusion of controls and across years of data. Possible interpretations of the results are discussed.

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This paper presents the first quasi-experimental estimates of the impact of community college on schooling and wages. In the 1960's, as part of a review of the education system, the government in the Canadian province of Quebec decided to create a new public educational institution, the College d'Enseignement General et Professionnel (College of General and Vocational Education), or CÉGEP, as they are commonly known. From 1967 to 1974, thirty-four CÉGEPs were created, more than doubling per capita college enrollment. The impact of the program was particularly large and sudden for the English-speaking community in Quebec, on which I focus in this paper. I exploit the creation of these colleges to measure how students respond to the educational incentives CÉGEP provides and to estimate the economic return to a year of CÉGEP.

Pooling data from the 1986, 1991, and 1996 Canadian censuses, I am able to construct a large sample of men and women with data on year of birth, province of birth, primary language, schooling, and wages. Since the majority of college entrants are seventeen to nineteen years old, year of birth determines exposure to the new colleges. Individuals who reached college age before the CÉGEPs opened faced higher costs to acquiring college education due to the smaller supply of colleges in the province. This suggests a difference-in-difference style approach to estimating the impact of college: the education and wage outcomes of cohorts who reached college age in Quebec just after creation of the CÉGEPs are compared to the cohorts who reached college age just before the CÉGEPs opened. To alleviate concerns that there may be other differences between these groups, these differences are compared to similar differences for a control group drawn from the rest of Canada.

Using this strategy, I find that the CÉGEPs caused an increase of about a third of a year of education for both men and women. This new education was concentrated in the new colleges; CÉGEP did not affect average years of university or high school. CÉGEP also had no effect on university enrollment, but I estimate that it increased university graduation rates by about ten

percent. Surprisingly, the estimated impact on wages, measured fifteen to twenty five years later, is negative. This is primarily due to a decrease in the return to university education for men, which coincides with the introduction of CÉGEP. I argue that this is likely the result of the new colleges, either from their disruptive effect on universities in Quebec or by encouraging students to pursue university elsewhere. After controlling for the fall in the return to university, the estimated return to CÉGEP is still negative for both men and women. These negative estimates can largely be explained by the work experience lost while attending college.

This study adds to a growing body of literature that finds no returns to schooling in a variety of contexts (e.g., Angrist 1993, Pischke 2002, and Öckert 2002). This contrasts sharply with most previous natural experiment studies of the returns to education, which tend to find large returns to education. Various explanations for the low estimated returns to CÉGEP are discussed. I argue that the nature of the intervention and the students affected are plausible explanations for the results.

The primary goal of this paper is to understand how CÉGEP has affected students' education decisions and to estimate the effect of CÉGEP on wages. It may be possible to generalize the findings, but there are several features of CÉGEP which are not shared by similar institutions. Most importantly, study at CÉGEP precedes university, rather than competing with it, as junior college competes with university in the United States, for example.

Kane and Rouse (1999) provide a summary of the research to date on the effect of community colleges on educational attainment and earnings. The evidence on educational attainment is mixed and weak. Rouse (1995) finds that for those who would otherwise attend university there is a negative effect of attending a community college on years of education, but without affecting the probability of completing a bachelor's degree. The evidence on earnings is clearer, with studies of panel data suggesting that the average return to a year of two-year college is roughly the same as the average return to a year of four-year college at between 5 and 8%.

The remainder of the paper proceeds as follows: Section I provides background information on the creation of the CÉGEPs and briefly describes the data and identification strategy. Section II presents the impact of introducing the CÉGEPs on education. Section III measures the effect of CÉGEP on wages. Section IV discusses possible interpretations of the results and the final section concludes.

## **I. Preliminaries**

### **A. Creation of the CÉGEP System**

In 1961, as part of attempts to modernize Quebec society, the Quebec government created a commission led by Alphonse-Marie Parent to study the province's education system. At the time, the anglophone school system (technically, the Protestant schools) and the francophone (Catholic) school system differed substantially. In the anglophone school system, which served approximately 20% of the population, elementary and high school lasted up to twelve years, although most students graduated after grade eleven. An undergraduate university degree required four years of study after grade eleven or three years for grade twelve graduates. Anglophone students could also attend a liberal arts or teachers college. For francophones, elementary and secondary school lasted eleven years. Post-secondary schooling consisted of a wide variety of public and private colleges, universities, and technical schools. Students who wished to attend university were normally required to first complete a four-year degree at a religious classical college. Anglophones were not likely to attend francophone schools, and vice versa.

The Parent Commission released its report in the years 1963 to 1966. Among its recommendations was the creation of the CÉGEPs. These new public colleges were meant to help modernize the education system by removing the influence of the church and increasing the teaching of science and business. They were also meant to fulfill a social role by bringing

together students pursuing academic and non-academic studies within a single institution, and by bringing anglophones and francophones within the same school system. For francophones, the CÉGEPs would be created by the merging and expansion of existing institutions. Primarily, they would replace the religious classical colleges. For anglophones, they needed to be created from scratch.

The first CÉGEP opened in 1967 and by 1974 thirty-six had been created. Four English-language CÉGEPs were built during this period, the first opening in the fall of 1969 and the last in the summer of 1971. The CÉGEPs remain an integral part of the province's education system, with almost fifty now in existence. Most of the colleges are non-residential and they are spread across the province. Enrollment is free for all full-time students.

Unlike community colleges in the United States or other parts of Canada, CÉGEP is not a substitute for university, but a prerequisite. The colleges offer two-year academic programs which are required for admission to the province's universities. They also offer three-year vocational and technical programs for those who do not plan on attending university. CÉGEP was accommodated in the anglophone system by standardizing high school graduation at grade eleven (although this took some time to implement) and reducing the time to complete a bachelor's degree from four years to three. In addition, from 1969 to 1975 the anglophone universities in Quebec offered CÉGEP-equivalent programs to allow all students who wished to attend university to complete the required two-year academic program.

College, across Canada, is generally quite distinct from university. It includes vocational and technical education not found in universities. Academic courses taught in colleges are usually considered to be at a pre-university level. In both enrollment and census data, college is not reported separately from other non-university alternatives, like vocational schools. Rather, post-secondary education is divided into university and non-university.

Figure 1 shows non-university post-secondary enrollment per thousand eighteen year-olds in Quebec and the rest of Canada from 1960 to 1974. For both men and women, enrollment

in Quebec is similar to the rest of Canada until 1968, at which point it begins to diverge. This confirms that the CÉGEPs did not simply replace private or religious colleges, but increased post-secondary enrollment.

Studying the effect of the CÉGEPs on anglophone Quebec is a better natural experiment than studying francophone Quebec or the province as a whole. This is true for three reasons. First, the intervention was far more sudden for anglophones than francophones. The francophone CÉGEPs were established over a period of six years, while the anglophone CÉGEPs were established in less than two years. This gives a better chance to find a significant pre-post difference and allows us to compare cohorts of more similar age, reducing the potential importance of unobserved variables. Second, since the college sector was less developed for anglophones, we might expect a larger response. Finally, the CÉGEPs were not meant to increase the total number of years of education for francophones. Indeed, the religious colleges they replaced had exceptionally long post-secondary degree programs. For anglophones, however, the CÉGEPs increased the time required to complete a bachelor's degree by one year: the two-year academic program was to be offset by reducing a bachelor's degree by only one year. For these reasons, the treatment group throughout the paper is restricted to anglophones. Francophone Quebecois are excluded for the primary analysis, but are included in the control group in some specifications.

## B. Data

The primary data set used in the paper is from the 1986, 1991, and 1996 Canadian Public Use Micro Data Files, provided by Statistics Canada. Each file contains data for about 3% of the population. The data include both men and women aged 39 to 48 in 1986, 44 to 53 in 1991, and 49 to 58 in 1996. This corresponds roughly to those born in years 1946 to 1955, so the same cohorts are being observed at three points in time. I refer to which census an observation comes from, i.e., 1986, 1991, or 1996, as the 'census year' of the observation. There are a total of

250,220 observations, 10,862 of which are categorized as anglophone Quebecois. Table 1 provides summary statistics.

Total years of education is the sum of years of elementary and secondary school, years of university, and years of non-university post-secondary. Years of elementary and secondary school refers to the highest grade attended. Years of university and non-university post-secondary refers to the number of academic years completed, regardless of the time it took to complete the education. Two semesters of a full course load is equal to one academic year. The census instructions define non-university post-secondary as “schooling in all post-secondary institutions other than university, whether or not a high school diploma was required for entrance”<sup>1</sup>. Individuals are explicitly told to include CÉGEP in non-university post-secondary in the census instructions. They are also instructed not to include any courses “taken for leisure, recreation, or personal interest.”

Hourly wages are constructed from data on annual earnings, weeks worked, and hours worked. Full-time, full-year is defined as working forty or more weeks in the previous year and thirty or more hours per week. We see from Table 1 that average wages are slightly higher for anglophone Quebecois, as are average years of education. The extra education is due to higher average years of university than in the rest of Canada. Total employment rates and full-time, full-year employment rates are similar between the two groups.

### C. Identification Strategy

The identification strategies used here exploit province and cohort variation in exposure to CÉGEP. In particular, I use the fact that cohorts educated in Quebec after 1950 may have participated in CÉGEP, while those born earlier are not likely to have. I use data from other

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<sup>1</sup> Statistics Canada (1996).

provinces, and from francophone Quebecois, as controls. Because the equation of interest includes cohort and control group main effects, this is a difference-in-differences type strategy.

Individuals born in the province of Quebec who do not report French as either their mother tongue or the only official language in which they are fluent are considered anglophone Quebecois. Since the first anglophone CÉGEP opened in the fall of 1969 and assuming the average age of college entrance is eighteen, those born in 1951 and later are included in the post group. One might be concerned that assigning treatment based on province of birth, rather than province of residence at age eighteen, which is not available, is problematic. Migration of anglophones was primarily out of Quebec in the late 1960's and early 1970's, so we are much more likely to mis-assign individuals to the treatment group than to fail to assign treatment to the treated. Thus, estimates of the size of the effect on the treated may be biased towards zero. Migration is investigated directly to assess its importance on the estimates of returns to education.

## **II. The Effect of Introducing CÉGEP on Education**

There are two basic questions I ask regarding the impact of CÉGEP on education: Did CÉGEP increase years of education, and did it divert students from university? CÉGEP is expected to increase total years of education, as it adds an extra year to acquiring a university degree and provides new schooling choices for those not attending university. But this need not be the case, since CÉGEP could substitute for years in university and other post-secondary institutions. In particular, CÉGEP may divert students from university. Instead of completing a university degree, they may be satisfied pursuing a non-academic CÉGEP degree, or stopping their schooling after completion of the two-year academic program. If the latter effect is strong enough, the new colleges could have decreased average education. I will begin by estimating the impact on years of education before turning to measuring the effect on university attendance and degree completion.

### A. Trends in Educational Attainment

Figure 2 shows average schooling by year of birth for anglophone Quebecois and the rest of Canada (excluding francophone Quebec). The figure shows separate averages for men and women at four levels of education: total schooling, elementary and high school, non-university post-secondary, and university. The data are unadjusted averages calculated from the pooled census data. To better show trends, the data have been extended to include all years of birth from 1940 to 1960, not just the 1946 to 1955 cohorts used in the remainder of the analysis.

The dramatic rise in non-university post-secondary education is clearly seen. The rise begins with the 1951 cohort for females, perhaps earlier for men. Years of elementary and secondary schooling are similar between the two groups, but rise faster for males in the treatment group between 1946 to 1955 than for the control. Trends in university attainment are similar, with both men and women in Quebec averaging about half a year more education.

To more formally examine differences in schooling between the treatment and control groups across cohorts, a regression approach using the micro-data set is employed. I estimate the difference in years of education for a given cohort as the coefficient of an anglophone Quebec-year of birth interaction term from a regression of years of schooling on a set of dummies. The dummies include a full set of province of birth, year of birth, and census year main effects, as well as interactions of census year and year of birth. Specifically, the following regression is estimated:

$$S_{icpt} = \alpha_{1c} + \beta_{1p} + \gamma_{1t} + \delta_{1ct} + \lambda_c Q_{ip} + \varepsilon_{icpt} \quad (1)$$

where  $S_{icpt}$  is the schooling of individual  $i$ , born in cohort  $c$ , in province  $p$ , observed in census year  $t$ ,  $\alpha_{1c}$  is a year of birth fixed effect,  $\beta_{1p}$  is a province of birth fixed effect,  $\gamma_{1t}$  is a census year fixed effect,  $\delta_{1ct}$  is a full set of province of birth-census year interactions,  $\lambda_c$  is a vector of cohort-specific effects of anglophone Quebec status, which is denoted  $Q_{ip}$ , and  $\varepsilon_{icpt}$  is a random error

term. (The year of birth-census year interactions are not necessary in this regression, but are included to allow for comparison with later wage results where they are needed to allow for a different age-earnings profile in each census year.)  $\lambda_c$ , the vector of year-by-year estimates of the difference in education between the treatment and control groups is plotted in Figure 3.

