University tuition fees and student work patterns: updated evidence from Canada

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Abstract. This study uses 1980-2011 Labor Force Survey data to investigate the effect of rising university tuition fees on student work patterns in Canada. The main results indicate that tuition fees do not affect either average hours worked or the probability that a full-time university student combines study with employment. Two potential reasons for these inconclusive results are explored in this study: the measurement of the tuition fee variable, and the compositional change in student body due to rising tuition fees. This study has two main contributions: first, it serves as an update to the limited literature that examines the direct effect of university costs on student work patterns; and secondly, it adds to literature that takes into account the endogeneity of tuition fees.

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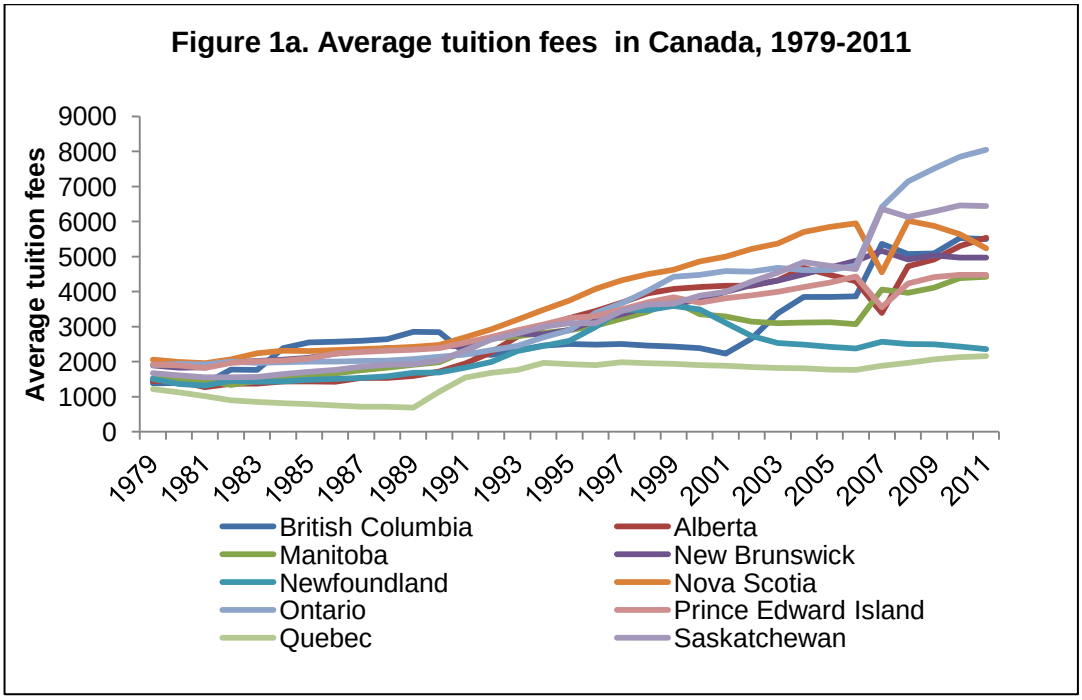
1. Introduction

Canadians have witnessed significant, yet disproportional increases over provinces in university tuition fees over the past three decades (Figure 1a). The variation in average tuition fee hikes ranges from 55% in Newfoundland to 284% in Alberta between 1980 and 2011, and it produces a number of implications.[1] Studies of Neill (2009) and Coelli (2009) report significant decreases in student enrollment rates caused by hikes in average tuition fees, especially for those who come from low-income/low-educated families. In a first study of its kind, Dooley *et al.* (2012) find that higher cost universities attract a higher share of students from high-income neighbourhoods, indicating a potential change in universities' student body demographics in the long-run. Neill (2006), the only study that uses Canadian data to estimate the effects of tuition fees on student work patterns, reports positive and significant results. Neill's findings suggest that 100% rise in tuition fees increases the probability a full-time university student works by 9.2 percentage points. These implications have repercussions of their own; increases in average hours worked are linked to lower GPA (Stinebrickner and Stinebrickner 2003, DeSimone 2009) and higher drop-out rates (Dustmann and van Soest 2007).

Over the same period of time, the percentage of students who combine full-time university with work has increased from approximately 20% in 1980 to 40% in 2011 (Figure 1b). Additionally, for those who work the average number of hours worked per week has also steadily increased.[2] Thus, the purpose of this paper is to investigate whether these changes are attributable to the rises in average tuition fees in the past three decades. To this end, I extend the study of Neill (2006) using 1980-2011 Labour Force Survey (LFS) data on 20-24 year old full-

[1] Percentages calculated using weighted average tuition fees from the Tuition and Living Accommodation Costs for Full-time Students at Canadian Degree-granting Institutions (TLAC) survey.
[2] These trends are discussed in detail in section 3; please see Figures 10 and 11.

time university students.[3] The main finding of this study is that rising tuition fees do not explain the variation in student work patterns. When compared to the time period covered by Neill (2006), estimates are similar in size and statistical significance. The measurement of the tuition fee variable, which was changed in 2006-2007, and enrollment rates are deemed as possible causes of the statistically insignificant results in the main sample. I investigate this possibility in sections 4 and 5.



The main contribution of this study is that it uses longer and newer cross-sectional data to investigate the link between cost of university and student work patterns. The extended time period, provides a good opportunity to investigate the relationship, since there is significant variation in tuition fees between 2003 and 2011. The second contribution is that it takes into account the endogeneity of tuition fees due to omitted variable bias and uses provincial political party in power as an instrumental variable. This paper finds that the IV estimates are larger but

[3] Neill (2006) uses 1980-2003 LFS Master Files data.

consistent with the OLS ones, across all samples. The rest of the paper is organized in the following way: section 2 reviews a number of relevant studies; section 3 discusses data sources, variables used in the model and descriptive statistics; in section 4 I introduce the empirical models along with several specifications; section 5 presents the results and compares them to estimates from relevant studies; and section 6 summarizes and concludes.

2. Literature review

Potential implications of rising university tuition fees vary from enrolment decisions to employment patterns, to choice of university. However, not all of these implications have received equal attention from researchers. While effects of rising tuition fees on enrolment rates have been at the centre of research (Neill 2009, Johnson and Rahman 2005, Hemelt and Marcotte 2011), little interest has been given to whether they impact other aspects such as employment patterns or choice of university . Yet, all of these implications have consequences of their own and on each other. For example, rising tuition fees can affect the choice of university, which can consequently lead to a decrease in the quality or quantity of programs offered by institutions (Dooley *et al*, 2012). What follows is a discussion on a number of studies that have looked at these implications in detail.

2.1 Tuition fees and enrollment rates

As explained, the majority of studies on tuition fees focus on access to higher education. This is due to the implications this relationship entails. In particular, a negative and significant effect can lead to marginalization and could signal less access to education for certain socio-economic groups. For example, rising tuition fees could deter individuals who do not qualify for student loans or who do not have parental financial support, from enrolling. Over time, this type

of trend could further lead to a different student body composition. This is problematic, since the majority of research on this topic indicates that there is a significant and negative relationship between tuition fees and enrolment rates. This is especially true in US literature, where studies like Hemelt and Marcotte (2011), Kane (1995) and Heller (1999) find that tuition fees decrease enrollment rate by a significant amount.

Hemelt and Marcotte (2011) use panel data to investigate the following: tuition elasticity of enrollment, variation in enrollment rates by institution, and the effect of large tuition hikes. They the 1994-2006 Integrated Postsecondary Education Data System (IPED) which contains extensive data on US students registered in 4-year public universities. The main finding of the study is that rising tuition fees have a negative, but small effect on enrollment rates; an increase in tuition of $1000.00 is associated with a decrease in enrollment rates of 2.5% (Hemelt and Marcotte, p. 452). An older study by Kane (1995) finds that $1,000 increase in tuition fees translates into a decrease in enrollment rate of 2.4 percentage points. Hemelt and Marcotte (2011) further find that tuition fees have a larger effect on enrollment rates at research-intensive and top 120 universities. On the other hand, Kane (1995) disaggregates the data by post-secondary type, and reports that tuition fees hikes have more negative effects on 2-year compared to 4-year college enrollment rates. Kane (1995) links his findings to the fact that financial aid for those most likely to be affected by hikes in tuition fees has a marginal effect on the enrollment rates of those individuals.

In contrast, Canadian literature on the topic has been inconclusive; studies like Neill (2009), Johnson and Rahman (2005) and Coelli (2009) find negative and significant estimates only under particular specifications, whereas Christofides, Cirello and Hoy (2001) report no

effect.[4] This inconclusiveness may be due to the limited Canadian data on students and parents characteristics, such as education and income (Coelli, 2009, p. 1077). Since these variables could explain demand for university, their use in the models could diminish the endogeneity of tuition fees (p. 1089). This is especially problematic since studies have found a strong link between parental education and university enrollment rates (Neill 2009, Finnie, Laporte and Lascelles 2004). Canadian studies that have looked at the relationship between parental income and enrollment rates have found mixed results; Christofides, Cirello and Hoy (2001), Drolet (2005) and Rivard and Raymond (2004) report no link, while Coelli (2009) finds statistically significant estimates. In any case, the inclusion of these variables has been supported by most studies, but it has also been hindered by their availability in Canadian surveys. With the exception of the Survey of Labour and Income Dynamics (SLID), the majority of the other surveys either record data on one of the variables or only on specific youth categories (LFS and SCF).

Neill (2009) and Johnson and Rahman (2005) studies use LFS data. Neill (2009) uses LFS master files, whereas Johnson and Rahman (2005) use LFS public files. The advantage of the LFS master files is that it records information on parental education for students living at home, whereas the public ones do not. Both studies reach similar conclusions – that tuition fees negatively affected enrollment rates of university students – but, under different specifications. Neill (2009) treats tuition fees as an endogenous variable, and uses political party power as an instrumental variable. The choice of instrument seems appropriate, as the decision over tuition policies largely depends on the political party in power at the provincial level. However, there is a possibility that the instrument may affect the demand for university through policies directed at university or student support spending (Neill, 2009, p. 563). To test for this, Neill (2009)

[4] Neill (2009), Johnson and Rahman (2005), Coelli (2009) find significant negative effects when they use instrumental variable approach, province-specific time trends, and a differencing method, respectively.

regresses each political party on university spending, student support, faculty per capita, and unemployment rates of high school and university graduates (p. 567). The results indicate that the instrument does not have a significant effect on the demand for university.[5] Data on tuition fees come from the Tuition Fees and Living Accommodations Survey (TLAC) and the variable is measured as a weighted average of Arts and Science tuition fees, within provinces. The IV estimates indicate that a $1,000 increase in tuition fees decreases the enrolment rate by 2.5 to 3 percentage points. When the model specification includes parental education, the effect jumps to 4 percentage points for those whose parent has some post-secondary education compared to other groups.[6] Neill (2009) links this unexpected finding to the fact that individuals with low-educated parents are more likely to get financial support due to parents' low earnings, reason for which a hike in tuition fees would not affect their enrollment rates. Parents who have some post-secondary education may earn just enough to not qualify for financial support, nor be able to finance their child's education. In this particular case, hikes in tuition fees have a more negative effect on enrollment rates. Lastly, Neill (2009) finds that increases in tuition fees have a larger effect on the enrolment rates of those who become eligible to attend university, in comparison to the effect on those who are further along in their studies.[7]

Johnson and Rahman (2005) treat tuition fees as an exogenous variable, and use province-specific time trends to measure whether rising tuition fees have contributed to the change in the probability of university attendance. Unlike Neill (2009), they use the LFS public use files, which contain no information on parental education or income. For this reason, the study concentrates on estimating a set of economic factors that affect enrollment rates:

[5] This is only indicative of a valid instrument, as the validity of exclusion restriction cannot be tested.
[6] Some post-secondary education does not include university or higher degree (Neill, 2009).
[7] Eligibility to attend university refers to those who are 18-19 years old in Neill (2009).

opportunity costs (wages), payoffs (wages and unemployment gap), and student support. The main finding of the study is that these three variables are key determinants of tuition fees within provinces over time. Furthermore, rising tuition fees significantly reduces the probability of enrollment only when province specific time trends are included; otherwise, the effect is significant and positive (Johnson and Rahman, 2005). When the data is disaggregated by age, the estimates further show that tuition fees have a larger, negative effect on the enrolment rates of 17, 18, and 19 year old students, compared to older groups (Johnson and Rahman, 2005, p. 122). This result is consistent with Neill (2009).