Figure 3 shows results similar to those of Figure 2. A large increase in years of college is observed for both men and women who reached college age after the introduction of the CÉGEPs. The total effect for the later cohorts is about four-tenths of a year of schooling on average per person. Total schooling reflects the increase in college, but it is mixed with rising years of elementary and secondary school for men, and somewhat noisy year effects for university.

#### B. Estimates of the Effect of CÉGEP on Years of Schooling

A restricted version of equation (1) used to produce a single estimate of the impact of introducing the CÉGEPs for each specification. The vector of cohort specific anglophone Quebec effects,  $\lambda_c Q_{ip}$ , is replaced by the interaction of an indicator,  $P_c$ , for birth in the post-CÉGEP period and an indicator,  $Q_{ip}$ , for membership in the treatment group (anglophone Quebecois):

$$S_{icpt} = \alpha_{1c} + \beta_{1p} + \gamma_{1t} + \delta_{1ct} + \lambda(P_c \times Q_{ip}) + \varepsilon_{icpt}. \quad (2)$$

The coefficient  $\lambda$  can be interpreted as the effect on years of education of introducing CÉGEP if we assume that years of education would have evolved similarly in anglophone Quebec and the control group in the absence of the intervention. Estimates of  $\lambda$  are presented for a variety of specifications in Table 2. Each entry in the table corresponds to a different regression. Four different dependent variables are used: the four levels of education used in Figures 2 through 4. Separate estimates are created by sex and employment status.

Panel A presents estimates using Canada, excluding Quebec, as the control group. The estimated effects on years of college, shown in Columns 3 for men and 7 for women, are similar

and highly significant. For men, the estimated effect for elementary and secondary school is also large and statistically significant. While this could be due to the incentive to graduate generated by the new colleges, Figure 2 suggests it may be due to a pre-existing trend rather than an outcome of introducing the CÉGEPs. This is potentially problematic as it suggests the rise in non-university post-secondary education may simply be part of a general trend in educational attainment, and therefore not exogenously caused by construction of the new colleges.

To check whether this is the case, an alternate control group was constructed consisting of individuals born in Ontario and francophone Quebecois. The two groups were chosen for the alternate control because their elementary and high school trends most closely matched those of the treatment group in the pre-period. It also presents an interesting comparison since Ontario has the most similar economy to Quebec and francophone Quebecois will naturally share many of the same economic shocks as anglophone Quebecois.

Panel B presents results with this alternate control group. For men, the estimated impact of CÉGEP on years of non-university post-secondary education is similar in size to the previous results, but the estimated effect on elementary and secondary school is now small and insignificant. Since a region of the country with a similar trend in elementary and high school education did not also have the same increase in non-university post-secondary education, I conclude that the increase can be attributed to the creation of the CÉGEP system.

For women, however, there is a significant negative estimated effect of CÉGEP on years of elementary and secondary school using the alternate control group which is similarly unlikely to be a result of the CÉGEPs. This suggests that the alternate control group is a poor substitute for the primary control of Canada excluding Quebec. To construct a more appropriate alternate control group, I employ a synthetic control group strategy, as presented in Abadie and Gardeazabal (forthcoming).

A synthetic control is a weighted average of the potential components of the control group. For example, the alternate control just presented is a synthetic control group with Ontario

and francophone Quebec each receiving weights of one and the rest of the provinces receiving weights of zero. The weights are not chosen randomly, though. They are chosen to make the synthetic control as similar as possible to the treatment group along some defined margin. For my purposes, weights were chosen to minimize the difference in average years of elementary and secondary school between anglophone Quebec and the synthetic control for the five pre-CÉGEP cohorts.

More formally, if  $Z_0$  is the  $5 \times 1$  vector of average years of elementary and secondary schooling among anglophone Quebecois in the five pre-CÉGEP cohorts, and  $Z_1$  is the  $5 \times n$  matrix of average years of elementary and secondary schooling for the  $n$  possible components of the control (in this case provinces, or parts of provinces), then the weights, given by the  $n \times 1$  vector  $v$ , are chosen to minimize a quadratic form:

$$v = \operatorname{argmin} (Z_0 - Z_1 v)' (Z_0 - Z_1 v)$$

conditional on all the elements of  $v$  being non-negative. Note that without the condition that the weights be non-negative, this is equivalent to finding the coefficients,  $v$ , in a regression of  $Z_0$  on the column vectors of  $Z_1$ .

The components of my synthetic control consist of Ontario and francophone Quebec<sup>2</sup>. The optimal weights were found to be 0.853 for Ontario and 0.147 for francophone Quebec. To apply the weights to the micro data, the weights were divided by the number of observations in each group. So, for example, the sum of regression weights of all observations for Ontario is 0.853.

Results for the synthetic control are shown in Panel C of Table 2. (Figure 4 graphs the  $\lambda$ 's that result from estimating equation (1) with the synthetic control.) The estimated increase in non-university post-secondary is similar to the previous results. For men, there is still an estimated impact on elementary and secondary school, but it is smaller than for the primary

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<sup>2</sup> An attempt was made to include additional provinces with trends in schooling similar to anglophone Quebec, such as Nova Scotia and Manitoba, but these provinces received zero weights.

control group. The large negative results for women that were obtained with the alternate control group are no longer observed. While not perfect, the synthetic control group provides an interesting contrast to the primary control group. Strategies for dealing with the trend in elementary and secondary school will be presented in later sections. Results for both the primary and synthetic control groups will be shown throughout the paper for comparison.

Note that the estimated effects of CÉGEP on years of university are insignificant in all specifications. This suggests either that individuals continued to pursue four-year undergraduate degrees or that the CÉGEPs encouraged some students to attend college who otherwise would not have. I now turn to investigating the effect that the new colleges had on both college and university attendance and degree completion.

### C. The Effect of CÉGEP on Post-Secondary Attendance and Degree Completion

The same strategy used to estimate the impact of CÉGEP on years of schooling can also be applied to investigate the impact on attendance and degree completion. An equation similar to equation (2), but with an indicator variable,  $D$ , as the dependent variable, is estimated. Specifically, the following equation:

$$D_{icpt} = \alpha_{2c} + \beta_{2p} + \gamma_{2t} + \delta_{2ct} + \lambda(P_c \times Q_{ip}) + \varepsilon_{icpt} \quad (3)$$

is estimated, where the independent variables are all defined as they were for equation (2).  $D$  will indicate either whether the individual has ever attended a college or a university, or whether the individual has a university or other post-secondary degree. Recall that  $\lambda$ , the coefficient on the interaction of an indicator,  $P_c$ , for birth in the post-CÉGEP period and an indicator,  $Q_{ip}$ , for membership in the treatment group, is the estimate of the impact of CÉGEP on the dependent variable.

Table 3 presents estimates for having attended a non-university post-secondary program, having received a non-university post-secondary degree (excluding trades certificates), having

attended university, and having obtained a university degree. Results are presented separately for men and women and for each control group. Means of the dependent variables for anglophone Quebecois in the pre-CÉGEP cohorts are given at the bottom of the table.

The results differ very little between the two control groups. In Columns 1 and 5 we see that CÉGEP is estimated to have increased the fraction of students attending non-university post-secondary institutions by about fourteen percentage points for men and ten percentage points for women. The estimated increase in the fraction holding non-university degrees is only slightly smaller, about eleven percentage points for men and nine percentage points for women. Relative to the pre-CÉGEP cohorts, this is almost a doubling of the fraction of men holding non-university degrees and an increase of about 50% for women. (The higher fraction of women holding non-university degrees can probably be explained by nursing and teaching certificates which were obtained in colleges rather than universities during this period.)

The equivalent estimates for university are presented in Columns 3 and 4 for men and Columns 7 and 8 for women. For both sexes, CÉGEP appears to have had no effect on university attendance. The estimates are statistically insignificant and small relative to the pre-existing rate of university attendance. Despite no significant increase in the fraction of students going to university, the post-CÉGEP cohorts are estimated to be about 10% more likely to receive a university degree. This is consistent with the earlier result that CÉGEP had no effect on average years of university. Since a degree required one year less of study, the same pattern of study would have resulted in more students obtaining degrees.

CÉGEP seems to have had no diversionary effect on university. It is rather surprising, in fact, that despite reducing the number of years of university necessary for completing a bachelor's degree, we see no decrease in the average years of university obtained. And despite increasing the total number of years of study needed to obtain a bachelor's degree, we see no decrease in the fraction of students receiving degrees, rather the probability of obtaining a degree increased.

To better understand how CÉGEP affected both non-university and university post-secondary education, Figure 5 gives the distribution of completed post-secondary education for the treatment and primary control groups born before and after the 1951 cutoff for exposure to CÉGEP. Panel A shows the distribution of years of non-university post-secondary education, Panel B shows the distribution of years of university, and Panel C shows the distribution of years of non-university post-secondary among those who reported attending at least some university.

In Panel A we see that the increase in non-university post-secondary education in Quebec is strongest for those completing two years of education. The distribution of non-university education does not change much in the rest of Canada during the same period. In Panel B we see once again that CÉGEP did not affect the percent attending university, but it did shift some from four to three years, as expected. The fall in the percent of the population completing four years of university is smaller than the increase in the three-year completion rate, though. Finally, in Panel C we see a dramatic increase in the fraction of those who are university educated with non-university post-secondary education, especially those with two years of non-university post-secondary education. All of the anglophone Quebecois attending university do not report attending CÉGEP because many will have attended university outside of Quebec, where CÉGEP is not required. It is also possible that some are reporting the CÉGEP-equivalent programs offered by the anglophone universities during this period as university education.

If all of the increase in university attendees reporting two years of non-university post-secondary education is due to CÉGEP, it suggests that one quarter of university students, or roughly ten percent of the population, completed two-year CÉGEP programs prior to attending university. This confirms that most of the estimated one-third year increase in non-university post-secondary education is students attending academic, pre-university CÉGEP programs rather than the three-year vocational and technical programs.

### III. The Effect of CÉGEP on Wages

I now turn to measuring the effect of CÉGEPs on wages. Hourly wages are calculated for full-time, full year (FTFY) workers from data on wage and self-employment income, weeks of work, and hours worked per week. Full-time, full-year is defined as working forty or more weeks in the previous year and thirty or more hours per week. Self-employment income is included because weeks of work is only measured including weeks of self-employment. Negative wages are not allowed and the purely self-employed are eliminated from the sample. I choose to work with hourly wages for FTFY workers to get a measure of wages more directly related to productivity and more easily comparable across workers.

Figure 6, Panel A, shows average log wages (in 1992 dollars) by year of birth for the whole data set and separately by census year. The x-axis has been reversed, so that younger workers are on the left, to better show the age-earnings profile. Even in 1996, the cohorts of interest, from 1946 to 1955, are still on the upward sloping portion of the age-earnings profile. Figure 6, Panel B, shows average log wages (in 1992 dollars) by year of birth for groups defined by highest level of education achieved. The age-earnings profiles are similar for the two groups and workers with same level of education earn similar wages.

#### A. Basic Results

To begin, the regression adjusted year-by-year differences between treatment and control groups are estimated for wages as for years of schooling. Equation (1) is estimated with log hourly wages replacing years of schooling as the dependent variable:

$$\ln(W)_{icpt} = \alpha_{3c} + \beta_{3p} + \gamma_{3t} + \delta_{3ct} + \theta_c Q_{ip} + \varepsilon_{icpt}. \quad (4)$$

The interactions between census year and year of birth effects,  $\delta_{3ct}$ , allow for a fully flexible age-earning profile in each census year. Figure 7 graphs the vector of cohort specific effects of

anglophone Quebec status,  $\theta_c$ .

The results are surprising. Despite an additional third of a year of education on average, the cohorts born after 1950 show no increase in wages. For men, wages are clearly lower for these cohorts relative to both control groups. The results for men might suggest a downward trend in wages across years of birth, but no such trend is observable in the results for women.

Estimates of the restricted version of Equation (4):

$$\ln(W)_{icpt} = \alpha_{3c} + \beta_{3p} + \gamma_{3t} + \delta_{3ct} + \theta(P_c \times Q_{ip}) + \varepsilon_{icpt} \quad (5)$$

confirm these observations. The estimated  $\theta$ 's for unadjusted wages are shown in Columns 1 and 3 of Table 4. The effects are similar using either control group: about a 4% fall in wages for men and a 2% fall in wages for women. The estimates for men are statistically significant, but those for women are not. As a robustness check, Columns 2 and 4 of Table 4 allow the impact on wages to vary by census year. There is no evidence that the negative results are being driven by data from any one of the years of census data. These estimates also rule out the possibility that the results are being driven by different trends in the treatment and control groups across census years.

To explore possible explanations for the negative estimates of the effect of CÉGEP on wages, I attempted to estimate the effect of years of non-university post-secondary schooling, while controlling for other sorts of schooling. The returns to this particular type of schooling may be especially low for a variety of reasons I discuss below. The equation used for this purpose is:

$$\ln(W)_{icpt} = \alpha_{4c} + \beta_{4p} + \gamma_{4t} + \delta_{4ct} + \pi_1 S_i^n + \pi_2 S_i^e + \pi_3 S_i^u + u_{icpt}, \quad (6)$$

where  $S_i^n$  is years of non-university post-secondary education,  $S_i^e$  is years of elementary and secondary, and  $S_i^u$  is years of university. Note that total years of schooling is the sum of these three types of education:  $S_i = S_i^n + S_i^e + S_i^u$ . As before,  $\alpha_{4c}$  is a year of birth fixed effect,  $\beta_{4p}$  is a province of birth fixed effect,  $\gamma_{4t}$  is a census year fixed effect,  $\delta_{4ct}$  is a full set of province of birth-census year interactions, and  $u_{icpt}$  is a random error term.