Coelli (2009) uses 1993-2004 SLID data because the survey is rich in information on both parental education and income. Time and province fixed effects are used in a reduced form model, to exploit the variability of tuitions fees across cohorts within provinces. Estimates show that the increase in tuition fees had a small and insignificant effect on the probability of enrollment, even in specifications that included university support, cohorts, and students/parental characteristics. Coelli (2009) uses differencing technique to analyze whether the effect of tuition fees on enrollment rates is larger for students with low-income background. The results from this approach suggest that rising tuition fees have a large, negative effect on students from low-income families, as compared to high-income ones. In particular, these estimates show an increase of $1,000 in tuition fees lowered the probability of university enrollment by 13 to 17 percentage points for the low-income group (Coelli, 2009).[8]

As discussed in the beginning of this section, there are a number of studies that have found no statistically significant link between income or tuition fees (by income groups) and enrollment rates. Rivard and Raymond (2004) use the 1997-1999 Youth in Transition Survey

[8] Parents from low-income groups earn less than $40,000/year, before taxes (Coelli, 2009, p. 1085).

(YTS) and find that neither parental income nor tuition fees affect the transition from high school to university or college. Christofides, Cirello and Hoy (2001) arrive at the same conclusion by using the 1975-1993 Survey of Consumer Finances (SCF) data.

2.2 Tuition fees and choice of university

One implication of rising tuition fees that has received little attention is choice of university to attend. Investigating this relationship is important for a number of reasons. First, as tuition has increased over the last two decades, so has the variation in fees across institutions. As Dooley *et al*. (2012) discuss in their study, this variation is mainly due to deregulation (in Ontario) and to the decision of universities to compete for academically strong students by offering guaranteed entry scholarships. As the quantity and amount of these scholarships increase, the question becomes what kind of students will these universities attract? In other words, a low cost of university can signal low quality and/or quantity of programs. This in turn, could lead to a change in the student body demographic; low cost universities could attract a disproportionate amount of unprivileged background students who qualify for scholarships.

Dooley *et al.* (2012) is the first study to investigate the relationship between rising tuition fees and choice of university. They define university cost as a tuition fee minus the guaranteed entry scholarship a student receives. The tuition data on Arts, Science, Engineering and Commerce programs is collected from the Council of Ontario Universities, the Statistics Canada TLAC survey, and university websites. Data on loans and scholarships comes from the Ontario Student Assistance Program (OSAP), the Ontario Universities Application Centre (OUAC), and the Maclean's Magazine Annual Report on Universities. The study finds that the link between cost and choice of university is statistically insignificant, with one exception of Science and

Engineering programs, at the highest grade range.[9] This finding further suggests that higher net cost of university does signal better quality programs.[10] As explained above, this is problematic as it can lead to a change in the student body demographic. In fact, the study further reports that higher cost of university attracts a higher share of students in Arts and Science programs who come from advantaged neighbourhoods (Dooley *et al*., 2012). Over time, these trends can significantly change the composition of students and the public image of educational institutions. Lastly, Dooley *et al*. (2012) discuss the possibility that students from advantaged backgrounds may disproportionally benefit from guaranteed entry scholarships (p. 757).[11] However, the study finds no such link.

2.3 Tuition fees and student employment pattern

Exploring the relationship between tuition fees and student employment pattern is important for several reasons. If students depend on employment to finance their schooling, this may impact their academic achievement. DeSimone (2008) finds that working in college 30 hours a week decreases the average GPA by one grade point. Stinebrickner and Stinebrickner (2003) show that working more than 10 hours a week has a significant, negative effect on grades.[12] Academic achievement in turn, can impact a student's decision to drop out. Dustmann and van Soest (2007) find that part-time work affects school-leaving decisions indirectly through test grades.

[9] It refers to students who qualified for scholarship at the 90-100 grade level.
[10] It follows from the finding that lower net cost does not attract a larger proportion of academically strong students (Dooley *et al.*, 2012).
[11] Dooley *et al.* (2012) explain this may be due to the positive correlation between student background and high school grades.
[12] I present results from US studies, as there are no studies that investigate the effect of tuition fees on academic achievement using Canadian data.

While these implications are relevant, only one study has looked into the relationship between tuition fees and student employment in Canada. Neill (2006) uses a final sample of 50,000 full-time university students from the 1979-2003 December LFS master files. Data from the survey contain detailed information on enrolment and employment status, parental education, job characteristics, parental employment status, unemployment rates, and a set of socio-economic characteristics. Data on tuition fees by institution is gathered from the Tuition Fees and Living Accommodations (TLAC) survey. Two dependent variables are constructed: first, it is the individual's number of hours worked per week; and secondly, it is a dummy variables coded one if the individual works for pay. The key independent variable is measured as the average of Arts and Science tuition fee across all university within a province. Overall, the study finds that tuition fees have a significant and positive effect on both the number of hours worked and the employment rates. In particular, a $2,000 increase in tuition fees increases the percentage of students working by 6.3% and the weekly hours worked by 1 hour (Neill, 2006, p. 24).[13] This increase in the number of hours worked per week may be detrimental to academic achievement, especially if an individual already works more than 10-15 hours a week, as pointed out by DeSimone (2008) and Stinebrickner and Stinebrickner (2003).

One unexpected result of the Neill (2006) study is that rising tuition fees have a smallest effect on the labour supply and enrolment rates of less-advantaged students, compared to advantaged ones. Estimates show that a 10% increase in tuition fees increases the probability of working for students whose parents have at least a university degree by 1.2 percentage points. The study attributes this result to the student loan programs that have increased students' allocations in response to tuition increases thus, concealing the true effect. For those whose

[13] Neill (2009) uses these estimates to be consistent with the actual tuition fee increases ($2,000 on average across provinces) that took place in the 1990s.

parents have high school or less, the estimated effect is negative. Compared to other groups, advantaged students also work more hours in response to higher tuition fees. Neill (2006) believes this may be due to the existence of credit-constrained individuals in the sample of advantaged students. Estimates further indicate that tuition fees have a diminishing marginal effect on the employment rates, indicating that there is a threshold above which hikes in tuition fees are no longer accompanied by substantial increases in employment rates (Neill, 2006).

The purpose of this paper is to investigate the effect of rising tuition fees on average hours worked by full-time university students. I use 1980-2011 Labour Force Survey for data on hours worked, unemployment rate, and student socio-economic characteristics. Data on tuition fees comes from the Tuition and Living Accommodations Costs for Full-time Students at Canadian Degree-granting Institutions (TLAC) survey.

3. Data

In this study I use 1980-2011 LFS data to investigate whether tuition fees affect student work patterns. The LFS is a mandatory cross-sectional survey carried out on a monthly basis across all Canadian provinces and territories. It has a multistage design: once each province is divided into geographical stratum, two processes take place in which clusters and dwellings are selected from each stratum (Statistics Canada, 2012). Within each household, data is collected on all individuals who are 15 years of age and older. The LFS is available in both master and public use files; this study employs the latter.[14] This is a disadvantage because the LFS public use files do not contain any information on parental education or income. The advantage of using the LFS over other surveys is its length and amount of data on variables such as: employment,

[14] The LFS master files contain (among other things) data on parental education only for students who live at home during their studies.

unemployment, number of hours worked, union status, occupations, student status, wages, as well as a number of socio-economic indicators such as age, sex, marital status, educational attainment, type of economic family, etc. Following Neill (2006), I use LFS data for the month of December only. This is because earlier months include students who drop courses (switch from full-time to part-time status) or programs.[15] The chance of dropping courses or dropping out of programs in December is smaller because, in some universities students cannot recuperate their tuition money, and there may be academic and financial repercussions associated with full-time/part-time status change.

In this study, the population of interest are 20-24 year old students who attend university in province *p* and time *t* on a full-time basis.[16] The choice of population is appropriate as approximately 30% of 20-24 year old individuals are full-time university students (table 1). The LFS data allows for construction of unemployment rates. Following Neill (2006), I create an unemployment variable for 25-29 year old high school graduates and one for 25-54 year old university graduates by year and province. It is important to include these variables in the model because they can impact the percentage of students who combine study with work and the number of hours worked. Consider the case of high unemployment rate for university graduates.[17] This may drive forward looking individuals to combine study with work in order to gain experience and be able to compete on the labor market after graduation.

Data on tuition fees come from the Tuition and Living Accommodation Costs for Full-time Students at Canadian Degree-granting Institutions (TLAC) survey. This provides accurate

[15] A change from full-time to part-time status may negatively impact students who are registered in co-operative education, receive scholarship or finance their studies through government loans.
[16] The LFS master files contain data on individual's age, rather than age groups, enabling Neill (2006) to use 18-24 year old full-time university students.
[17] Neill (2006) finds that high unemployment rates of university graduates significantly decrease the number of hours worked by full-time university students.

undergraduate and graduate tuition fee estimates by fields of study from 1976 to 2011. The survey was revised in 2006 to include a different subject classification in accordance with the Classification of Instructional Programs (Statistics Canada, 2012). As a result, the 2006-2007 TLAC includes 17 instead of 10 fields of study. In this paper, I combine the data from the two TLAC surveys and use the weighted average tuition fees of undergraduate programs deflated by provincial CPI (2002). The weighing process is achieved by using the total number of undergraduate students enrolled at degree granting institutions, within each province.[18] Because the LFS does not provide any information on the institution a student attends, or the program they are registered in, I use weighted average tuition fees charged for all undergraduate programs. This is a departure from Neill (2006) who uses average cost of undergraduate arts and science programs. There are two reasons behind my choice. First, since there are no data on program registration at institutions, one should not assume that all students pay the equivalent cost of an art or science program. Secondly, it allows me to see whether there are differences in tuition fees between programs.

Figure 1c presents the evolution of average university cost of arts, science and all programs. Significant differences in tuition trend by program are observed for a majority of provinces after 2005-2006. Given the time frame, these differences might be explained by the revision of the TLAC survey which took place in 2006. In any case, this implies that using average tuition fees charged for all undergraduate programs is appropriate in this study.[19]

Data on provincial minimum wage, student support, population, GDP and Consumer Price Index were collected from Canadian Socioeconomic database from Statistics Canada

[18] In particular, TLAC uses the most recent enrolment data available at the time the data were released.
[19] This also implies that using average tuition fees charged for undergraduate arts and science programs, as in Neill (2006), is also appropriate since the data range of the study is 1979 to 2003.

(CANSIM). The use of the student average wage in the model is important, as it is an opportunity cost. It represents the amount of money that a student could be making if he/she was not attending university. Thus, student wage can have a significant impact on the percentage of students who combine study with work, and the number of hours worked. Unfortunately, the LFS contains data on individual average hourly earnings after 1997, reason for which Neill (2006) suggests the use of provincial minimum wage as a proxy for student wage. Following Neill (2006), I use provincial minimum wage, deflated by provincial CPI (2002). Student support is another variable that varies by province and time and that could affect the percentage of students who work or the number of hours worked. It represents the amount of provincial expenditure dedicated to scholarships, bursaries, etc. There are two disadvantages to using this data: first, it is crude measurement of student support as it does not account for the amount of students who receive it; and secondly, it is only available up to 2001-2002. Therefore, I estimate an additional model with data from 1980 to 2002, which includes the student support variable. This allows me to investigate whether the estimated coefficient on tuition fees changes when the model controls for student support.[20]

Lastly, I take inspiration from the Neill (2009) study which takes an instrumental variable approach to deal with the endogeneity of tuition fees. In that study, the instrumental variable is provincial political party in power. This paper employs a similar approach; data on political party in power is taken from a collection of provincial electoral outcomes available on Wikipedia. Figure 2 displays the political party in power from 1976 to 2011, in each province. It is worth noting that the Progressive Conservative Party has been in power for 32 years in Alberta. As a robustness check, an IV regression is estimated on a sample that excludes Alberta. The validity

[20] Johnson and Rahman (2005) use this approach and find that, when the model includes the student support variable, tuition fees have a slightly larger effect on the probability of enrollment in university.

of the instrumental variable depends on its exogeneity and relevance. In other words, the instrument cannot be correlated with the error term in the main model, and is correlated with the endogenous variable (tuition fees). When these conditions are met, the exogenous variation in hours worked caused by tuition fees is identified. The model and reliability of the instruments are analyzed in Section 5.3.

3.1. Variables

This section describes how each variable is calculated. Individual characteristics enter the model as dummy variables. The unemployment rates are calculated by dividing the number of unemployed by the total labor force, given a specific population. Unemployment rate of high school graduates refers to individuals 25-29 years old who have a high school diploma or 11-13 years of schooling.[21] Likewise, the unemployment rate of university graduates refers to individuals 25-54 years old who have a university degree. The support variable is measured by the total provincial expenditure on student support, divided by the total number of 20-24 year old individuals. Provincial minimum wage, student support and tuition fees are deflated using provincial CPI (2002=100). The tuition fee variable enters the model in a logarithmic form. I construct a dummy variable coded one if the respondent has at least one unemployed family member. This variable is used in the model because those with unemployed family members are more likely to be credit constrained and thus, more likely to start working or increase work in response to rise in tuition fees.