Table 5 presents ordinary least squares estimates of equation (6). Columns 1 and 3 present estimates with the restriction that the returns to the three types of education are constant. The schooling coefficients are estimated separately for anglophone Quebec and the rest of Canada. On average, an extra year of education raises hourly wages by a similar amount in the two regions, although the returns are slightly lower for females born in Quebec. Columns 2 and 4 allow the returns to vary by type of education. Here we see greater variation between anglophone Quebec and the rest of Canada. Non-university post-secondary education, in particular, has a much lower return for anglophone Quebecois than other Canadians. In fact, at 1.9%, the return to a year of non-university post-secondary education is not statistically significant for males. These estimates are lower than American estimates of the return to junior (two-year) college, the closest equivalent to CÉGEP in the United States. Kane and Rouse (1993) estimate the return to an extra year's worth of junior college credits to be between 3.5 and 5.7% for men and 5.8 and 6.9% for women.

Ordinary least squares estimates of equation (6), however, are, in general, biased because of correlation between years of education and the error term due, for example, to unobserved ability. Any variable or variables correlated with years of education, but uncorrelated with the error term, can be used to instrument for education to obtain an unbiased estimate of the coefficient. Assuming that introducing CÉGEP had no direct effect on wages, an indicator variable for treatment status interacted with an indicator variable for birth in the post period is a suitable excluded instrument for estimating the coefficient on years of non-university post-secondary education.

But I cannot simply instrument for years of non-university post-secondary education alone since years of elementary and secondary and years of university are also correlated with the error term and therefore are not valid instruments. Lacking potential excluded instruments for these other schooling variables, I will instead attempt to control for these variables by assuming values for their coefficients ( $\pi_2$  and  $\pi_3$ ) and adjusting the dependent variable accordingly. That is,

I will estimate the coefficient  $\pi_1$  by instrumenting for years of non-university post-secondary education,  $S_i^n$ , in the following variant of equation (6):

$$\ln(W)_{icpt} - \underline{\pi}_{2p}S_i^c - \underline{\pi}_{3p}S_i^u = \alpha_{4c} + \beta_{4p} + \gamma_{4t} + \delta_{4ct} + \pi_1 S_i^n + u_{icpt}, \quad (7)$$

where  $\underline{\pi}_{2p}$  and  $\underline{\pi}_{3p}$  are parameters I choose. I use the OLS estimates of the returns to these two types of education for the parameters. Note that I allow the returns to differ between the treatment and control groups, as in Table 5. I also try estimates twenty per cent higher and lower to gauge the sensitivity of the results. I refer to  $\ln(W)_{icpt} - \underline{\pi}_{2p}S_i^c - \underline{\pi}_{3p}S_i^u$  as ‘adjusted wages’.

As an alternative identification strategy, we can also use variation in the number of CÉGEPs opened each year for identification. This is done by using year-of-birth dummies multiplied by the number of CÉGEPs per thousand eighteen year olds eighteen years later as instruments for education in equation (7), instead of the interaction of treatment and post indicators. These instruments are not perfectly correlated with exposure to the CÉGEPs since year of birth is not a perfect predictor of year of CÉGEP entrance.

#### B. Estimates of the Effect of an Extra Year of CÉGEP on Wages

Tables 6a and 6b present the instrumental variable estimates of the effect of CÉGEP on wages. The results in Table 6a are from regressions that use an indicator variable for anglophone Quebecois interacted with an indicator variable for birth after 1950 as the excluded instrument. Table 6b presents results using cohort specific anglophone Quebec indicators interacted with colleges per capita as excluded instruments. Unlike the results in Table 4, which presented the net effect of CÉGEP on wages, the estimates in Tables 6a and 6b are estimates of the effect on an individual’s hourly wage of acquiring an extra year of CÉGEP.

Columns 1 and 4 present the base results, where the dependent variable is log hourly wages, adjusted for years of elementary and secondary school and years of university using OLS estimates of the returns which are allowed to vary by treatment status and differ between the pre-

and post-CÉGEP cohorts. For men, the estimates are large, negative, and statistically significant with an average estimate of about -10%. For women, the estimates are negative, but smaller and insignificant, with estimates between -3% and -6.4%.

The adjusted wages used in Columns 1 and 4 were calculated as  $\ln(W)_{icpt} - \pi_{2p}S_i^e - \pi_{3p}S_i^u$ . The returns to each type of schooling were allowed to vary by treatment status, but not by time. If CÉGEP had an effect on the return to university this would not be captured, biasing the estimated effect of CÉGEP on wages. OLS estimates which allow the return to university to differ between pre- and post-CÉGEP cohorts confirm that the return to university fell for anglophone Quebecois men relative to the rest of Canada. The estimated return to a year of university is 8.2% for the pre-CÉGEP cohorts and 6.4% for post-CÉGEP cohorts. For women the return appears not to have fallen significantly: it is 8.5% for the pre- cohorts and 8.3% for post-cohorts.

To investigate this further, Figure 8 plots OLS estimates of the return to university by year of birth for men and women<sup>3</sup>. For men, the return to university is consistently higher for anglophone Quebec than the rest of Canada in the pre-CÉGEP cohorts. The first post-CÉGEP anglophone Quebec cohorts have lower returns than earlier cohorts. For these cohorts the returns are similar to those for the rest of Canada. There is some evidence that later cohorts again had higher returns than elsewhere in the country, although the gap is smaller in magnitude than previously. This may reflect that the lowered returns to university were temporary in nature. For women, the return to university for anglophone Quebecois is consistently a little lower than for the rest of Canada. There is no evidence of any systematic difference between the pre- and post-CÉGEP cohorts.

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<sup>3</sup> For each figure, an equation similar to equation (6) was estimated by OLS. Unlike equation (6), years of university was interacted with a complete set of year-of-birth dummies for the years 1940 to 1960 for both anglophone Quebec and Canada excluding Quebec. It is coefficients on these interactions that are plotted in Figure 8.

The decrease in the return to university for men is plausibly another outcome of CÉGEP. The new colleges disrupted the activities of the anglophone universities in Quebec. It required them to create three-year degree programs out of their existing four-year programs. At the same time, since there was not enough capacity at the new colleges in the first several years to accommodate all of the anglophones who wished to complete the two-year pre-university programs, the universities created two-year CÉGEP-equivalent programs. This required them to construct five-year degree programs out the existing four-year bachelor's degrees. By lengthening the time it took to complete a university degree, CÉGEP may also have encouraged some students to leave the province for post-secondary education. Students who otherwise would have preferred staying in Quebec likely suffered lower returns to university as a consequence.

There is no evidence that women suffered these negative effects, however. The differences in the results for men and women likely arise from differences in the subjects typically studied and by differences in the jobs held by the two sexes. For example, education may play more of a signaling role for women than for men. And there is some evidence for men that later cohorts regained a higher rate of return to university than men in other provinces, although the returns remained lower than for earlier cohorts.

To account for differences in the rate of return to university across time, I allow the returns used to estimate adjusted wages to differ between the pre-CÉGEP and post-CÉGEP cohorts, as well as between the treatment and control groups. Results using this new adjusted wage variable are presented in Columns 2 and 5 of Tables 6a and 6b. Now none of the estimates of the effect of an extra year of CÉGEP on wages, for men or women, are statistically significantly different from zero. For men, the point estimates range from  $-1.9\%$  to  $-3.8\%$ . For women they range from  $-2.2\%$  to  $-5.6\%$ , with particularly large standard errors. The results do not vary significantly between the two sets of instruments.

One might be concerned that the negative wage results are due to the effects of the political violence taking place in Quebec at the time of the introduction of the CÉGEPs. The

Front de Liberation du Quebec (FLQ), a group violently advocating the separation of Quebec from the rest of Canada, was active from 1963 to 1970. They planted more than 85 bombs and killed seven people<sup>4</sup>. These events could bias the estimates of the effect of CÉGEP on wages if they had different effects on the cohorts born before and after 1950. It is possible the heightened violence towards the end of the 1960s may have caused more young anglophones to leave the province. Similarly, the election in 1976 of a separatist government in Quebec is believed to have sparked an increase in the outflow of anglophones from the province.

To investigate the importance of migration, Columns 3 and 6 in Tables 6a and 6b report estimates of the effect of CÉGEP which include additional fixed effects for province of residence. If, for example, migrants from Quebec in the post group moved to provinces with lower wages than earlier migrants, controlling for province of residence would account for this lowering the estimated effect. This is not found to be the case. The estimates are very close to the equivalent estimates without province of residence fixed effects<sup>5</sup>.

The estimates of the return to CÉGEP just presented are for a limited sample: full-time full-year workers only. It is possible that selection into this sub-sample could be responsible for the low estimates. If the workers affected by the introduction of the CÉGEPs have inherently lower earnings capacity, and in the absence of the additional schooling would not have had full-time full-year jobs, the estimated return would not pick up the positive impact on the affected workers. To test for this possibility, Table 7 presents tests of the importance of sample selection.

Whether an individual works or has a FTFY job is explained by their total years of schooling:

$$D_{icpt} = \alpha_{5c} + \beta_{5p} + \gamma_{5t} + \delta_{5ct} + \tau S_i + \varepsilon_{icpt}, \quad (8)$$

<sup>4</sup> See Zolf (1999) for additional historical details.

<sup>5</sup> Migrants who have left the country are not in my sample. To investigate the importance of this, I used data from Statistic Canada on births to calculate the fraction of those born in Ontario and Quebec who are not captured in the censuses used in this analysis (due to death, migration, or under-sampling). For Ontario, 13.3% of the pre-CÉGEP cohorts are missing compared to 13.2% of the post-CÉGEP cohorts. For Quebec, the similar figures are 13.6% and 12.8%. While I cannot separate this effect by language, it suggests that the post-CÉGEP cohorts were less likely to leave the country. This would tend to bias the estimates upward, since it is the most productive workers who tend to migrate (the ‘Brain Drain’ from Canada to the United States).

where  $D$  is an indicator variable for working or having a FTFY job.  $\tau$ , the parameter of interest, is estimated by instrumenting for schooling with an indicator for treatment interacted with an indicator for birth in the post period.

There is weak evidence that education affects the probability of having a FTFY job. Column 2 suggests that men are about six percentage points more likely to work FTFY with an extra year of education. This should not be large enough to have a substantial impact on the results. The estimates of the impact of CÉGEP on years of education from section II imply that perhaps one-third of the population received an extra year of education because of the program. Thus selection is likely to have affected at most about 2% of the sample of FTFY workers. If, for example, these workers were 10% less productive than average, this would imply a 0.2 percentage point lowering of the estimated return to education. This suggests that selection cannot explain the negative IV estimates of the return to CÉGEP.

As an additional, and more direct, test of the importance of selection, the remaining columns show estimates of the earnings impact of CÉGEP using weekly wages. This allows me to estimate the impact for all workers, not just FTFY workers. Hourly wages can not be used for all workers, since hours worked are only reported for the week prior to the census, so hourly wage rates are not available for many of the less than full year workers.

Columns 3 and 7 show estimates for FTFY workers equivalent to those in Table 6, but with adjusted weekly wages instead of adjusted hourly wages. The results are similar, with slightly higher estimates for men and slightly lower estimates for women. The remaining columns show results for all workers using adjusted weekly wages. The estimated wage impact from an extra year of CÉGEP is slightly lower for men and very similar to the return estimated for FTFY workers from hourly wages. For women, the estimates are now positive, but small and still lower than the OLS estimates of the return. Due to the imprecision of the estimates for

females, the differences between the estimates for FTFY workers and all workers are not large relative to the standard errors.<sup>6</sup>

## V. Interpretation

We have seen that the introduction of CÉGEP increased average years of non-university post-secondary education by about a third of a year for both men and women without changing average years of university. Despite this increase in schooling, wages of both men and women in the affected cohorts fell. Part of the fall in wages was shown to result from a decrease in the return to university experienced by men at the same time as CÉGEP was introduced. This is likely due to the difficulty for anglophone universities of adapting to the new institutional structure in Quebec. There is some evidence that this was a temporary effect. Accounting for this change still leaves negative, though insignificant, estimates of the effect on wages of an extra year of CÉGEP. There are several possible explanations for these results. One of the most likely is that the wages of those who attended CÉGEP are lower due to the work experience lost while attending the colleges (cf. Angrist, 1990). I will first estimate the size of this effect and then discuss other interpretations of the findings.

### A. Estimating the Value of Lost Experience

To estimate the value of lost labor market experience, I estimate the following wage equation:

$$\ln(W)_{icpt} = \beta_{6p} + \gamma_{6t} + \sum_m (\phi_t \cdot e_{icpt} + \varphi_t \cdot e_{icpt}^2) + \pi S_i + u_{icpt}, \quad (9)$$

where  $\beta_{6p}$  and  $\gamma_{6t}$  are province of birth and census year fixed effects, respectively, and  $S_i$  is total years of schooling. Experience,  $e_{icpt}$ , enters as a quadratic separately for each census year and is

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<sup>6</sup> Results, not reported here, assigning zero wages to those who do not work were similar, with large standard errors for both men and women.

estimated as age- $S_t-5$ . This is similar to the previous wage equations, with quadratic age-earnings profiles replacing the year-of-birth effects for each census year. The average value of an additional year of experience in any census year,  $t$ , can be estimated from Equation (9) as:

$$\partial \ln(W) / \partial e_t = \phi_t + 2\phi_e e.$$

Table 8 presents estimates of the key coefficients in Equation (9) and accompanying estimates of the average value of an additional year of experience for anglophones born in Quebec after 1950. These are calculated using the expression  $\phi_t + 2\phi_e e$ , with average experience in the given census year of anglophone Quebecois born after year 1950 used as the value of  $e$ .

As expected, the marginal value of experience decreases with age and is lower for women than men. With estimates as high as 3.1%, the estimated impact of a lost year of experience can be substantial. The results in Table 8 suggest the average effect across census years is about 2% for males and 1% for females. This is enough to almost completely explain the negative point estimates for men presented in Table 6. It is not enough to explain the negative point estimates of the return to CÉGEP for women, but the standard errors on these estimates are quite large. Indeed, for women, the estimates are sufficiently imprecise to prohibit ruling out any plausible value of the return to education. Furthermore, evidence was presented in Table 7 that the estimates for women may be biased downwards due to selection effects.

While I can not rule out with 95% confidence that the IV estimates of the return to CÉGEP are different from the OLS estimates, taking into account the value of lost work experience suggests that an additional year of CÉGEP had close to no effect on wages.

## B. Other Interpretations

Among the explanations for the very low estimated impact of CÉGEP on wages are general equilibrium effects, characteristics of the control group, and characteristics of CÉGEP itself. A large increase in education may have a depressing general equilibrium effect on wages

by increasing the supply of educated workers (see, for example, Angrist, 1995). This is unlikely to be responsible for my results. Approximately half of the anglophone Quebecois born in the cohorts exposed to CÉGEP migrated to other parts of Canada, with almost two-thirds moving to Ontario. Since the migrants are a small fraction of the work force in their province of residence, their wages would not suffer from this depressing effect. Yet controlling for province of residence did not substantially alter the results.

Instrumental variable estimates of the return to education are often larger than the corresponding OLS estimates. This has been attributed to two factors: measurement error which biases the OLS estimates downwards, but does not affect the IV estimates, and the special nature of the group being affected by the instrument (Card, 1999). Specifically, the quasi-experiments which generate the IV approach often involve changes in education for individuals from more disadvantaged socioeconomic backgrounds or who may be more impatient. That is, these individuals have higher marginal costs to acquiring education than average. In equilibrium, educational attainment should equate the marginal benefits and marginal costs to additional education. Thus the affected individuals have correspondingly higher marginal benefits, helping to explain why the IV estimate is higher than the OLS estimate.

Among anglophones, however, the introduction of CÉGEP appears to have affected primarily those who attended university (Figure 5). These students are likely, on average, to be from well-off families and to be higher scholastic achievers than others. These individuals may have lower marginal costs to acquiring an extra year of education, and thus lower equilibrium marginal benefits. CÉGEP is also free, unlike most other post-secondary education, which may further lower equilibrium marginal benefits. Indeed, this may help explain the particularly low OLS estimate of the return to non-university post-secondary schooling for Quebecois.

It is also possible that the education provided by CÉGEP simply had no value for the students who attended. Angrist (1993) found that veterans who attended vocational training received no economic benefits, unlike those who attended university. And Pischke (2002) finds

that Germans who received less schooling due to compressed school years in high school did not receive lower wages later in life. He argues that the same content may have been provided in a shorter period of time, resulting in no adverse effects. This argument seems applicable here as well.

The CÉGEPs were primarily designed to meet the needs of francophone Quebecois. They helped modernize francophone education in the province by removing the dominance of the religious colleges, with their focus on classical education including ancient languages and philosophy. They filled no such need in the anglophone school system. The CÉGEPs were primarily used by anglophones who went on to university studies. Particularly for students who completed a university degree, they may have added an extra year of schooling without greatly changing the total amount of education received. The failure to find any decrease in average years of university or university enrollment is consistent with students finding little benefit in the academic CÉGEP programs.

## **Conclusion**

An interesting natural experiment in the Canadian province of Quebec was used to estimate the impact of community college on educational attainment and wages. In the late 1960's, a new institution, the CÉGEP, was created both as a bridge between high school and university for students pursuing academic studies and as a source of vocational education for students who did not plan to attend university.

The introduction of these new colleges was shown to increase attendance in non-university post-secondary institutions by between 50 and 100%, increasing average years of this type of education by about a third of a year for both men and women. CÉGEP did not divert students from university. Indeed, it appears to have increased the fraction of anglophone

Quebecois obtaining a bachelor's degree by roughly 10% even though it increased the number of years of study required.

These results are important for policy debates in American states that wish to encourage more students pursuing bachelor's degrees to begin their post-secondary education in junior colleges. There is concern that diverting students from universities will adversely impact their educational attainment<sup>7</sup>. Previous literature has had difficulty addressing this issue because it is difficult to identify effects for students at junior college who plan on attending university separately from those who do not. Rouse (1995), using college proximity as an instrumental variable, finds that students at junior college who would otherwise have attended university end up receiving about three-quarters of a year less education. However, she also finds that there is no statistically significant decrease in the probability that these students receive a bachelor's degree. She concludes that the students diverted were probably unlikely to receive a bachelor's degree had they not attended junior college.

CÉGEP can be viewed as the extreme case in which all students are forced to begin their degrees at junior colleges. This provides a fairly convincing strategy for identifying the effect of community college on students who wish to obtain a university degree. My findings that CÉGEP had no effect on average years of university or university attendance suggest that students diverted from university are unlikely to be adversely affected. If peer effects are very important, though, the high fraction of CÉGEP students planning on attending university may not replicate the results that would be observed by having university-bound students attend junior colleges primarily attended by students who do not wish to obtain a bachelor's degree.

Even with the increase in educational attainment caused by CÉGEP, there is no evidence of a corresponding increase in wages for the affected cohorts when they are observed fifteen to twenty-five years later. Negative point estimates of the effect on wages of an additional year of

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<sup>7</sup> See Kane and Rouse (1999) for additional discussion of this issue.

CÉGEP were shown to be largely explained by a fall in the return to university that coincided with CÉGEP and the work experience lost when attending an extra year of school. Several possible explanations for these results were examined. I argue it is likely the CÉGEPs failed to produce wage gains because the academic programs contained insufficient new schooling and the vocational programs were simply of little value to students.

While surprising, these findings are not unprecedented. Angrist (1993) finds no economic return for veterans who used veterans benefits to attend non-university post-secondary education, despite finding a positive return for those who attended university. Öckert (2002) and Pischke (2002) also find no returns to education for some students in industrialized countries using natural experiments.

Previous studies of community colleges have tended to find positive returns that are comparable to the returns at four-year colleges (see Kane and Rouse 1999 for a summary of this literature). Almost all of these studies rely on regression covariates to control for ability and other missing or poorly observed variables that may bias their estimates. It is possible that they have failed to fully control for unobserved variables, leading them to overstate the returns. It may also be that I fail to find a positive effect of CÉGEP on wages because of problems in the initial years associated with creating a new educational program. The fall in the rate of return to university for these cohorts adds plausibility to this argument. It would be important in any cost-benefit analysis to account for these 'growing pains'.

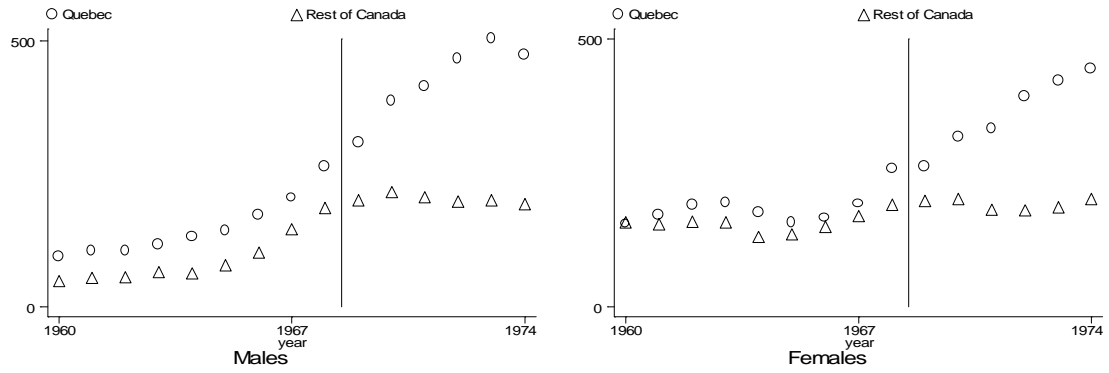
Despite its apparent failure to produce large wage gains, CÉGEP may have succeeded on margins other than simply increasing educational attainment. In particular, it may have succeeded in its social goals of bringing together a diverse group of students in a single institution and uniting the anglophone and francophone school systems.

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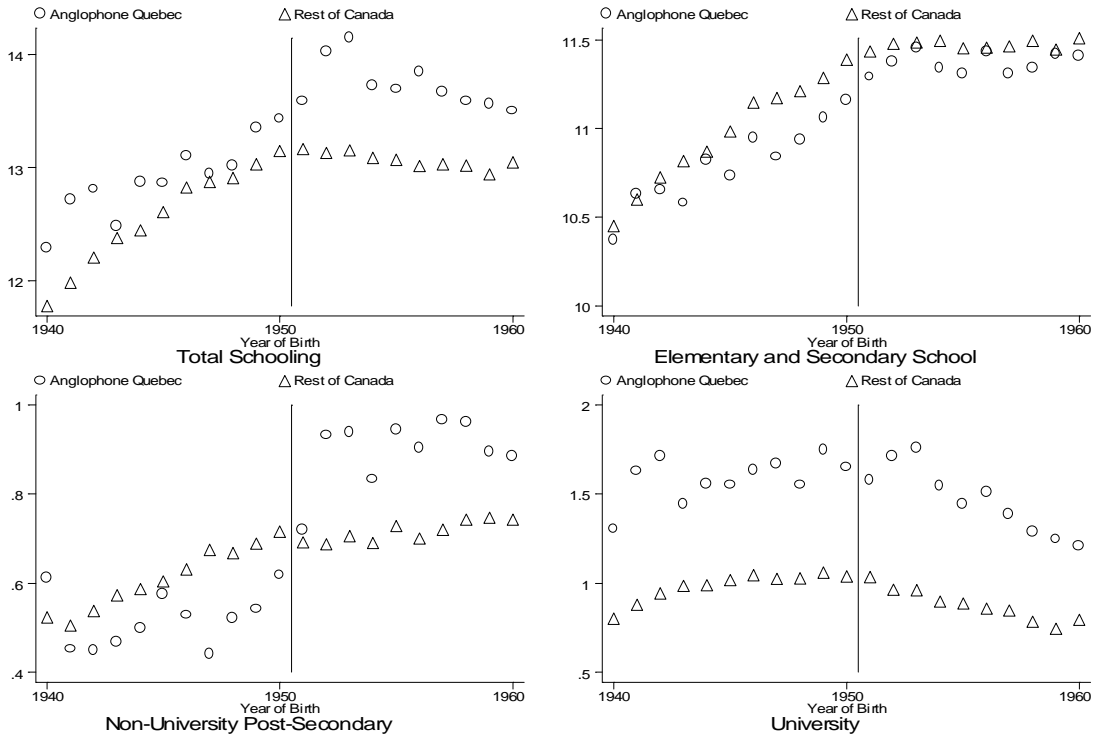
Figure 1. Non-University Post-Secondary Enrollment per Thousand Eighteen Year Olds



Source: Statistics Canada, *Historical Statistics of Canada*, Series W307\_339.