[21] In the LFS, the educational attainment includes whether an individual has a high school diploma (12 years of schooling) or 11-13 years of schooling prior to 1990.

3.2 Descriptive statistics

Summary statistics in table 1 indicate a total number of 109,358 students attended university on a full-time basis from 1980 to 2011, of which approximately 42% are 20-24 years old. The final sample used in this study comprises of 46,320 20-24 year old full-time university students. From 1980 to 2011, on average 40.3% female and 33.3% male students combine full-time university with work, as indicated in Table 1. Figure 3 indicates that the percentage of full-time students who work has steadily increased over time. When the data is disaggregated by gender it shows that the increases in the percentage of male and female full-time students who work follow a similar pattern, and that throughout the period women are more likely to work (Figure 4).

There are considerable differences in the percentage of full-time students who work within each province. Figure 5 reveals that on average, the highest percentage (51%) of full-time students who work is found in Manitoba. Lowest percentages are reported by Newfoundland and New Brunswick. On average, females are more likely to combine full-time university and work compared to males, across all provinces (Figure 6).[22] When these percentages are plotted by province and year, Figure 7 reveals a steady increase over time in the percentage of students who work in all provinces. The fastest increases are noticed for Prince Edward Island and Manitoba. Further decomposition of work patterns reveals that an increasing percentage of full-time students who work part-time (Figure 8). The proportion of those who combine full-time work and full-time university is relatively small and constant over time (1%-5%).

[22] The highest difference between percentage of male and female students who work is observed in Alberta (15 percentage points).

Summary statistics for minimum wage, unemployment rates, student support per capita and average hours worked are available in table 2. Figure 9 displays student support as a percentage of university expenditures over time. Slight increases are noticed in all provinces. The trends are similar across all provinces with the exception of Saskatchewan, where expenditure dedicated to student support far exceeds the others.[23] Increases in the average hours worked by university students are observed over time, conditional on working and otherwise (figures 10 and 11).[24] When the data is further disaggregated by gender, it becomes clear that, on average full-time university males work more hours than females.[25] Relatively small increases in average hours worked are also noticed within each province, over time (Figure 14).

Figure 1a displays the evolution of tuition fees over time, within each province. Significant increases are noticed starting with 1990 across all provinces. Overall, average tuition fee is lowest in the province of Quebec, even with increases of over 120% between 1980 and 2011. Significant increases in the percentage of university full-time students who work are noticed from 1980 through 2011 (figure 1b). This represents a good opportunity to test whether the variation in employment rates is caused by the rise in tuition fees.

4. Empirical Strategy

The effect of tuition fees on hours worked by full-time university students is estimated using the following model:

$$H_{ipt} = \beta_0 + \beta_1 log\_tuition_{pt} + Y_{ipt}\rho + X_{pt}\sigma + \lambda_p + \varphi_t + \varepsilon_{ipt} \quad (1)$$

[23] This is observed after 1991.
[24] I use 2 as the minimum number of hours worked for an individual to be considered working
[25] Figures 12 and 13 display the trends.

where, H_{ipt} is the number of hours worked a week, by full-time student *i*, in province *p* and year *t*; or a dummy variable coded 1 if that individual works at least 2 hours a week.[26] Here, the unit time is a year from 1976 to 2011. $Log\_tuition_{pt}$ represents the average weighted tuition fee in province *p* and year *t*; it enters the model in a logarithmic form. Y_{ipt} is a set of dummy variables for sex, marital status, and whether there are one or more unemployed members in the family (excluding the respondent). The dummy variables are coded 1 if the individual if female, married or has at least one unemployed family member and zero otherwise, respectively. X_{pt} represents variables that vary by province and time and may affect the number of hours worked by full-time university students. These variables are: unemployment rate of high school graduates, unemployment rate of university graduates, student support, and minimum wage. Finally, λ_p and φ_t are sets of provincial and year dummies, respectively.

Both dependent variables are estimated using Ordinary Least Squares, LFS weights and robust standard errors. Since data on student support is available 1979-1980 to 2001-2002, it restricts the final sample to that time range. For this reason, each model is estimated using: a full-sample 1980-2011, a constrained sample from 1980-2002 without the student support variable, and a sample constrained by the student support variable. Using the constrained sample from 1980 to 2002 allows for comparison to the Neill (2006) results. Estimates of the full-sample will illustrate whether newer data confirms Neill's previous findings. The strength of the student support variable is tested by comparing the two constrained models. Finally, I compare estimates of all samples across a number of specifications.

There are reasons to believe that tuition fees are endogenous in equation (1), one reason being omitted variables that affect both hours worked and tuition fees. Neill (2006) believes one

[26] In the LFS, the respondent is identified as working if he is employed and at work.

such example is returns to education. Increased returns to education could lead to an increase in enrollment rates, consequently affecting both tuition fees and the number of hours worked. In other words, increased benefits to attending university (wages, employment rates, etc.). drive more individuals to enroll; in an attempt to financially cope with the increase in the demand for education, institutions increase tuition fees. This has different effects on the number of hours worked, depending on the student. Some may substitute time working for time studying, while others may combine study and work in response to the increased tuition fees. Johnson and Rahman (2005) use the unemployment gap between high school and university graduates as a "benefit" to attending university and find that it has a significant effect on the enrollment rates.

In this paper I use the provincial political party instrument suggested by Neill (2006). As previously discussed, a good instrument must meet two criteria. First, it must be correlated with the endogenous variable, conditional on the other independent variables. It is reasonable to believe this is the case, as the decision over tuition policies highly depends on the provincial political party in power.[27] Secondly, it is correlated with hours worked only through its effect on tuition fees. One reason why this may not be the case is that provincial governments may pass legislation that affects the work patters of university students (Neill, 2006). For example, if a political party's dogma is that tuition fees should increase and they pass that legislation, they may also have to increase government loans to students and expenditures to universities (Neill, 2006, p. 567). In that case, the number of hours worked by students may also be affected. Neill (2006) finds that political parties have a statistically insignificant effect on student support, and unemployment rates of high school or university graduates.[28]

[27] The 1st stage results in table 12 suggest a significant correlation between tuition fees and political party in power.
[28] As the exclusion restriction cannot be formally tested, the results found by Neill (2006) are only indicative of a valid instrument.

In terms of the estimation procedure, the following models are estimated:

$$log\_tuition_{pt} = \theta_0 + \theta_1 Party_{pt} + Y_{ipt}\vartheta + X_{pt}\Omega + \lambda_p + \varphi_t + \upsilon_{ipt} \quad (2)$$

$$H_{ipt} = \alpha_0 + \phi\widetilde{log\_tuition}_{pt} + Y_{ipt}\rho + X_{pt}\sigma + \tau_p + \psi_t + \epsilon_{ipt} \quad (3)$$

where, $Party_{pt}$ is a set of dummy variables coded 1 if that political party is in power in province *p* and year *t*, and zero otherwise. Equation (2) represents the first-stage equation: tuition fees are regressed on the instrument and the other independent variables from equation (1). Equation (3) is estimated as the first model, but the tuition fee variable is replaced by the predicted values from equation (2). The expectation is that a large portion of the variability in tuition fees is explained by political party ideology and that this consequently explains the change in hours worked.

5. Results

5.1 Ordinary Least Squares estimates

Table 3 presents OLS estimates of the effect of tuition fees on hours worked, for the full-sample 1980-2011. Estimates differ in size, sign, and significance depending on the combination of province/year fixed effects used. Without any province or year fixed effects, the relationship between tuition fees and hours worked is significant and positive, all other variables held constant. On average, a 10% increase in tuition fees translates into an increase of 0.06 hours worked by full-time university students per week. When only province fixed effects are used, the estimate remains significant and positive, but increases in magnitude (0.22). Controlling for both province and year fixed effects, a 10% increase in average tuition leads to a decrease of 0.027 hours worked by full-time university students, holding all other variables constant. Although the

relationship between tuition fees and hours worked is negative, the estimate is not significant. Conditional on being a full-time student, females work on average 0.94 hours more than males. Married students work on average 0.76 hours more than other groups. Students who have at least one unemployed family member work on average 1.23 hours less than those who have none. Higher unemployment rates of high school graduates have a significant (at the 5% level) and negative effect on the number of hours worked by university students.

Table 4 presents estimates of the effect of tuition fees on hours worked, for the two constrained samples. As previously explained, the full-sample is constrained to include data from 1980 to 2002 in order to compare the estimates with those of Neill (2006). The second constrained sample also runs from 1980 to 2002, since data on the student support variable is available only for that time range. As with the full-sample, estimates differ in sign, size and significance, depending on combination of fixed effects used. With no province or year fixed effects, the estimated coefficients for tuition fees in both constrained samples are positive and significant (1.22 and 0.51, respectively). With province and year fixed effects, both coefficients increase in size and remain significant at the 5% level. In the constrained 1980-2002 sample, a 10% increase in tuition fees increases average hours worked per week by 0.13 hours. Neill's estimated coefficient on hours worked is 1.63; it is significant at the 1% level and slightly higher than the one reported by this paper.

Estimates in table 4 further show that females work on average 0.72 hours more than males, which is similar to those reported by Neill (2006). Having at least one unemployed family member reduces average hours per week by 1.52 hours. This estimate is considerably higher and more significant than the one Neill finds; this may be possibly due to the different sample used

and to the way the variable is constructed in this study.[29] Higher unemployment rate of high school graduates is associated with fewer hours worked by university students. A possible explanation of this finding is related to the type of jobs most university students have. A large percentage of university students work in retail or food services; these jobs require skills that most high school graduates would have. It follows then that if there is a high unemployment rate for high school graduates, it would also affect the labor market of university students.

When the sample is constrained so that student support can be included in the regression, the estimates remain unchanged in both size and significance (table 4). A 10% increase in tuition fees is associated with an increase of 0.13 hours in average hours worked per week. The estimated coefficient on student support is positive, but not statistically significant. This may indicate that increases in expenditure for student support over the years have not been substantial enough to impact students' work patterns. Since data on student support is available up to 2002, inference on whether increases since that time has impacted hours worked by students cannot be made.

I also test whether the estimated coefficient on tuition fee changes when other controls are included in the model. Specification (I) includes only the tuition fee variable. In Specification (II), (III), and (IV) individual characteristics are added. Specification (V) adds all province/year varying covariates. All specifications are run on the full-sample and include province and year fixed effects. Table 5 displays the results; the estimated coefficient on hour worked is negative and statistically insignificant across all specifications.

[29] Neill (2006) constructs the variable as the number of unemployed family members; in this study it is a dummy variable coded 1 if there are any unemployed family members and zero otherwise.

Overall, these estimates indicate that tuition fees do not have a significant effect on hours worked by university students, in the full sample. In both constrained samples, a 100% rise in tuition fees (similar to the rise observed in some provinces between 1980 and 2002) is associated with a 1.3 hour increase in average hours worked per week by full-time university students. This paper offers two possibilities as to the different results when the model is estimated with 1980-2011 and 1980-2002 data. First, estimates may differ across the samples due to the measurement of the tuition fee variable. As explained in the data section, the TLAC survey was re-designed in 2006-2007 to include a different program classification. As a result, the new variable may misrepresent total tuition fees when taken as a continuation of previous method of measurement. This is clearly noticed in graph 1a; there are dips and peaks of considerable size in the otherwise steady increase of tuition fees over time. These dips and peaks are noticed in the majority of provinces and they correspond to the 2006-2007 revision of the TLAC survey. To identify whether this is the reason, I run a regression using data from 1980 to 2011 and exclude 2006-2007 time period.[30] The estimated coefficient on tuition fees is positive, but small and statistically insignificant. A 10% rise in tuition fees is associated with a 0.001 hour increase in average hours worked (table 6). Thus, removing the 2006-2007 data from the model does nothing more than change the sign of the estimate.

The second possibility is that the decreasing trend in average hours worked noticed during 2002-2011 may have impacted the estimated coefficient on tuition fees in the 1980-2011 sample.[31] Since tuition fees increased during this period, they may have negatively impacted enrollment rates, especially for those who are more likely to work in order to finance their

[30] Since the changes in the TLAC that took place in 2006-2007 were permanent, it would also make sense to estimate a model with 1980-2005 data only; however, excluding all years after 2005 would leave only 2003-2005 of new data which allows for little variation in tuition fees.
[31] The decreasing trend in average hours worked between 2002 and 2011 is observed in graph 10.

studies. Neill (2009) and Coelli (2009) both find that increasing tuition fees between 1979 and 2003 had a negative and statistically significant effect on the enrollments. If the student population changes as tuition fees rise, it becomes harder to isolate the impact of tuition fees on working, conditional on attending university. When hours worked are regressed on tuition fees using data from 2002-2011, the estimated coefficient on tuition fees is negative and statistically insignificant. The results in table 6 indicate that a 10% increase in tuition fees is associated with a 0.023 hour decrease in average hours worked. This finding indicates that the rise in tuition fees may have had a large impact on enrollment rates between 2002 and 2011, thus changing the composition of the full-time university body. As such, some full-time university students may have switched to part-time university or college, or even have dropped out altogether in response to the rise in tuition fees.[32] If the students affected were those who most likely rely on working to finance their studies, then the true effect of rising tuition fees on hours worked is not being measured. Since there is no significant effect found in the 2002-2011, it is possible that this may mitigate or dilute the results in the 1980-2011 sample.

5.2 Linear Probability Model estimates

Table 7 displays estimates of the effect of tuition fees on percentage of students who work, for the full-time sample 1980-2011. Again, the estimated coefficients on tuition fees differ, depending on the fixed effects used. First, with no province or year fixed effects, tuition fees do not affect the probability a student works. When province or year fixed effects are used separately, the estimated coefficient on tuition fees becomes significant; in the first case it is negative. With both province and year fixed effects, the estimated effect becomes negative and

[32] Figure 3 shows a decreasing trend in part-time university students who work, and an increasing trend in full-time university between 1980 and 2011. Panel data would be more appropriate to investigate whether some full-time university students switch to other programs in response to rising tuition fees.

insigficant. An increase of 10% in tuition fees decreases the probability a student works by 0.14 percentage points. With the exception on minimum wage and being female, the estimated coefficients on all other covariates are not statistically significant. Females are 8.2 percentage points more likely than males to combine study and work, conditional on being a full-time student.

The LPM estimates from the two constrained samples show an entirely different trend (table 8). In the constrained 1980-2002 sample, without any fixed effects the estimated coefficient on tuition fees is positive and statistically significant. With both province and year fixed effects, a 10% rise in tuition fees increases the probability a student works by 0.85 percentage points. This estimate is similar in magnitude and statistical significance to the one reported by Neill (2006). Column 4 in table 8 further indicates that being female or having at least one unemployed family member has a significant effect on the probability that a full-time student works. Conditional on being a full-time student, females are 7.5 percentage points more likely than males to work. Having at least someone unemployed in the family decreases the probability a student works by 7.2 percentage points.

When the full sample is constrained by the introduction of the student support variable, the estimated coefficients on all covariates remain essentially the same (table 8, column 8). With the exception of the unemployment rate of high school graduates variable, all other remain statistically insignificant. The OLS estimates in table 4 report the same trend. This indicates that both the probability a university student works and hours worked are sensitive to the unemployment rate of high school graduates, rather than that of university graduates. Estimates in table 8 further show that controlling for student support does not impact the estimated

coefficient on tuition fees. This may indicate that the rise in student support between 1980 and 2002 was not large enough to impact students' employment.

I run the LPM model using the same specifications as in the previous section, to determine whether the estimated coefficient on tuition fees changes relative to the introduction of several controls. The results in table 9 indicate that the estimated coefficient remains negative and statistically insignificant across all specifications. A similar pattern is found when the dependent variable is measured as the number of hours worked.

Overall the LMP estimates presented in this study show that increases in tuition fees do not affect the probability of work for a full-time student, in the 1980-2011 sample. However, when the full sample is constrained to 1980-2002, the estimates show that a 10% rise in tuition fees increase the probability a full-time student works by 0.85 percentage points. As in the previous section, I test for the possibility that the measurement of the tuition fee variable contributed to the inconsistency of the estimates across samples. The probability a student works is regressed on tuition fees and all other variables using a full sample that excludes the 2006-2007 data. This corresponds to the time frame the TLAC survey was re-designed. The estimate is negative, small, and statistically insignificant, suggesting that the measurement of the tuition fee variable did not impact the estimates in the full sample (table 10, column 5).

Lastly, I investigate whether the negative trend in the percentage of students who combine study and work during 2002-2011 may have weakened the estimates in the 1980-2011 sample. The probability a student works is regressed on the usual covariates, using the 2002-2011 data. The results in table 9 show a negative and statistically insignificant relationship,

indicating that tuition fees may have impacted the probability a student works through factors like enrollment rates.

5.3 Instrumental Variable estimates

Table 11 displays the estimates from the 1st stage and 2SLS regressions. Across all samples, the political party in power has a significant effect on hours worked. Estimates from the full sample show that compared to when the Conservative Party is in power, tuition fees under Parti Québécois (PQ), the New Democratic Party (NDP) and the Liberal Party are 35%, 19%, and 8% lower, respectively. The estimated coefficients on the political parties keep their sign and significance, but change in magnitude when the full sample is constrained (columns 2 and 3). Nonetheless, compared to the Conservative Party, tuition under the PQ is still 16% lower. Note that there is no estimate on the Saskatchewan Party variable as this party was elected in 2008, and the constrained sample run from 1980 to 2002. Estimated coefficients on minimum wage and unemployment rates are statistically significant at the 0.1% level across all samples, indicating that they impact tuition fees. The F-tests of excluded variables are reported in table 13, under each sample. They are all greater than 10, indicating that the instrumental variables are jointly significant and can be considered not weak.

The second half of table 11 reports the 2SLS estimates. Overall, the results indicate that all estimated coefficients on tuition fees are positive, but statistically insignificant. In the full sample, a 10% rise tuition fees decreases the number of hours worked per week by 0.045 hours. A similar rise is associated with a 0.17-0.18 hours increase per week, in both constrained samples. Conditional on being a full-time student, females work on average more hours than males, across all samples. University students who have at least one unemployed family member

work on average 1.2-1.5 hours less per week. Additionally, married students work on average 0.7-0.8 hours less per week than other groups. The overidentification test reports a statistic of 9.703 and a p-value of 0.0049 (table 13). In this case, the null hypothesis that all instruments are valid is rejected only in the full sample at the 5% significance level.

OLS and IV estimates are presented together in table 12, for easy comparison. In the full sample, both the IV and OLS estimated coefficients on tuition fees are negative and statistically insignificant. These estimates change sign and increase in magnitude in both of the constrained samples, but again, they are not statistically different from zero. Across all samples, the IV estimated coefficients on tuition fees and their standard errors are considerably larger than the OLS ones. In the IV model, a 10% rise in tuition fees is associated with an increase in average hours worked by 0.18 hours, compared to 0.13 hours reported by the OLS estimates.[33] Across all models, the estimated coefficients on the female, family unemployment and marital status variables remain significant at the 0.1 and 1% level, respectively. Among economic variables, only the unemployment rate of high school graduates is significant at the 5% level. Overall, IV estimates of the effect of tuition fees on hours worked are considerably larger than the ones reported in this study (OLS, LPM), or those reported by Neill (2006).

As a robustness check, I run the IV regressions on a data set that excludes Alberta, since there is no variation in the political party in power in this province between 1980 and 2011. Estimates from the 1St Stage regression are similar to ones reported in the full sample (table 14). The 2SLS results indicate that a 10% rise in tuition fees is associated with a 0.05 hour decrease in average hours worked. This estimate is almost twice as large as the one estimated using OLS. The F-test in table 13 indicates that the instruments are jointly significant. The overidentification

[33] These estimates are displayed in columns 3 and 4, table 12.

test reports a statistic of 10.976 and a p-value of 0.027. Thus, the null hypothesis that the overidentification restrictions are valid is rejected at the 5% significance level.

6. Summary and conclusion

In this paper I have used 1980-2011 LFS data to investigate whether rising tuition fees explain the variation average hours worked per week and employment rate. The main result of this study is that rising tuition fees have a negative and statistically insignificant effect on average hours worked. A possible explanation of this result is that increases in tuition fees decrease enrollment rates in particular possibly for university full-time students (as found by Neill 2009, Coelli 2009, Johnson and Rahman 2005). As such, some full-time university students may have switched to part-time university or college, or may have even dropped out altogether in response to rising tuition fees. Significant changes in enrollment rates make it harder to isolate the effect of tuition fees on hours worked or on the probability a student combines study with work.

When the model is estimated using the 1980-2002 data, the results indicate a positive and statistically significant relationship between hours worked and tuition fees. A 100% rise in tuition fees (similar to increases that took place in some provinces between 1980 and 2011) is estimated to increase average hours worked per week by 1.3 hours. This result is consistent with that reported by Neill (2006). However, when the model is estimated using 2002-2011 data, the results indicate a negative and statistically insignificant effect on average hours worked. This may indicate that the rise of tuition fees between 2002 and 2011 had a large impact on enrollment rates of full-time students. Whether this led to full-time students switching to part-

time university or college is not being investigated in this paper, but should be addressed in future research.

When the dependent variable is measured as the probability a full-time university student works, the results follow a similar trend as the ones presented above. In the 1980-2011 samples, a 10% increase in tuition fees is associated with a 0.14 percentage point decrease in the probability a student works. When the full sample is constrained to include only 1980 to 2002 data, the estimated coefficient on tuition fees is positive and significant. A similar rise in tuition fees is estimated to increase the probability a student work by 0.85 percentage points. This result is consistent with the one reported by Neill (2006). Using data from 2002 to 2011, a time period when the percentage of students who work decreases, the relationship in question becomes negative and statistically insignificant. Again, this decrease could have been driven by tuition fees through enrollment rates, especially if those most likely to work were affected.

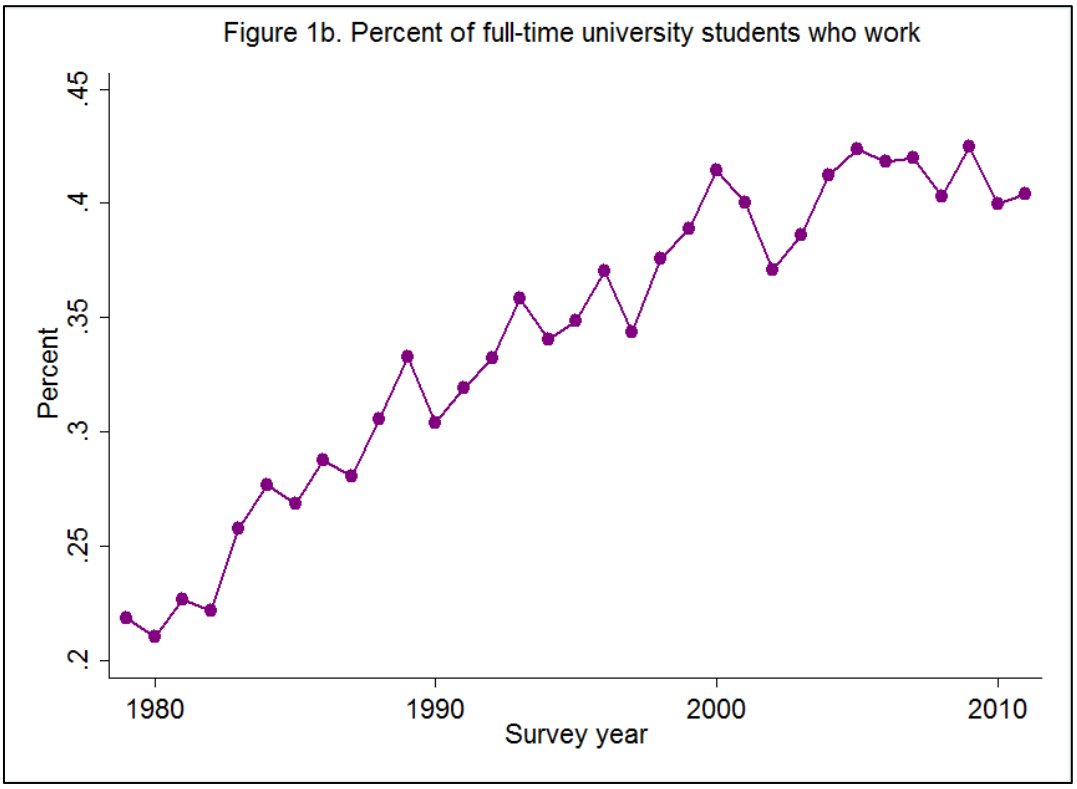
This study considers the possibility that tuition fees are endogenous, that is, that they are correlated with the error term likely due to omitted variable bias. For this reason, I investigate the effect of tuition fees on average hours worked using political party in power as an instrumental variable. The 1st stage estimates reveal that political party in power has a significant effect on tuition fees. Compared to when the Conservative Party is in power, tuition fees under almost all other parties are significantly lower. Generally, the IV estimates and their standard errors are slightly larger but consistent with the OLS ones, across all samples. This suggests that models which estimate the relationship between university cost and student work patterns should take

into account the endogeneity of tuition fees. An improvement to the IV approach in the study would be to estimation a system of equations as done by Neill (2009).[34]

Overall, the results presented in this study suggest that further research on this topic is necessary. The use of additional data on individual characteristics, such as parental income/education, whether a student is receives a government/bank loan, or what institution he attends, would greatly improve the model and give insight into which groups are more likely to be affected by the rise in tuition fees. It is also worth exploring additional factors that could impact hours worked, such as cohort size or business cycle. The use of panel data would benefit this analysis as one can investigate the effect of rising tuition fees on whether full-time university students switch to part-time university or college programs, or whether some of them drop out in response to rising tuition fees.