Figure 2. Trends in Years of Schooling by Level

Males



Females

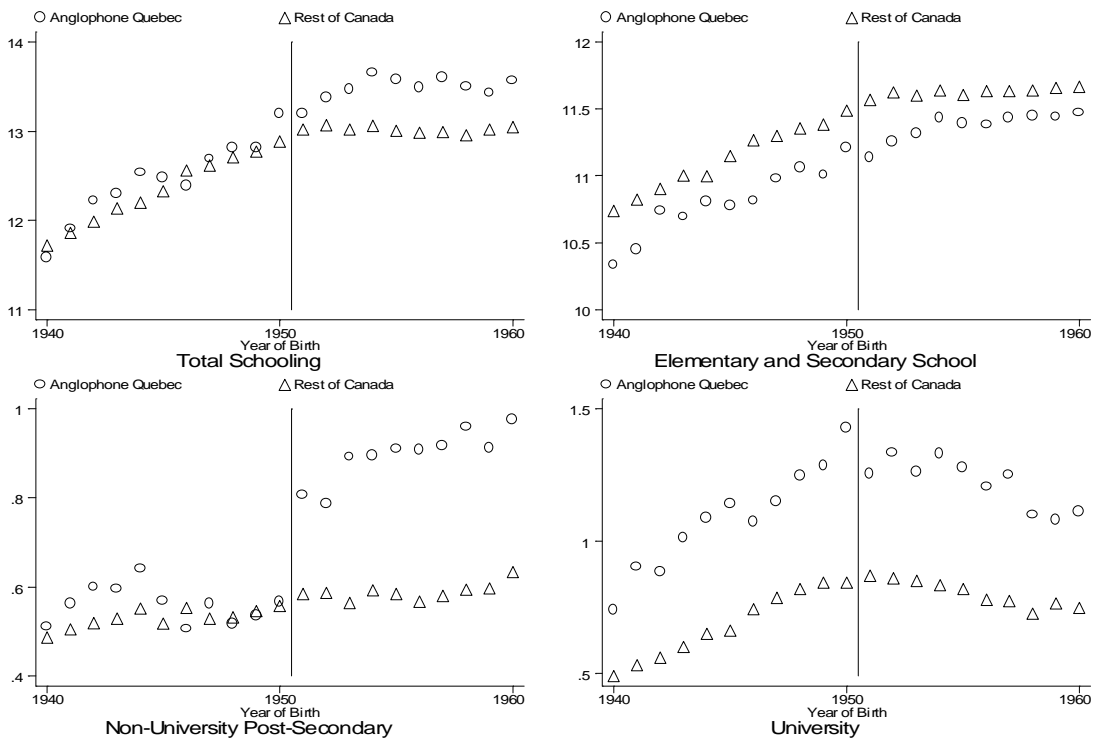
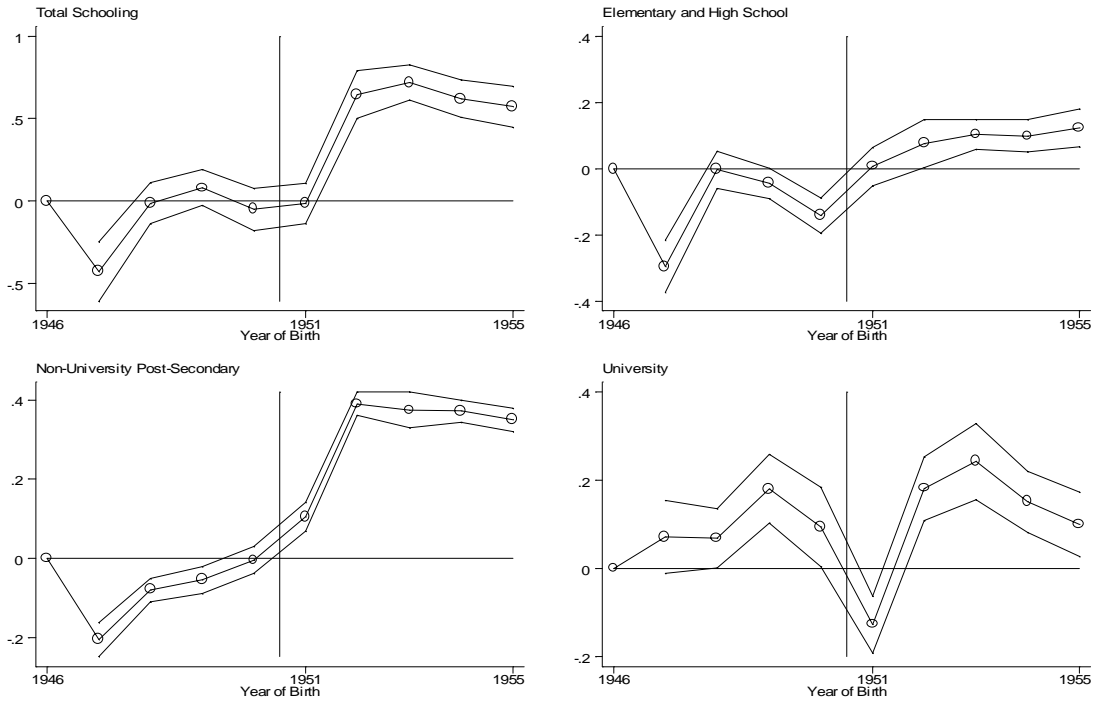


Figure 3. Coefficients on Year of Birth \* Anglophone Quebec Dummies in Regressions Explaining Years of Schooling with 95% Confidence Interval

Control Group: Canada excluding Quebec

Males



Females

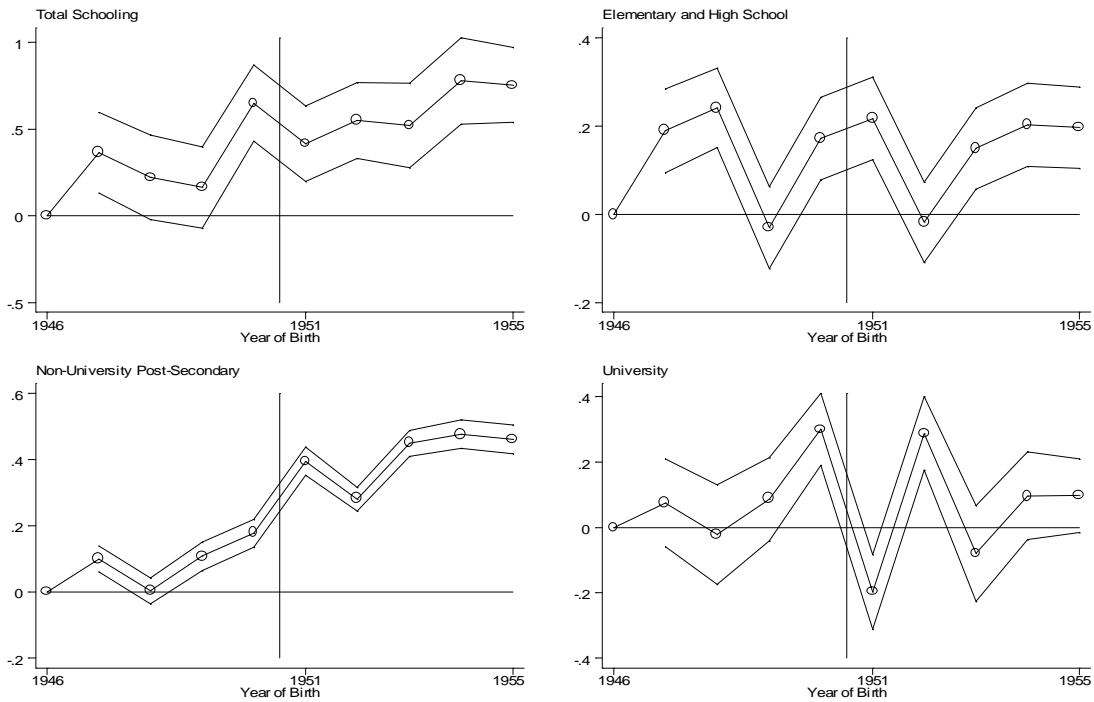
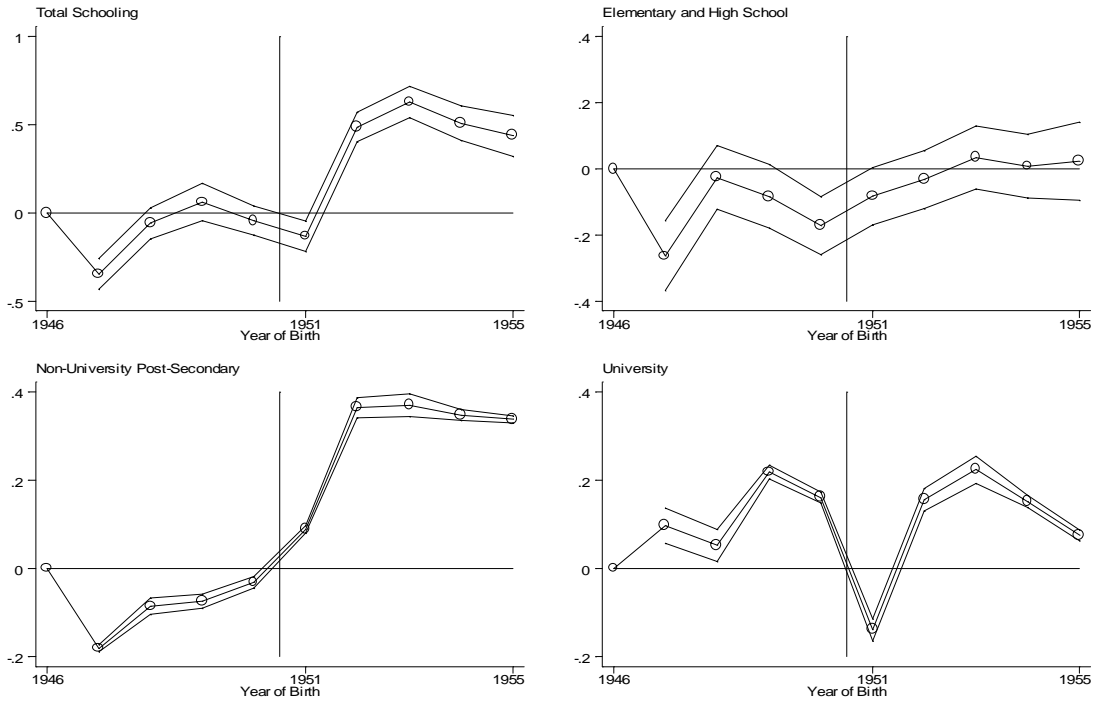


Figure 4. Coefficients on Year of Birth \* Anglophone Quebec Dummies in Regressions Explaining Years of Schooling with 95% Confidence Interval

Synthetic Control Group: Weighted Average of Ontario and Francophone Quebec

Males



Females

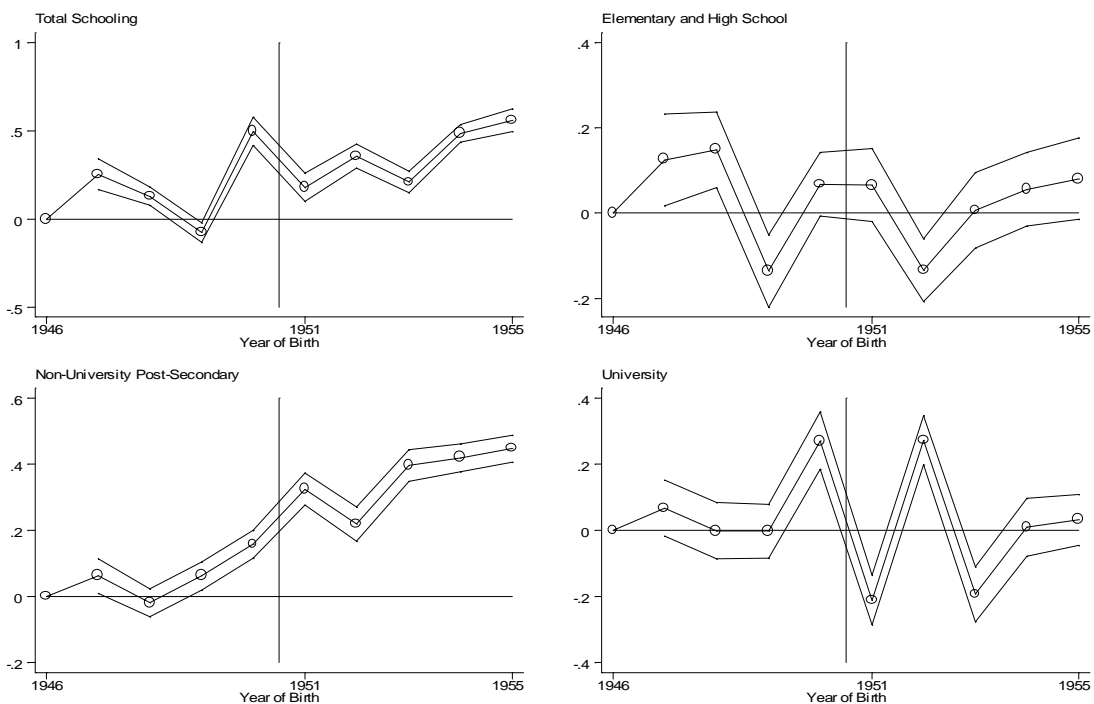
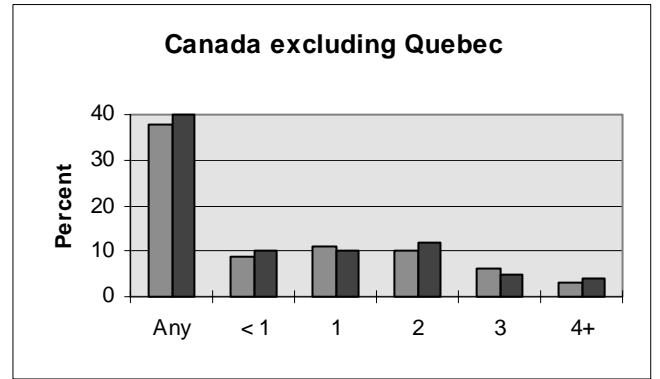
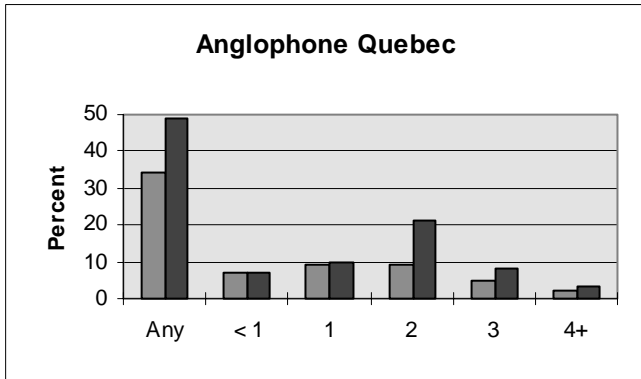