[34] This would entail estimating Equations (1) and (2) simultaneously, as a system.

Appendix A: Figures



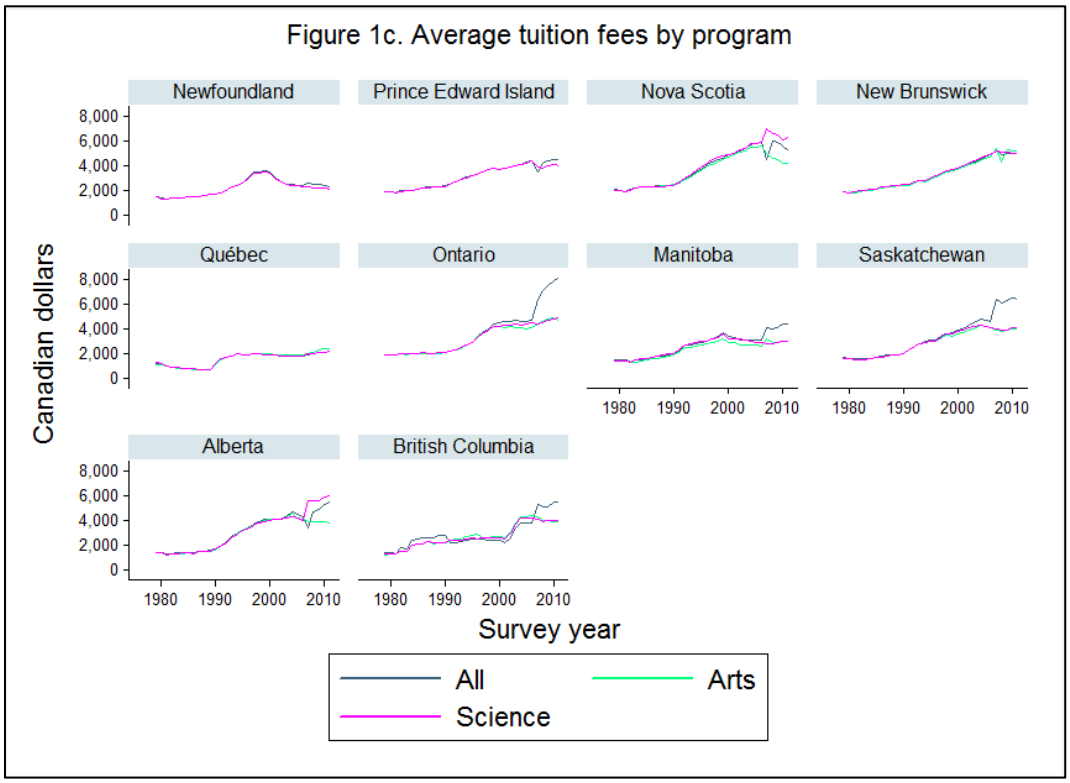


Figure 2. Political party in power, 1976-2011

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
AB	PC																																			
ON	PC															LIB																					
																NDP																					
																							PC													
																																	LIB			
QU	PQ															LIB																					
																							PQ													
																																	LIB			
BC	SC															NDP																					
																																	LIB			
SA	PC															NDP																					
																																	SKP			
MA	PC															NDP																					
																							PC													
																																	NDP			
NB	PC															LIB																					
																							PC										LIB			
																																				PC
NO	LIB															PC																					
																							LIB													
																																	PC			
																																				NDP
PEI	LIB															PC																					
																							LIB													
																																	PC			
NF	PC															LIB																					
																							PC													

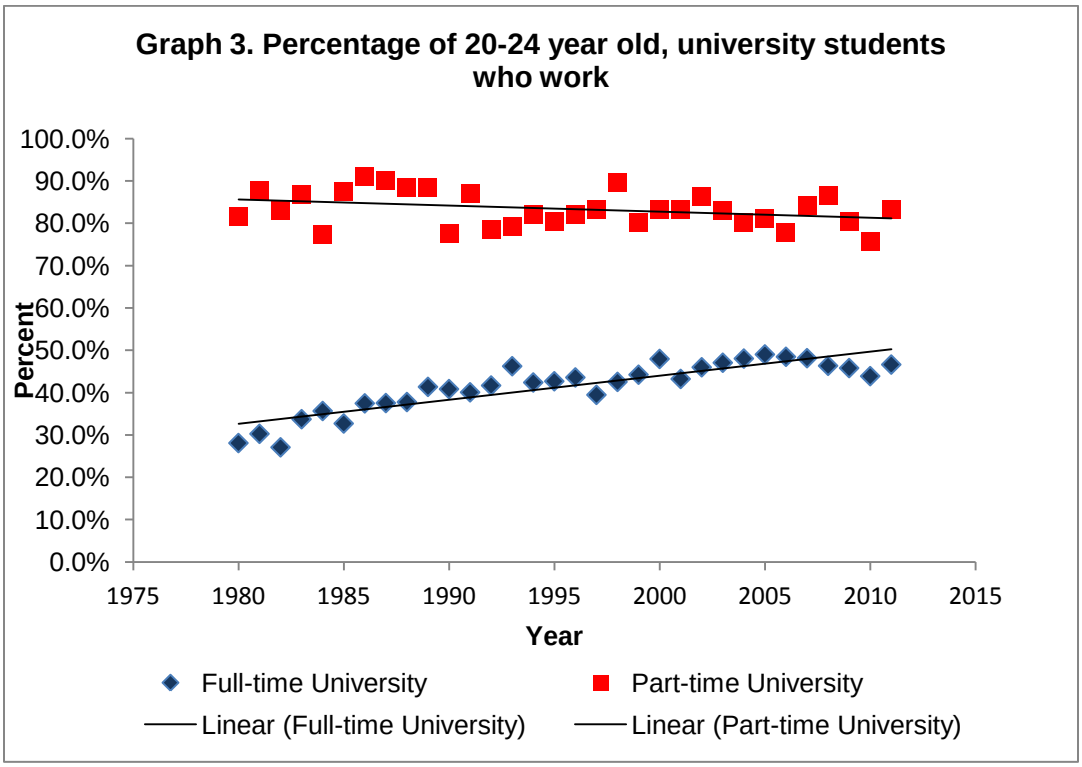


Figure 4. University full-time students, 20-24 years of age, employed by year and gender

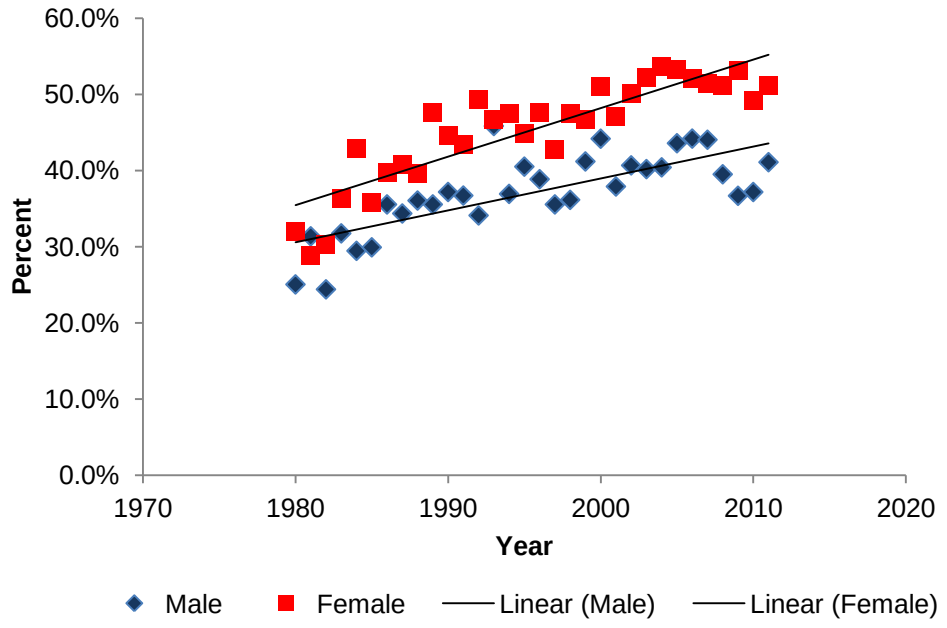


Figure 5. University full-time students, 20-24 years of age, employed, by province

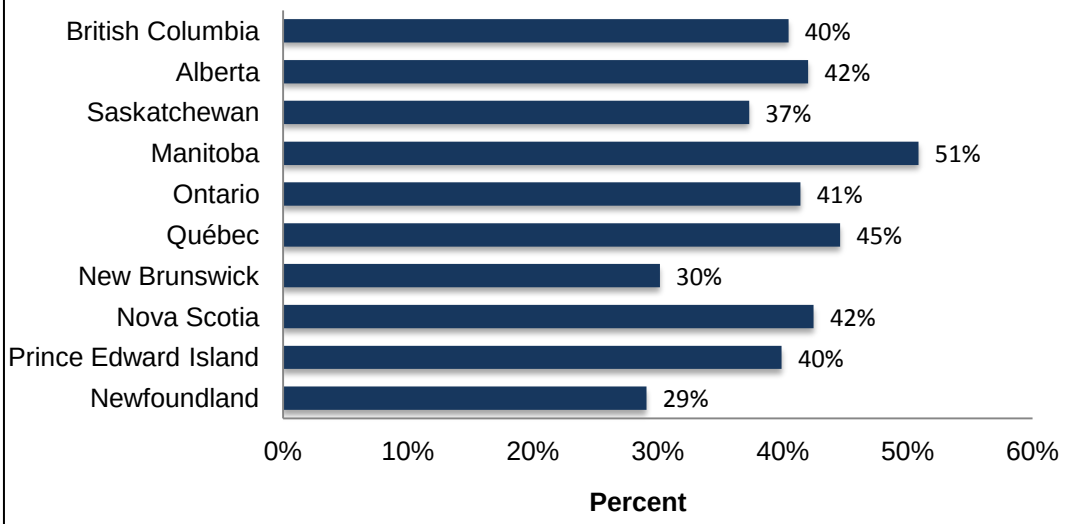


Figure 6. University full-time students, 20-24 years of age, employed, by province and gender