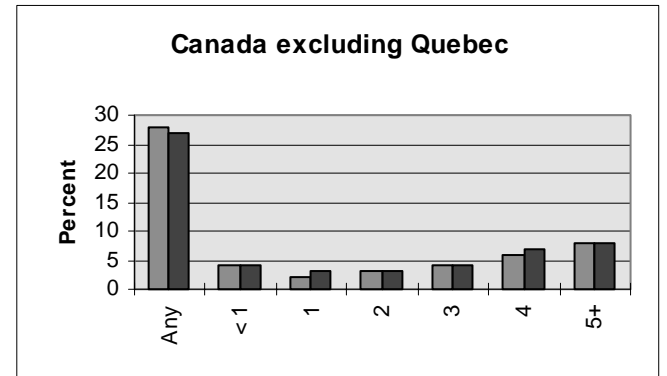
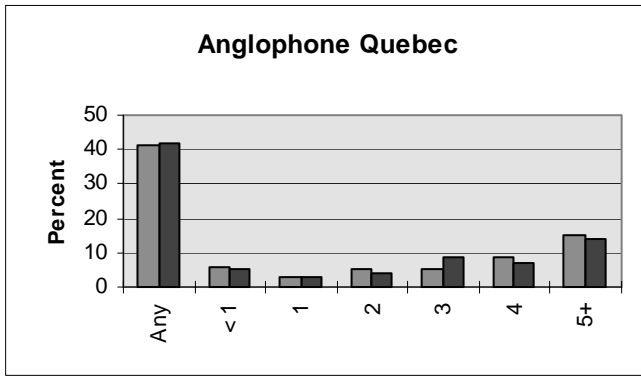
Figure 5. Distribution of Years of Post-Secondary

Legend: In each pair of bars, the left bar is for pre-CÉGEP cohorts (born from 1946 to 1950) and the right bar is for post-CÉGEP cohorts (born from 1951 to 1955).

Panel A: Years of Non-University Post-Secondary



Panel B: Years of University



Panel C: Years of Non-University for Those with Any University

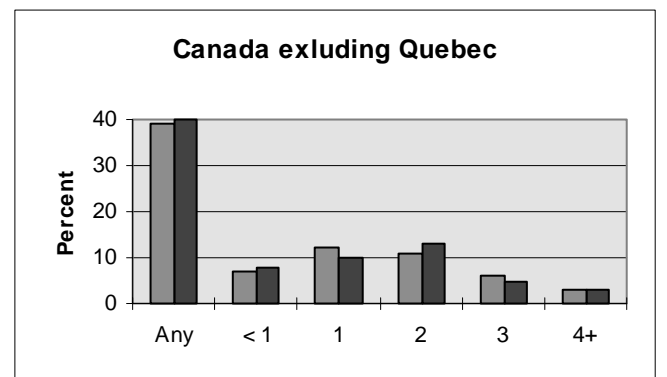
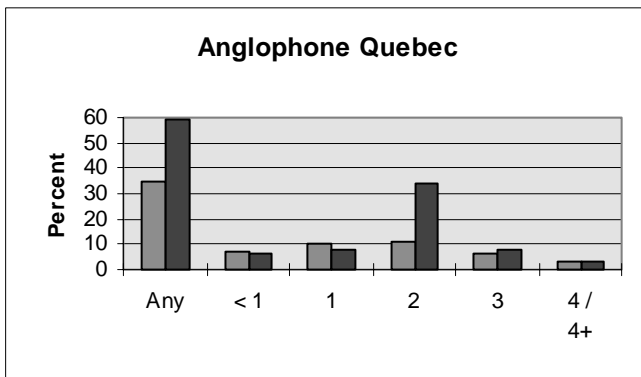
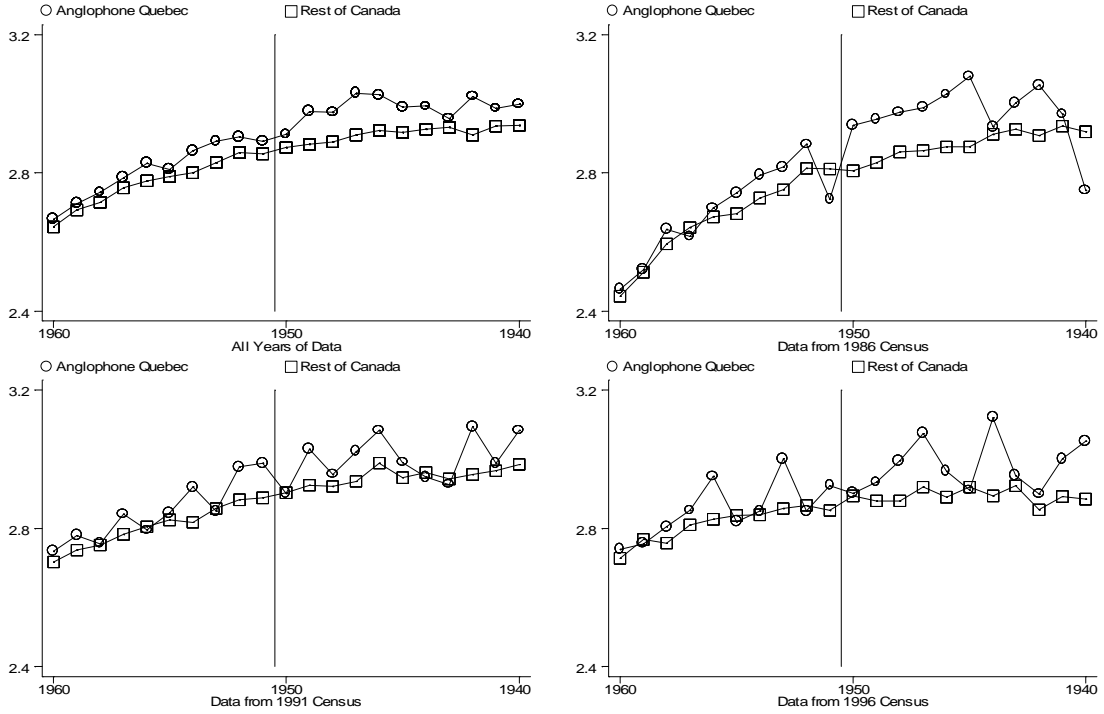


Figure 6a. Age-Earnings Profile of Full-Time Full-Year Workers  
Log Wages By Census Year (1992 Dollars)

Males



Females

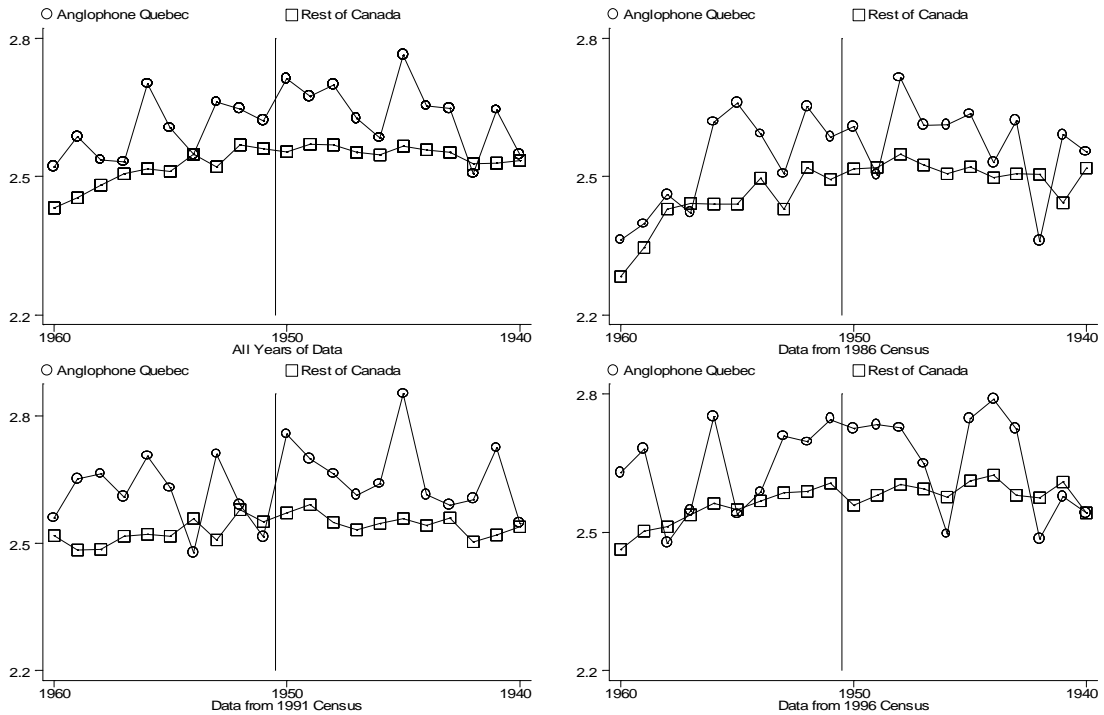
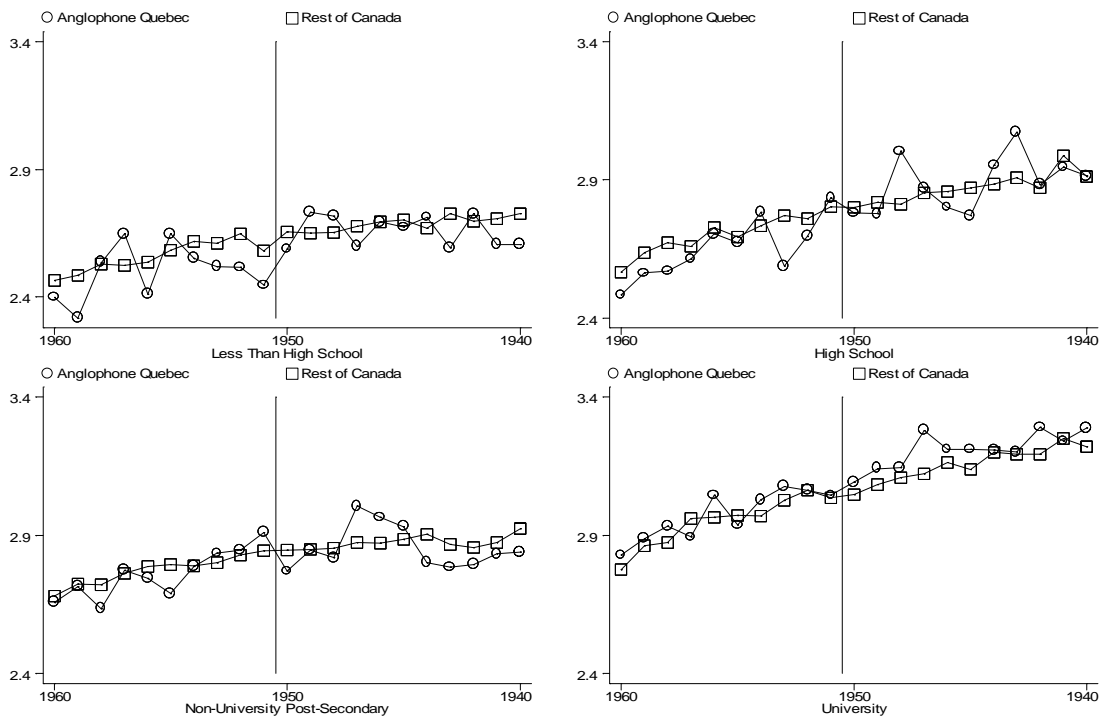


Figure 6b. Age-Earnings Profile of Full-Time Full-Year Workers  
Log Wages By Education (1992 Dollars)

Males



Females

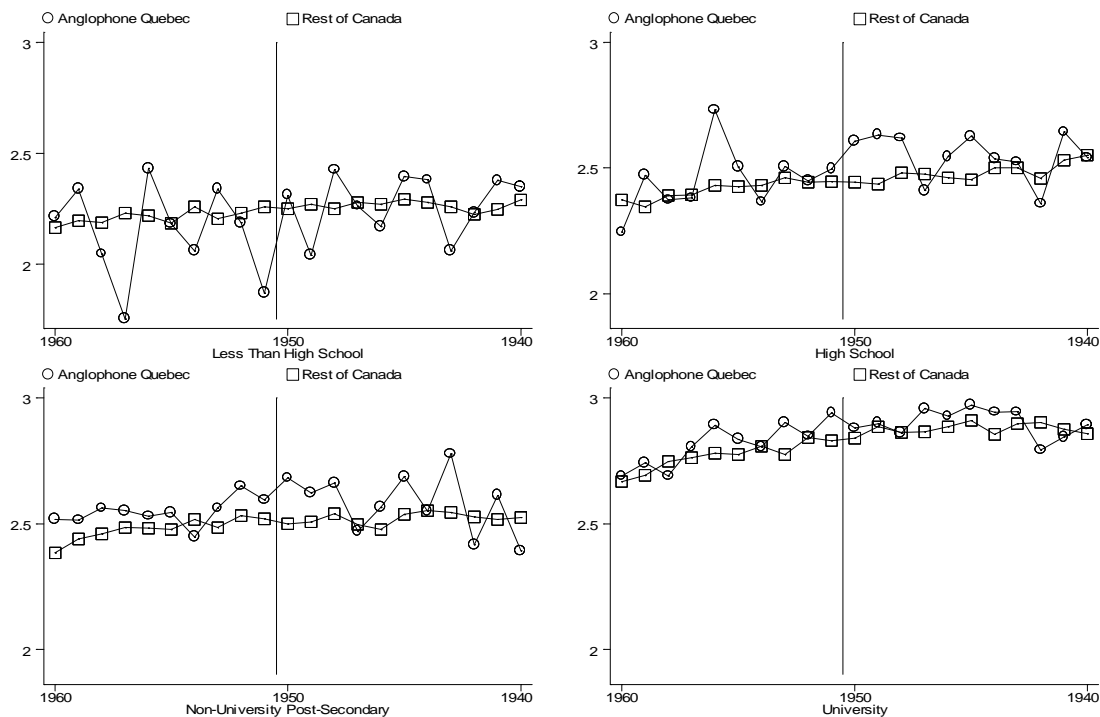
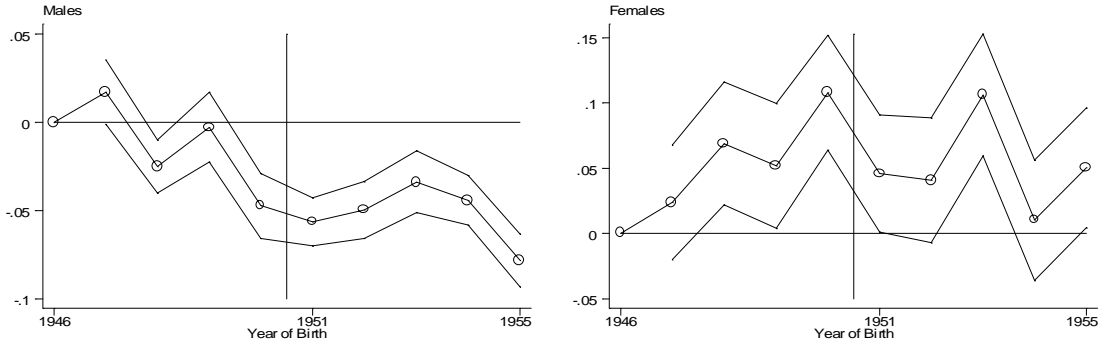


Figure 7. Coefficients on Year of Birth \* Anglophone Quebec Dummies in Regressions Explaining Wages with 95% Confidence Interval

Primary Control Group: Canada excluding Quebec



Synthetic Control Group: Weighted Average of Ontario and Francophone Quebec

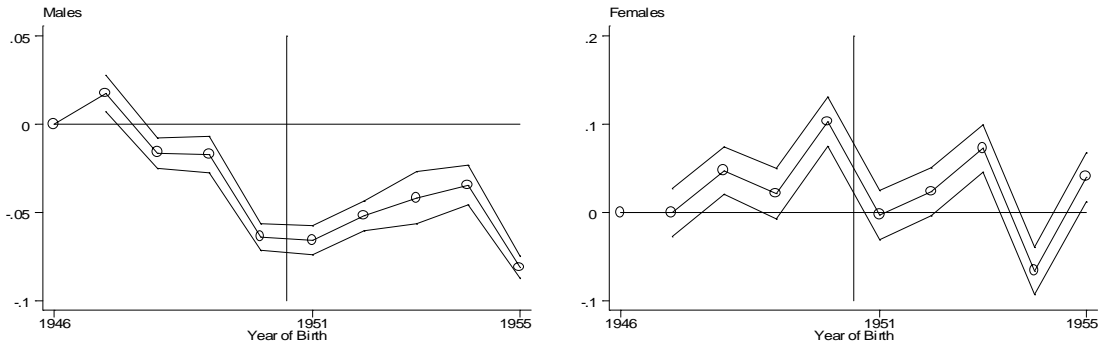


Figure 8. Ordinary Least Squares Estimates of the Returns to University by Cohort

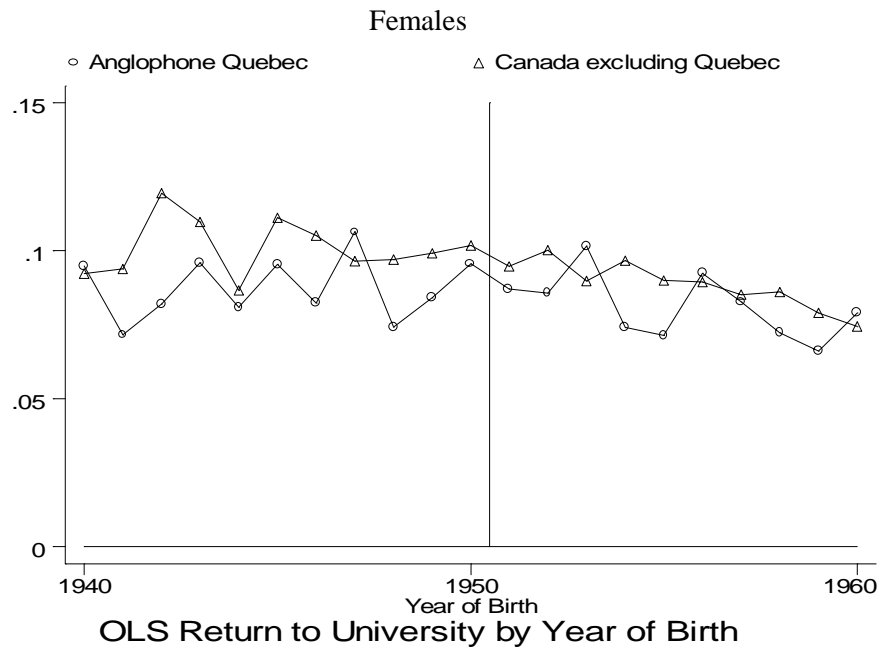
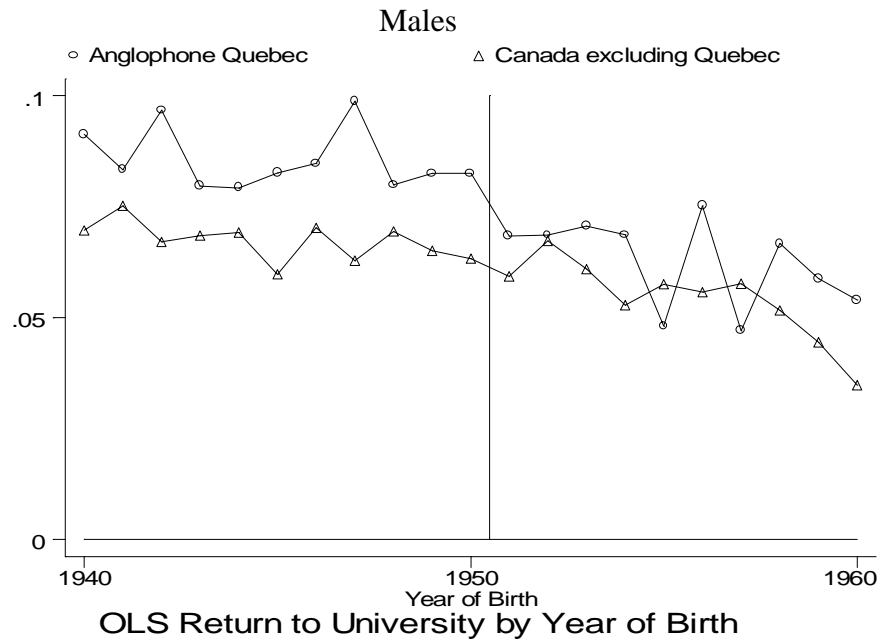


Table 1 – Descriptive Statistics

	Total Sample	Variable Means	
		Anglophone Quebec	Canada, excluding Quebec
Total Years of Education	12.8	13.3	13.0
Years of Elementary & Secondary	11.3	11.2	11.4
Years of University	0.9	1.4	0.9
Years of Non-University Post-Secondary	0.7	0.7	0.6
Log Hourly Wages (FTFY workers, 1992 Dollars)	2.65	2.72	2.65
Worked Full-Time Full-Year in Previous Year	0.58	0.60	0.59
Employed During the Previous Year	0.86	0.85	0.87
Residing in Province of Birth	0.22	0.52	0.28
Total Number of Observations	250,220	10,862	167,815

Source: Statistics Canada, 1986, 1991, and 1996 Canadian Census Public Use Micro Data Files.

Table 2 – Estimates of the Effects of the Introduction of CÉGEP on Educational Attainment

	Males			Females				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Years of Education	Years of Elementary and Secondary School	Years of Non-Univ. Post-Second. Education	Years of University Education	Years of Education	Years of Elementary and Secondary School	Years of Non-Univ. Post-Second. Education	Years of University Education
	Dependent Variable							
	Panel A: Primary Control Group: Anglophone Quebec vs. Canada excluding Quebec							
Whole Sample (88973 Males, 89704 Females)	0.531 (0.102)**	0.160 (0.032)**	0.320 (0.039)**	0.051 (0.051)	0.355 (0.100)**	0.058 (0.049)	0.284 (0.026)**	0.013 (0.045)
FTFY Workers (57881 Males, 38443 Females)	0.583 (0.138)**	0.178 (0.050)**	0.382 (0.055)**	0.023 (0.062)	0.324 (0.114)**	0.028 (0.060)	0.334 (0.043)**	-0.039 (0.087)
	Panel B: Anglophone Quebec vs. Ontario and Francophone Quebec							
Whole Sample (80070 Males, 81254 Females)	0.312 (0.104)**	-0.012 (0.053)	0.298 (0.041)**	0.026 (0.056)	0.079 (0.073)	-0.146 (0.055)**	0.222 (0.032)**	0.004 (0.049)
FTFY Workers (52564 Males, 34723 Females)	0.391 (0.129)**	0.023 (0.060)	0.356 (0.053)**	0.012 (0.068)	0.118 (0.119)	-0.120 (0.064)*	0.278 (0.049)**	-0.040 (0.097)
	Panel C: Synthetic Control Group: Anglophone Quebec vs. Weighted Average of Ontario and Francophone Quebec							
Whole Sample (80070 Males, 81254 Females)	0.419 (0.069)**	0.084 (0.027)**	0.314 (0.027)**	0.021 (0.034)	0.184 (0.055)**	-0.033 (0.036)	0.253 (0.020)**	-0.035 (0.028)
FTFY Workers (52564 Males, 34723 Females)	0.464 (0.091)**	0.100 (0.035)**	0.376 (0.037)**	-0.013 (0.044)	0.198 (0.077)**	-0.029 (0.043)	0.309 (0.032)**	-0.083 (0.063)

\* significant at 10%, \*\* significant at 5%

Notes: Standard Errors are corrected for province of birth – year of birth clustering. The data are from the 1986, 1991, and 1996 Canadian Census Public Use Microdata Files. The sample is restricted to non-minorities born in Canada in the years 1946 to 1955 inclusive. All regressions contain census year, year of birth, and province of birth main effects, as well as census year – year of birth interactions. Treatment is assigned based on province of birth rather than province of residence.

Table 3 – Estimates of the Effects of the Introduction of CÉGEP on Post-Secondary Attendance and Degree Completion

	Males			Females				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
				Dependent Variable				
	Attended Non-Univ. Post-Sec.	Received a Non-Univ. Post-Sec. Degree	Attended University	Received a University Degree	Attended Non-Univ. Post-Sec.	Received a Non-Univ. Post-Sec. Degree	Attended University	Received a University Degree
Whole Sample (88973 Males, 89704 Females)	0.145 (0.017)**	0.117 (0.017)**	0.017 (0.014)	0.027 (0.010)**	0.106 (0.014)**	0.094 (0.011)**	0.012 (0.012)	0.026 (0.012)**
			Primary Control Group: Anglophone Quebec vs. Canada excluding Quebec					
Whole Sample (80070 Males, 81254 Females)	0.142 (0.012)**	0.110 (0.013)**	0.012 (0.009)	0.020 (0.007)**	0.095 (0.012)**	0.088 (0.009)**	0.009 (0.007)	0.018 (0.007)**
			Synthetic Control Group: Anglophone Quebec vs. Weighted Average of Ontario and Francophone Quebec					
Mean of Dep. Var. for Anglo. Quebec in Pre-CÉGEP cohorts	0.32	0.14	0.46	0.31	0.36	0.20	0.37	0.26

\* significant at 10%, \*\* significant at 5%

Notes: Standard Errors are corrected for province of birth – year of birth clustering. The data are from the 1986, 1991, and 1996 Canadian Census Public Use Microdata Files. The sample is restricted to non-minorities born in Canada in the years 1946 to 1955 inclusive. All regressions contain census year, year of birth, and province of birth main effects, as well as census year – year of birth interactions. Treatment is assigned based on province of birth rather than province of residence.