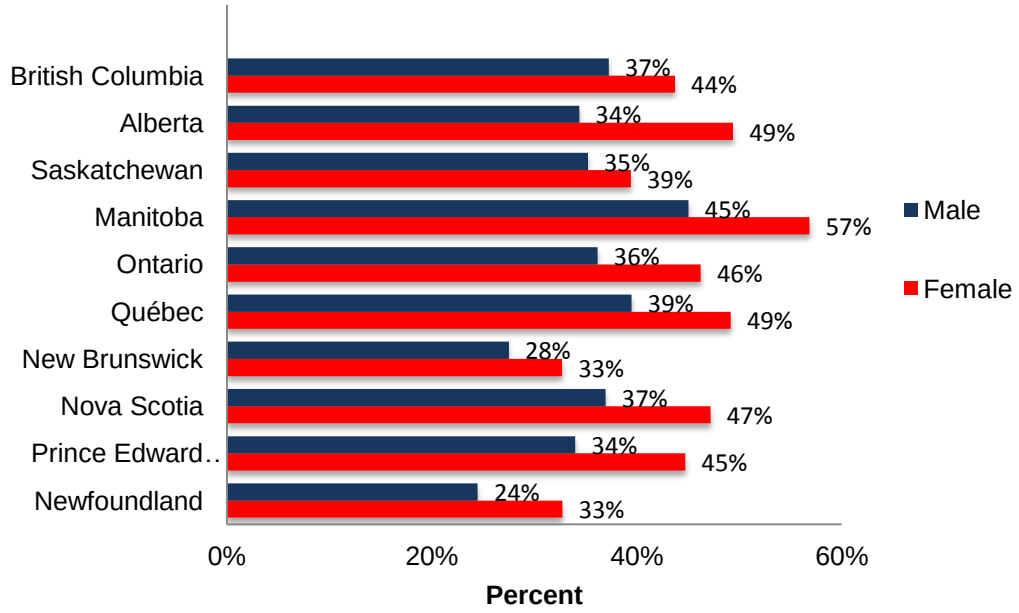
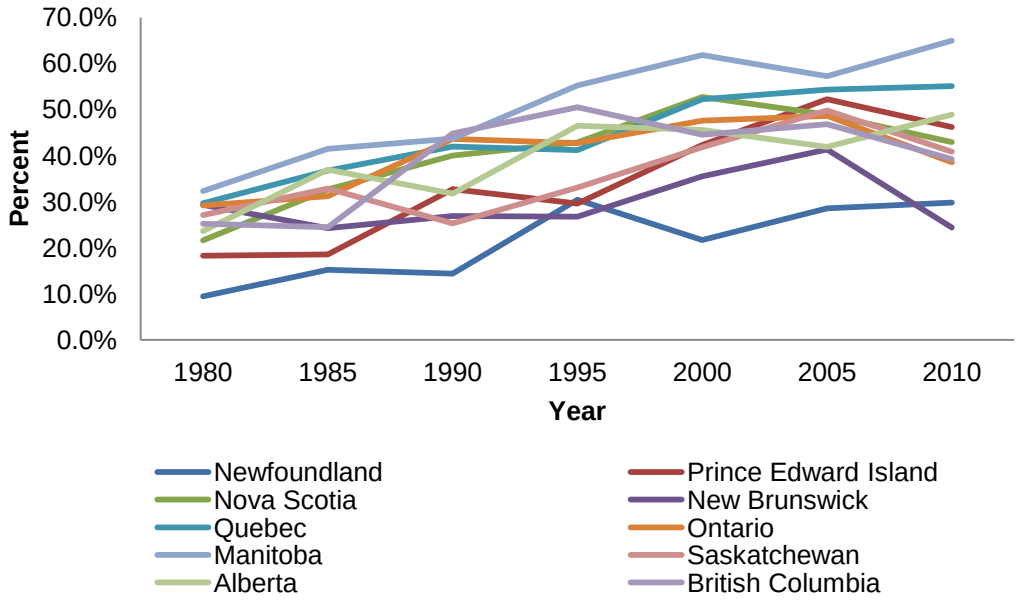


Figure 7. University full-time students, 20-24 years of age, employed, by province and year



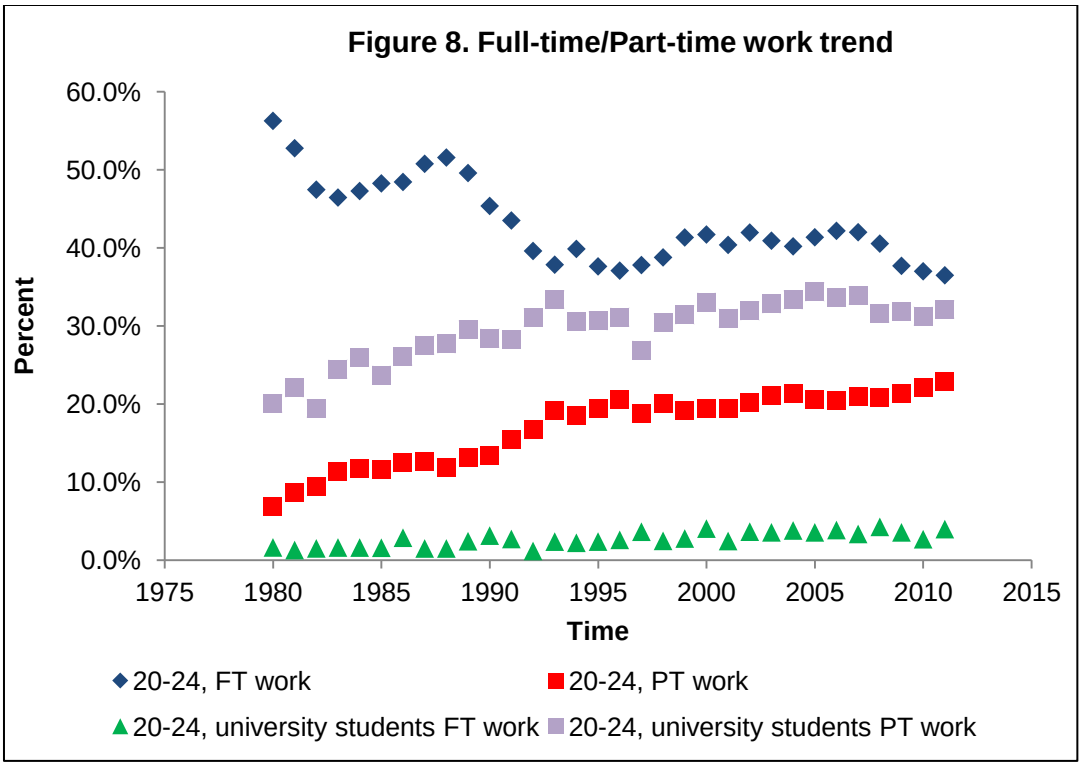


Figure 8. Full-time/Part-time work trend
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
Percent
1975
1980
1985
1990
1995
2000
2005
2010
2015
Time
20-24, FT work
20-24, PT work
20-24, university students FT work
20-24, university students PT work

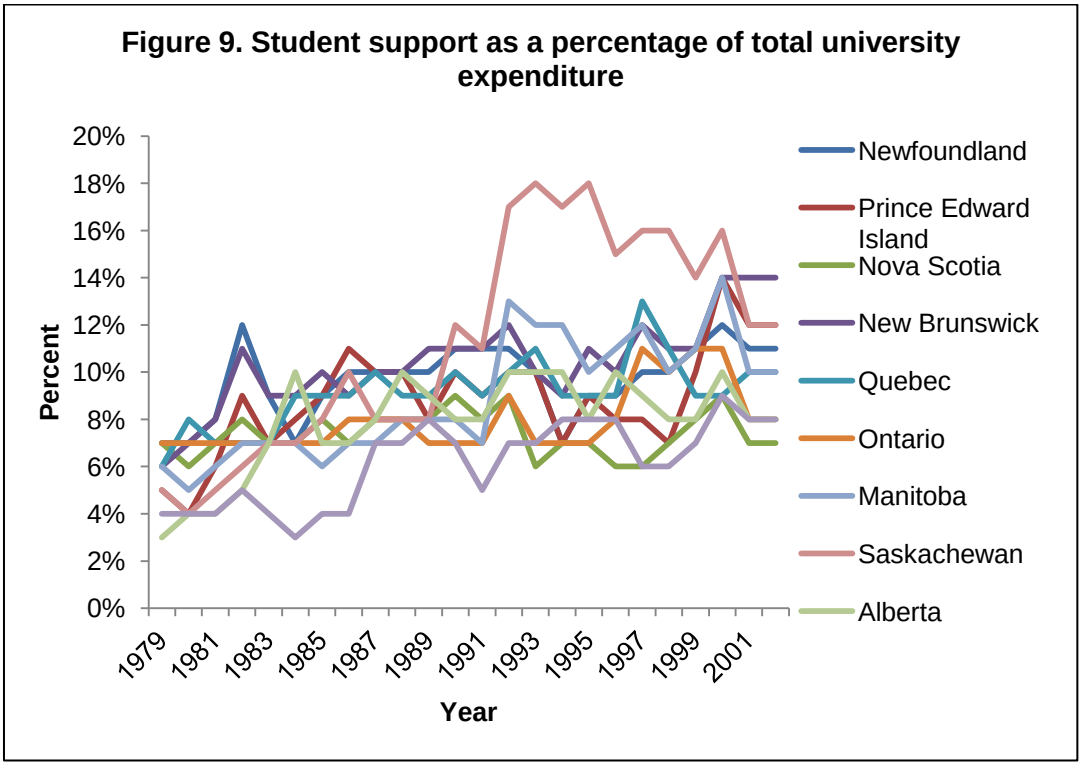


Figure 9. Student support as a percentage of total university expenditure
20%
18%
16%
14%
12%
10%
8%
6%
4%
2%
0%
Percent
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
Year
Newfoundland
Prince Edward Island
Nova Scotia
New Brunswick
Quebec
Ontario
Manitoba
Saskachewan
Alberta

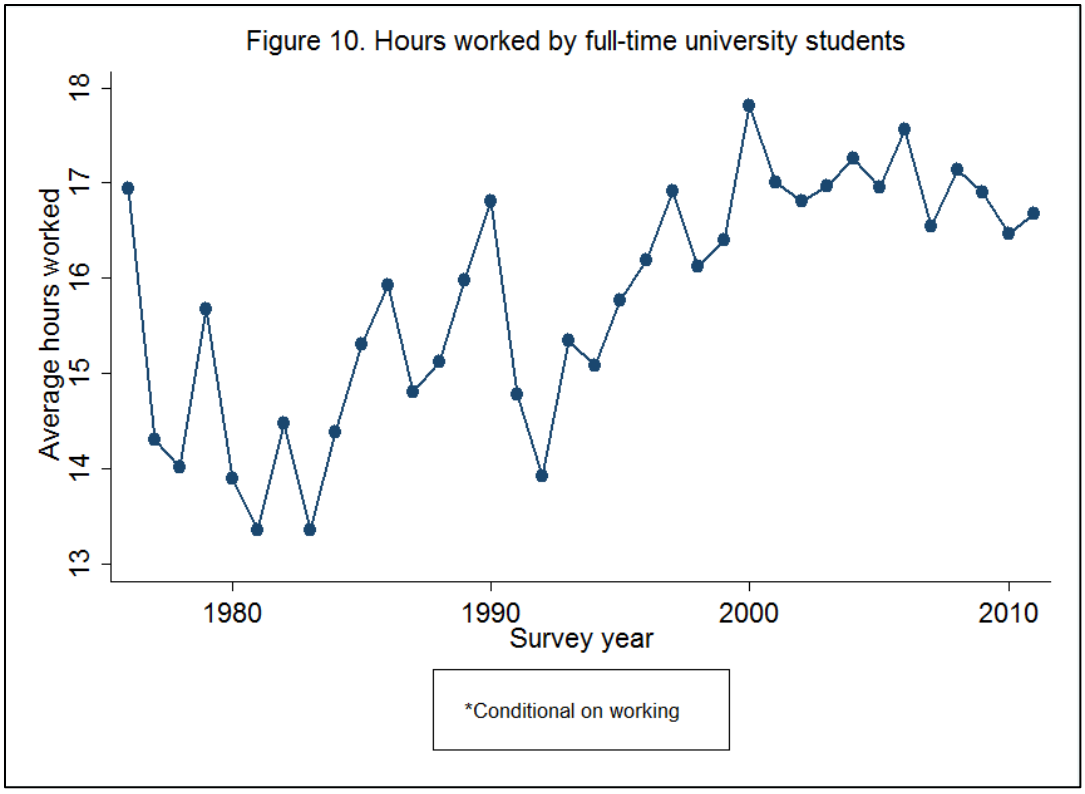


Figure 10. Hours worked by full-time university students
Average hours worked
13
14
15
16
17
18
1980
1990
2000
2010
Survey year
*Conditional on working

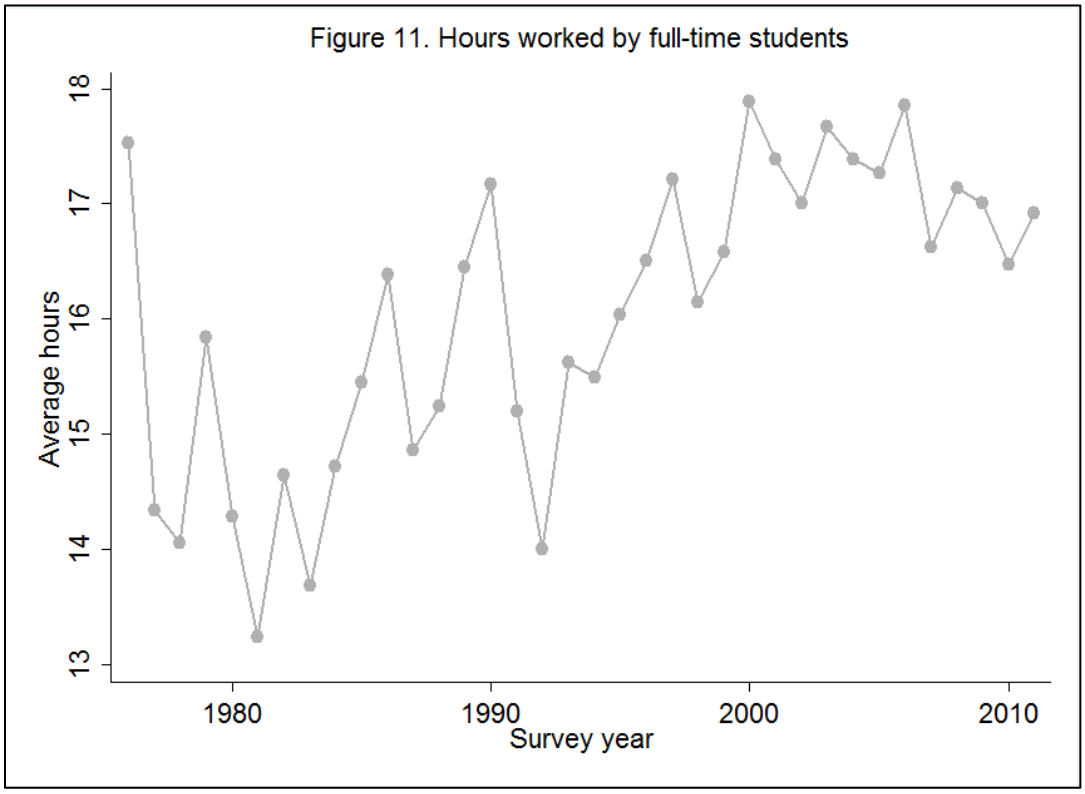


Figure 11. Hours worked by full-time students
Average hours
13
14
15
16
17
18
1980
1990
2000
2010
Survey year

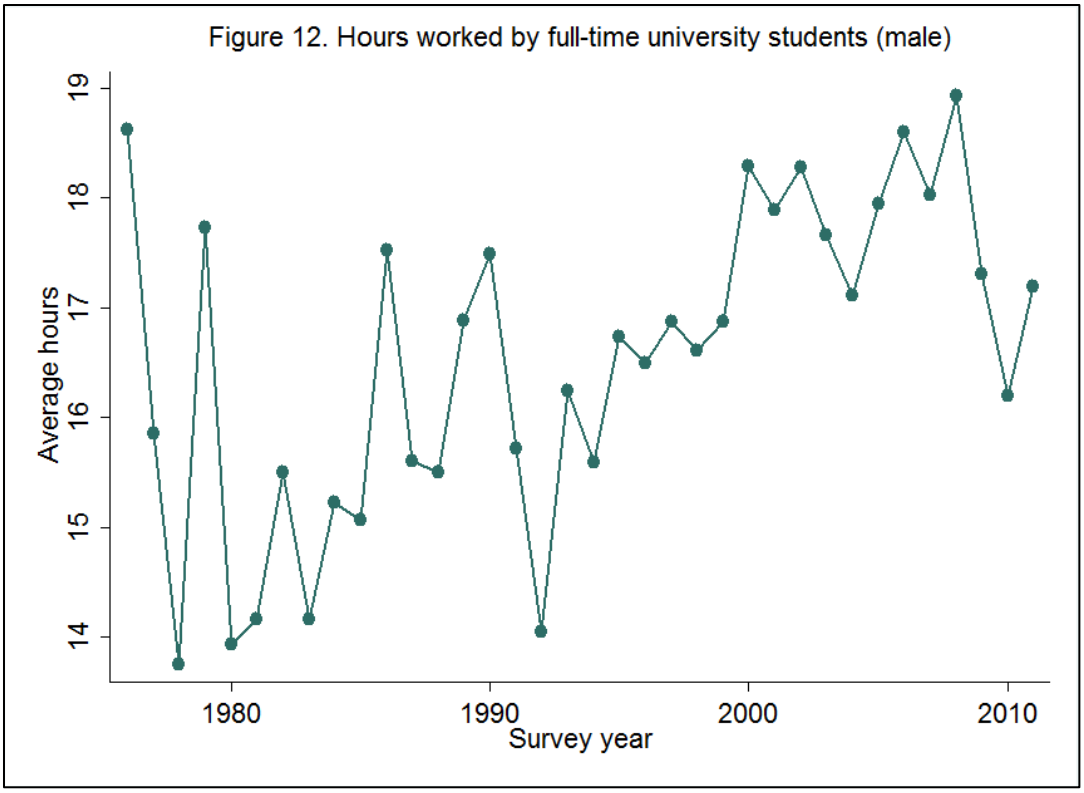


Figure 12. Hours worked by full-time university students (male)
Average hours
14
15
16
17
18
19
1980
1990
2000
2010
Survey year

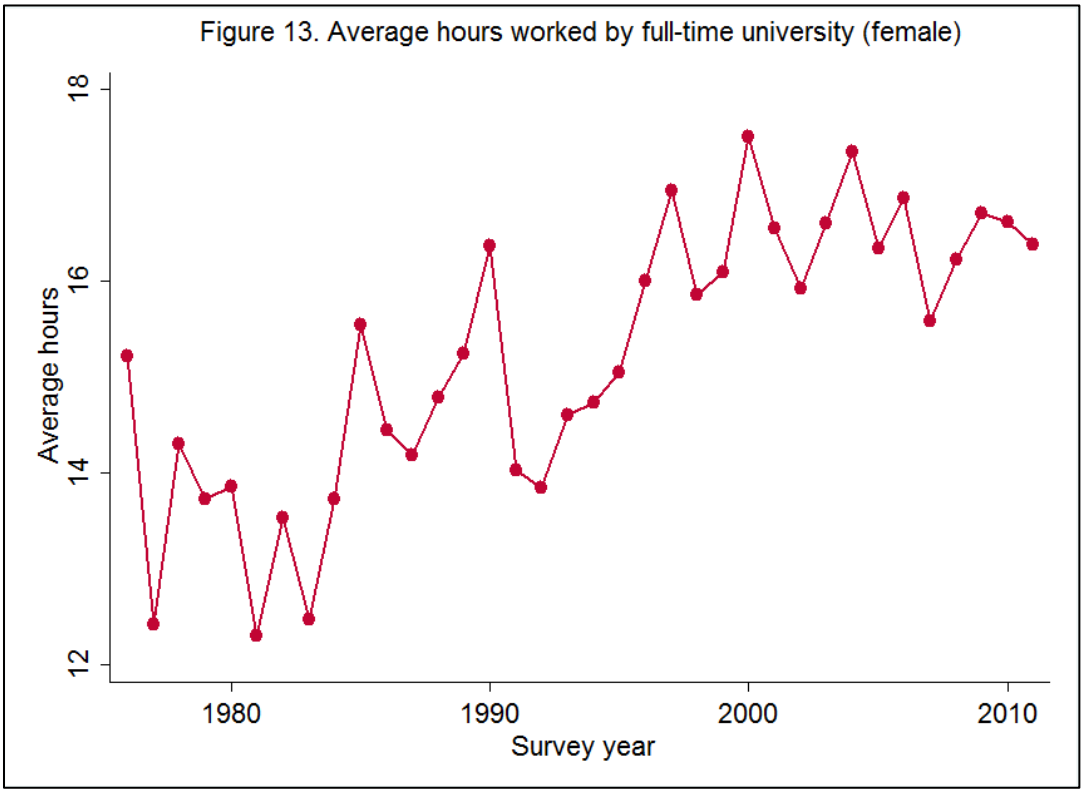
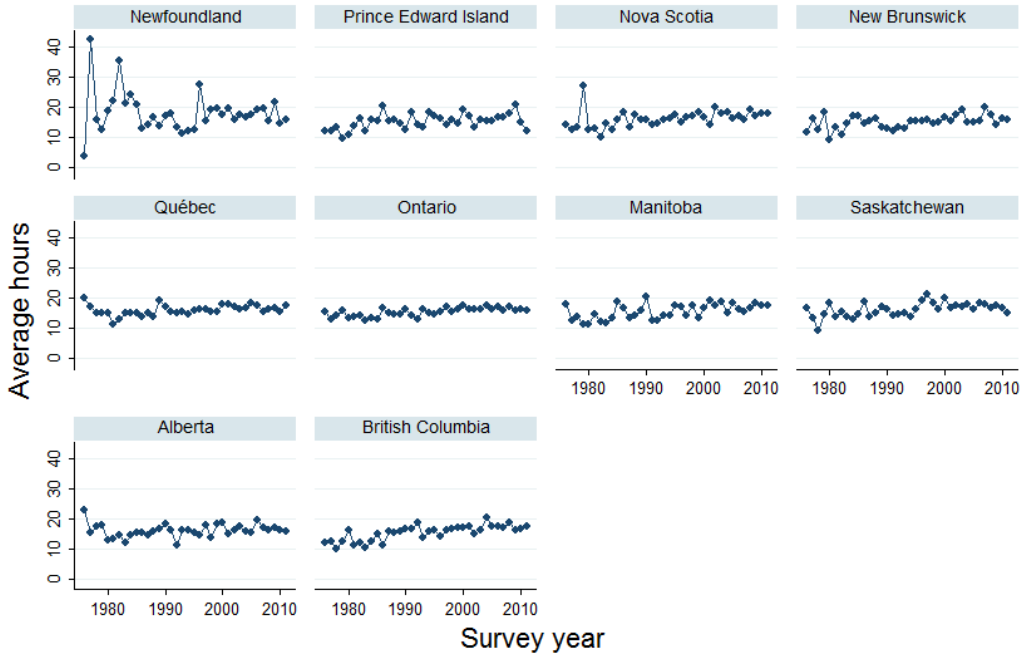


Figure 13. Average hours worked by full-time university (female)
Average hours
12
14
16
18
1980
1990
2000
2010
Survey year

Figure 14. Average hours worked by full-time university students



Appendix B: Summary statistics tables

Table 1. Summary Statistics: work characteristics

	Individuals		Final Sample
	Full-time university	*20-24 year old*	*Full-time, 20-24*
All	109,358	378,817	46,320
Work	35.40%	67.30%	36.84%
Work, female	38.20%	66.10%	40.30%
Work, male	32.30%	68.50%	33.31%
Work full-time	-	38.4%	2.4%
Work part-time	-	15.1%	26.1%
Unemployed family member	7.9%	13.7%	6.3%

All percentages are weighted by LFS weights

Table 2. Summary statistics: final sample

Aggregated data	*Observations*	*Mean*	*Standard deviation*	*Min*	*Max*
Minimum wage	46,320	7.11	.74	5.38	8.97
Average weighted tuition	46,320	3,333.89	1857.23	683.65	8047.71
Student support 1976-2002	31,325	563.37	231.97	115.85	1,596.6
Unemployment rate HS degree %	46,320	8.2	2.9	1.8	32.43
Unemployment rate U degree %	46,320	3.52	1.08	0.61	10.06
University full-time students					
Avg. hours worked	46,320	16.06	1.71	9.5	35.53
Avg. hours worked | work	16,609	16.37	1.64	10	35.21
Avg. hours worked, female	24,883	15.66	1.87	3.0	33.5
Avg. hours worked, male	21,437	16.66	3.09	4.0	40.0
Avg. hours worked, female | work	9,717	15.99	1.73	3.0	32.77
Avg. hours worked, male | work	6,892	16.96	2.46	4.1	40.0
Dummy variables					
Female	46,320	0.53	0.49	0	1
Marital Status	46,320	2.93	0.22	0	1
Unemployed family member	46,320	0.07	0.26	0	1

All percentages are weighted by LFS weights.

Appendix C: Estimates tables

Table 3. OLS estimates of the effect of tuition fees on hours worked, full-sample

	Full-sample 1980-2011			
log_tuition	0.667***	2.248***	-1.061***	-0.277
	(0.118)	(0.151)	(0.186)	(0.422)
Female	1.087***	0.997***	0.942***	0.938***
	(0.127)	(0.126)	(0.126)	(0.126)
Married	0.458	0.546	0.769*	0.764*
	(0.317)	(0.319)	(0.317)	(0.318)
minimum_wage	0.077	-0.368***	-0.093	-0.194
	(0.077)	(0.091)	(0.103)	(0.134)
Unemplhs	-0.169***	-0.123***	-0.124***	-0.085*
	(0.023)	(0.029)	(0.025)	(0.035)
Unemplu	0.268***	-0.056	0.056	-0.078
	(0.065)	(0.072)	(0.073)	(0.087)
student_support	-	-	-	-
	-	-	-	-
fam_unemployed	-1.304***	-1.275***	-1.229***	-1.232***
	(0.222)	(0.220)	(0.221)	(0.220)
Province FE	*No*	*Yes*	*No*	*Yes*
Year FE	*No*	*No*	*Yes*	*Yes*
Observations	46320	46320	46320	46320
R-sq	0.009	0.018	0.021	0.024
Constant	1.029	-8.203***	13.405***	7.329*

All regressions are weighted by LFS weights.