Table 4 – Estimates of the Effect of the Introduction of CÉGEP on Wages

	Males		Females	
	(1)	(2)	(3)	(4)
Dependent Variable: Log(Hourly Wage) of FTFY Workers				
Primary Control Group: Anglophone Quebec vs. Canada excluding Quebec (N = 57881 Males, 38443 Females)				
Quebec Anglophone * Post	-0.038 (0.015)**		-0.023 (0.028)	
Q.A. * Post * Data Year 1986		-0.053 (0.031)*		0.027 (0.033)
Q.A. * Post * Data Year 1991		-0.020 (0.024)		-0.052 (0.048)
Q.A. * Post * Data Year 1996		-0.047 (0.030)		-0.026 (0.032)
Synthetic Control Group: Anglophone Quebec vs. Weighted Avg. of Ontario and Francophone Quebec (N = 52564 Males, 34723 Females)				
Quebec Anglophone * Post	-0.038 (0.011)**		-0.021 (0.019)	
Q.A. * Post * Data Year 1986		-0.038 (0.023)		0.053 (0.027)*
Q.A. * Post * Data Year 1991		-0.024 (0.020)		-0.051 (0.033)
Q.A. * Post * Data Year 1996		-0.054 (0.020)**		-0.034 (0.022)

\* significant at 10%, \*\* significant at 5%

Notes: Standard Errors are corrected for province of birth – year of birth clustering. The data are from the 1986, 1991, and 1996 Canadian Census Public Use Microdata Files. The sample is restricted to non-minorities born in Canada in the years 1946 to 1955 inclusive who report positive wage income. All regressions contain census year, year of birth, and province of birth main effects, as well as census year – year of birth interactions. Treatment is assigned based on province of birth rather than province of residence.

Table 5 – OLS Estimates of the Return to Education

	Males		Females	
	(1)	(2)	(3)	(4)
	Dependent Variable: Log(Hourly Wage) of FTFY Workers			
	Anglophone Quebec vs. The Rest of Canada (N = 79729 Males, 52876 Females)			
Years of Education * Rest of Canada	0.058 (0.001)**		0.089 (0.001)**	
Years of Education * Anglophone Quebec	0.058 (0.002)**		0.075 (0.004)**	
Years of Non-Univ. Post-Sec. * Rest of Canada		0.027 (0.003)**		0.060 (0.004)**
Years of Non-Univ. Post-Sec. * Anglophone Quebec		0.019 (0.013)		0.034 (0.008)**
Years of Elementary and Secondary * Rest of Canada		0.062 (0.003)**		0.087 (0.004)**
Years of Elem. and Secondary * Anglophone Quebec		0.051 (0.008)**		0.084 (0.011)**
Years of University * Rest of Canada		0.068 (0.002)**		0.102 (0.003)**
Years of University * Anglophone Quebec		0.072 (0.003)**		0.084 (0.005)**

\* significant at 10%, \*\* significant at 5%

Notes: Standard Errors are corrected for province of birth – year of birth clustering. The data are from the 1986, 1991, and 1996 Canadian Census Public Use Microdata Files. The sample is restricted to non-minorities born in Canada in the years 1946 to 1955 inclusive who report positive wage income. All regressions contain census year, year of birth, and province of birth main effects, as well as census year – year of birth interactions. Geography is assigned based on province of birth rather than province of residence.

Table 6a – Instrumental Variables Estimates of the Return to CÉGEP

	Males			Females		
	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable in all regressions: Adjusted Log Hourly Wage <sup>†</sup>						
Primary Control Group: Anglophone Quebec vs. Canada excluding Quebec (N = 57884 Males, 38445 Females)						
Years of Non-Univ. Post-Sec.	-0.123 (0.037)**	-0.038 (0.038)	-0.042 (0.038)	-0.064 (0.083)	-0.056 (0.083)	-0.063 (0.081)
Province of Residence Fixed Effects	N	N	Y	N	N	Y
Synthetic Control Group: Anglophone Quebec vs. Weighted Average of Ontario and Francophone Quebec (N = 54185 Males, 35756 Females)						
Years of Non-Univ. Post-Sec.	-0.105 (0.027)**	-0.019 (0.029)	-0.011 (0.027)	-0.033 (0.063)	-0.024 (0.062)	-0.016 (0.061)
Province of Residence Fixed Effects	N	N	Y	N	N	Y
Instrument for Years of Non-University Post-Secondary: Anglophone Quebec Indicator * Born after 1950 Indicator						

<sup>†</sup> Adjusted Log Hourly Wages: Log wages are adjusted for each individual for years of elementary and secondary,  $S_e$ , and years of university,  $S_u$ , by subtracting the number of years of education times the OLS estimate of the return ( $\pi_e$  and  $\pi_u$ , respectively):  $\log(\text{Wage}) - \pi_e S_e - \pi_u S_u$ . The OLS estimates of the returns are allowed to vary by sex and between the treatment and control in columns 1 and 4, and between pre-CEGEP and post-CEGEP cohorts as well as by sex and treatment and control in columns 2, 3, 5, and 6.

\* significant at 10%, \*\* significant at 5%

Notes: Standard Errors are corrected for province of birth – year of birth clustering. The data are from the 1986, 1991, and 1996 Canadian Census Public Use Microdata Files. The sample is restricted to non-minorities born in Canada in the years 1946 to 1955 inclusive who report positive wage income. All regressions contain census year, year of birth, and province of birth main effects, as well as census year – year of birth interactions. Treatment is assigned based on province of birth rather than province of residence.

Table 6b – Instrumental Variables Estimates of the Return to CÉGEP

	Males		Females			
	(1)	(2)	(3)	(4)	(5)	(6)
	Dependent Variable in all regressions: Adjusted Log Hourly Wage <sup>†</sup>					
	Primary Control Group: Anglophone Quebec vs. Canada excluding Quebec (N = 57884 Males, 38445 Females)					
Years of Non-Univ. Post-Sec.	-0.109 (0.033)**	-0.037 (0.035)	-0.040 (0.034)	-0.063 (0.091)	-0.056 (0.091)	-0.061 (0.089)
Province of Residence Fixed Effects	N	N	Y	N	N	Y
	Synthetic Control Group: Anglophone Quebec vs. Weighted Average of Ontario and Francophone Quebec (N = 54185 Males, 35756 Females)					
Years of Non-Univ. Post-Sec.	-0.094 (0.024)**	-0.021 (0.026)	-0.015 (0.024)	-0.030 (0.067)	-0.022 (0.067)	-0.012 (0.065)
Province of Residence Fixed Effects	N	N	Y	N	N	Y
	Instruments for Years of Non-University Post-Secondary: Anglophone Quebec Cohort Effects * CÉGEPs per 1000 18 year olds 18 years later					

<sup>†</sup> Adjusted Log Hourly Wages: Log wages are adjusted for each individual for years of elementary and secondary,  $S_e$ , and years of university,  $S_u$ , by subtracting the number of years of education times the OLS estimate of the return ( $\pi_e$  and  $\pi_u$ , respectively):  $\log(\text{Wage}) - \pi_e S_e - \pi_u S_u$ . The OLS estimates of the returns are allowed to vary by sex and between the treatment and control in columns 1 and 4, and between pre-CEGEP and post-CEGEP cohorts as well as by sex and treatment and control in columns 2, 3, 5, and 6.

\* significant at 10%, \*\* significant at 5%  
Notes: Standard Errors are corrected for province of birth – year of birth clustering. The data are from the 1986, 1991, and 1996 Canadian Census Public Use Microdata Files. The sample is restricted to non-minorities born in Canada in the years 1946 to 1955 inclusive who report positive wage income. All regressions contain census year, year of birth, and province of birth main effects, as well as census year – year of birth interactions. Treatment is assigned based on province of birth rather than province of residence.

Table 7 – Testing for Sample Selection

	Males			Females				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Dummy for Working	Dummy for FTFY	Adjusted Log Weekly Wage <sup>†</sup> FTFY only	Adjusted Log Weekly Wage <sup>†</sup> All Workers	Dependent Variable Dummy for Working	Dummy for FTFY	Adjusted Log Weekly Wage <sup>†</sup> FTFY only	Adjusted Log Weekly Wage <sup>†</sup> All Workers
Years of Education	0.010 (0.015)	0.056 (0.027)**			-0.017 (0.036)	0.032 (0.048)		
Years of Non-Univ. Post-Sec.			-0.017 (0.044)	-0.036 (0.045)			-0.068 (0.088)	0.024 (0.096)
Number of Observations	88973	88973	57881	74689	89704	89704	38443	66833
			Primary Control Group: Anglophone Quebec vs. Canada excluding Quebec					
			Synthetic Control Group: Anglophone Quebec vs. Weighted Average of Ontario and Francophone Quebec					
Years of Education	0.005 (0.014)	0.062 (0.025)**			-0.060 (0.061)	0.010 (0.067)		
Years of Non-Univ. Post-Sec.			0.001 (0.033)	-0.019 (0.030)			-0.029 (0.067)	0.021 (0.068)
Number of Observations	80070	80070	52564	67146	81254	81254	34723	58780
			The excluded instrument in all regressions is Anglophone Quebec * Post					

† Adjusted Log Hourly Wages: Log wages are adjusted for each individual for years of elementary and secondary,  $S_e$ , and years of university,  $S_u$ , by subtracting the number of years of each type of education times the OLS estimate of the return ( $\pi_e$  and  $\pi_u$ , respectively):  $\log(\text{Wage}) - \pi_e S_e - \pi_u S_u$ . The OLS estimates of the returns are allowed to vary by sex and between pre-CEGEP and post-CEGEP cohorts as well as between the treatment and control groups.

\* significant at 10%, \*\* significant at 5%  
 Notes: Standard Errors are corrected for province of birth – year of birth clustering. The data are from the 1986, 1991, and 1996 Canadian Census Public Use Microdata Files. The sample is restricted to non-minorities born in Canada in the years 1946 to 1955 inclusive who report positive wage income. All regressions contain census year, year of birth, and province of birth main effects, as well as census year – year of birth interactions. Treatment is assigned based on province of birth rather than province of residence.

Table 8 – Estimating the Value of Experience

	Primary Control Group: Anglophone Quebec vs. Canada excluding Quebec			Synthetic Control Group: Anglophone Quebec vs. Weighted Average of Ontario and Francophone Quebec				
	Males		Females	Males		Females		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Dependent Variable is Log of Hourly Wages							
	FTFY	All Earners	FTFY	All Earners	FTFY	All Earners	FTFY	All Earners
Years of Education	0.072 (0.001)**	0.070 (0.002)**	0.093 (0.002)**	0.097 (0.002)**	0.076 (0.001)**	0.074 (0.002)**	0.095 (0.002)**	0.101 (0.002)**
Experience * Data Year 1986	0.054 (0.007)**	0.052 (0.010)**	0.026 (0.013)**	0.016 (0.015)	0.043 (0.008)**	0.056 (0.010)**	0.034 (0.011)**	0.021 (0.011)*
Experience * Data Year 1991	0.026 (0.008)**	0.029 (0.009)**	0.028 (0.009)**	-0.001 (0.011)	0.030 (0.006)**	0.021 (0.006)**	0.020 (0.011)*	0.015 (0.011)
Experience * Data Year 1996	0.006 (0.011)	0.002 (0.012)	0.011 (0.015)	-0.011 (0.015)	0.008 (0.009)	-0.010 (0.010)	0.008 (0.016)	-0.008 (0.019)
Experience <sup>2</sup> * Data Year 1986	-0.001 (0.000)**	-0.001 (0.000)**	0.000 (0.000)**	0.000 (0.000)	-0.001 (0.000)*	-0.001 (0.000)**	0.000 (0.000)	0.000 (0.000)
Experience <sup>2</sup> * Data Year 1991	0.000 (0.000)	0.000 (0.000)	-0.001 (0.000)**	0.000 (0.000)	0.000 (0.000)*	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Experience <sup>2</sup> * Data Year 1996	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)**	0.000 (0.000)	0.000 (0.000)
Number of Observations	57884	66762	38445	57153	54185	62046	35756	52022
	Average Impact of a Lost Year of Experience on Anglophone Quebecois Born after 1950							
In Census Year 1986	0.026	0.026	0.015	0.012	0.028	0.031	0.021	0.018
In Census Year 1991	0.018	0.018	0.009	0.005	0.020	0.019	0.011	0.012
In Census Year 1996	0.012	0.011	0.007	0.005	0.013	0.012	0.009	0.009

\* significant at 10%, \*\* significant at 5%

Notes: Standard Errors are corrected for province of birth – year of birth clustering. The data are from the 1986, 1991, and 1996 Canadian Census Public Use Microdata Files. The sample is restricted to non-minorities born in Canada in the years 1946 to 1955 inclusive who report positive wage income. All regressions contain census year and province of birth main effects. Geography is assigned based on province of birth rather than province of residence.