Robust standard errors are presented in parentheses.

* Significant at 5%; ** Significant at 1%; *** Significant at 0.1%

Table 4. OLS estimates of the effect of tuition fees on hours worked, by sample

	1980-2002				1980-2002 with support			
log_tuition	1.222***	2.785***	-0.493	1.339*	0.508**	1.359***	-0.452	1.304*
	(0.169)	(0.224)	(0.267)	(0.579)	(0.192)	(0.335)	(0.275)	(0.577)
Female	0.826***	0.754***	0.718***	0.716***	0.771***	0.742***	0.718***	0.718***
	(0.150)	(0.149)	(0.149)	(0.149)	(0.149)	(0.149)	(0.149)	(0.149)
Married	0.826*	0.788*	0.899**	0.887**	0.779*	0.807*	0.893**	0.882**
	(0.338)	(0.341)	(0.339)	(0.339)	(0.340)	(0.341)	(0.339)	(0.339)
minimum_wage	0.059	-0.225*	-0.070	-0.000	0.094	-0.135	-0.043	0.049
	(0.095)	(0.113)	(0.115)	(0.148)	(0.095)	(0.115)	(0.123)	(0.159)
Unemplhs	-0.128***	-0.069	-0.120***	-0.095*	-0.107***	-0.059	-0.119***	-0.094*
	(0.028)	(0.036)	(0.029)	(0.041)	(0.028)	(0.036)	(0.029)	(0.041)
Unemplu	0.310***	-0.042	0.083	-0.146	0.175*	-0.068	0.081	-0.162
	(0.074)	(0.085)	(0.083)	(0.103)	(0.073)	(0.085)	(0.083)	(0.102)
student_support	-	-	-	-	0.003***	0.003***	0.001	0.001
	-	-	-	-	(0.000)	(0.001)	(0.001)	(0.001)
fam_unemployed	-1.559***	-1.547***	-1.511***	-1.524***	-1.552***	-1.544***	-1.512***	-1.525***
	(0.229)	(0.227)	(0.227)	(0.227)	(0.227)	(0.227)	(0.227)	(0.226)
Province FE	*No*	*Yes*	*No*	*Yes*	*No*	*Yes*	*No*	*Yes*
Year FE	*No*	*No*	*Yes*	*Yes*	*No*	*No*	*Yes*	*Yes*
Observations	31325	31325	31325	31325	31325	31325	31325	31325
R-sq	0.009	0.018	0.020	0.023	0.014	0.019	0.020	0.023
Constant	-3.865*	-14.446***	9.063***	-5.540	-0.121	-5.846*	8.452**	-5.828

All regressions are weighted by LFS weights. Robust standard errors are presented in parentheses.
* Significant at 5%; ** Significant at 1%; *** Significant at 0.1%

Table 5. OLS estimates of the effect of tuition fees on hours worked, by specification

	(I)	(II)	(III)	(IV)	(V)
log_tuition	-0.330	-0.310	-0.356	-0.312	-0.277
	(0.389)	(0.388)	(0.388)	(0.388)	(0.422)
Female	-	0.956***	0.935***	0.935***	0.938***
	-	(0.126)	(0.126)	(0.126)	(0.126)
Married	-	-	0.809*	0.764*	0.764*
	-	-	(0.318)	(0.318)	(0.318)
fam_unemployed	-	-	-	-1.247***	-1.232***
	-	-	-	(0.220)	(0.220)
minimum_wage	-	-	-	-	-0.194
	-	-	-	-	(0.134)
Unemplhs	-	-	-	-	-0.085*
	-	-	-	-	(0.035)
Unemplu	-	-	-	-	-0.078
	-	-	-	-	(0.087)
Prov FE	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Year FE	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Observations	46320	46320	46320	46320	46320
R-sq	0.020	0.022	0.022	0.023	0.024
constant	5.496	4.897	5.164	4.973	7.330*

All regressions are weighted by LFS weights.

Robust standard errors are presented in parentheses.

* Significant at 5%; ** Significant at 1%; *** Significant at 0.1%

Table 6. OLS estimates, by sample

	1980-2011	1980/02 support	1980-2002	2002-2011	1980-2005 & 2008-2011
log_tuition	-0.277	1.304*	1.340*	-0.234	0.014
	(0.421)	(0.577)	(0.580)	(1.022)	(0.451)
Female	0.9382***	0.718***	0.716***	1.229***	0.998***
	(0.126)	(0.149)	(0.149)	(0.215)	(0.133)
Married	0.7639*	0.882**	0.887**	0.647	0.837*
	(0.318)	(0.340)	(0.340)	(0.839)	(0.330)
minimum_wage	-0.194	0.050	-0.000	-0.070	-0.150
	(0.134)	(0.160)	(0.149)	(0.271)	(0.137)
Unemplhs	-0.0853*	-0.094*	-0.095*	-0.120	-0.114**
	(0.035)	(0.041)	(0.041)	(0.064)	(0.036)
Unemplu	-0.078	-0.162	-0.146	0.131	-0.114
	(0.087)	(0.102)	(0.103)	(0.182)	(0.093)
student_support	-	0.001	-	-	-
	-	(0.001)	-	-	-
fam_unemployed	-1.232***	-1.525***	-1.524***	-0.730	-1.320***
	(0.220)	(0.226)	(0.226)	(0.429)	(0.227)
Province FE	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Year FE	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Observations	46320	31325	31325	16518	41186
R-sq	0.024	0.023	0.023	0.0121	0.025
Constant	7.330*	-5.828	-5.540	8.769	5.279

All regressions are weighted by LFS weights. Robust standard errors are presented in parentheses.

* Significant at 5%; ** Significant at 1%; *** Significant at 0.1%

Table 7. LPM estimates of the effect of tuition fees on probability of work, full sample

	Full sample 1980-2002			
log_tuition	0.010	-0.063***	0.082***	-0.014
	(0.006)	(0.009)	(0.007)	(0.021)
Female	0.088***	0.082***	0.084***	0.082***
	(0.006)	(0.006)	(0.006)	(0.006)
Married	-0.014	-0.003	-0.010	-0.003
	(0.014)	(0.014)	(0.014)	(0.014)
minimum_wage	0.005	-0.001	-0.020***	-0.015*
	(0.004)	(0.005)	(0.005)	(0.006)
Unemplhs	-0.008***	-0.007***	-0.004*	-0.003
	(0.001)	(0.001)	(0.001)	(0.002)
Unemplu	0.017***	0.004	0.002	-0.003
	(0.003)	(0.004)	(0.003)	(0.004)
student_support	-	-	-	-
	-	-	-	-
fam_unemployed	-0.062***	-0.060***	-0.061***	-0.060***
	(0.011)	(0.011)	(0.011)	(0.011)
Province FE	*No*	*No*	*Yes*	*Yes*
Year FE	*No*	*Yes*	*No*	*Yes*
Observations	46320	46320	46320	46329
R-sq	0.012	0.021	0.021	0.025
Constant	0.238***	0.728***	-0.253***	0.353*

All regressions are weighted by LFS weights.

Robust standard errors are presented in parentheses.

* Significant at 5%; ** Significant at 1%; *** Significant at 0.1%

Table 8. LPM estimates of the effect of tuition fees on the probability of work, by sample

	1980-2002				1980-2002 with support			
log_tuition	0.040***	-0.028*	0.110***	0.085**	0.014	-0.030*	0.058***	0.084**
	(0.008)	(0.013)	(0.011)	(0.030)	(0.010)	(0.013)	(0.017)	(0.029)
Female	0.078***	0.075***	0.076***	0.0747***	0.076***	0.075***	0.075***	0.075***
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
Married	-0.002	0.000	-0.003	-0.001	-0.004	0.001	-0.003	-0.001
	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)
minimum_wage	6.23E-05	-0.000	-0.019***	-0.006	0.001	-0.001	-0.016**	-0.005
	(0.005)	(0.006)	(0.006)	(0.008)	(0.005)	(0.006)	(0.006)	(0.008)
Unemplhs	-0.007***	-0.008***	-0.002	-0.005*	-0.006***	-0.008***	-0.002	-0.005*
	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)	(0.002)
Unemplu	0.020***	0.006	0.005	-0.007	0.016***	0.007	0.004	-0.007
	(0.004)	(0.004)	(0.004)	(0.005)	(0.004)	(0.004)	(0.004)	(0.005)
student_support	-	-	-	-	0.000***	-1.2E-05	0.000***	1.15E-05
	-	-	-	-	(1.65E-05)	(2.28E-05)	(2.49E-05)	(3.33E-05)
fam_unemployed	-0.073***	-0.072***	-0.072***	-0.072***	-0.073***	-0.072***	-0.072***	-0.072***
	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)
Province FE	*No*	*No*	*Yes*	*Yes*	*No*	*No*	*Yes*	*Yes*
Year FE	*No*	*Yes*	*No*	*Yes*	*No*	*Yes*	*No*	*Yes*
Observations	31325	31325	31325	31325	31325	31325	31325	31325
R-sq	0.013	0.020	0.021	0.026	0.015	0.020	0.022	0.026
Constant	0.008	0.469***	-0.516***	-0.410	0.143	0.489***	-0.206	-0.414

All regressions are weighted by LFS weights. Robust standard errors are presented in parentheses.

* Significant at 5%; ** Significant at 1%; *** Significant at 0.1%

Table 9. LPM estimates of the effect of tuition fees on the probability of work, by specification

	(I)	(II)	(III)	(IV)	(V)
log_tuition	-0.014	-0.013	-0.013	-0.010	-0.014
	(0.019)	(0.019)	(0.019)	(0.019)	(0.021)
Female	-	0.082***	0.082***	0.082***	-.082***
	-	(0.006)	(0.006)	(0.006)	(0.006)
Married	-	-	-0.001	-0.003	-0.003
	-	-	(0.014)	(0.014)	(0.014)
fam_unemployed	-	-	-	-0.061***	-0.060***
	-	-	-	(0.011)	(0.011)
minimum_wage	-	-	-	-	-0.015*
	-	-	-	-	(0.006)
Unemplhs	-	-	-	-	-0.003
	-	-	-	-	(0.002)
Unemplu	-	-	-	-	-0.003
	-	-	-	-	(0.004)
Prov FE	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Year FE	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Observations	46320	46320	46320	46320	46320
R-sq	0.017	0.024	0.024	0.025	0.025
Constant	0.235	0.184	0.184	0.175	0.353*

All regressions are weighted by LFS weights.
Robust standard errors are presented in parentheses.
*** Significant at 5%; ** Significant at 1%; *** Significant at 0.1%**

Table 10. LPM estimates of the effect of tuition fees on the probability of work, comparison by sample

	1980-2011	1980-2002 support	1980-2002	2002-2011	1980-2005 & 2008-2011
log_tuition	-0.014	0.084**	0.085**	-0.018	-0.003
	(0.021)	(0.029)	(0.030)	(0.048)	(0.022)
Female	0.082***	0.075***	0.075***	0.094***	0.084***
	(0.006)	(0.007)	(0.007)	(0.010)	(0.006)
Married	-0.003	-0.001	-0.001	0.012	-0.003
	(0.014)	(0.015)	(0.015)	(0.034)	(0.014)
minimum_wage	-0.015*	-0.005	-0.006	-0.002	-.013*
	(0.006)	(0.008)	(0.008)	(0.012)	(0.007)
Unemplhs	-0.003	-0.005*	-0.005*	-0.004	-0.005**
	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)
Unemplu	-0.003	-0.007	-0.007	0.007	-0.003
	(0.004)	(0.005)	(0.005)	(0.008)	(0.004)
student_support	-	1.15E-05	-	-	-
	-	(3.33E-05)	-	-	-
fam_unemployed	-0.060***	-0.072***	-0.072***	-0.035	-0.065***
	(0.011)	(0.013)	(0.013)	(0.020)	(0.012)
Province FE	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Year FE	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Observations	46329	31325	31325	16518	41186
R-sq	0.025	0.026	0.026	0.021	0.026
Constant	0.353*	-0.414	-0.410	0.407	0.276

All regressions are weighted by LFS weights. Robust standard errors are presented in parentheses.

* Significant at 5%; ** Significant at 1%; *** Significant at 0.1%

Table 11. 1st Stage and 2SLS estimates, by sample

	1st Stage *(log_tuition=dep. var.)*			**2SLS** *(hours worked=dep. var.)*		
	1980-2002	**1980/02 support**	**1980-2002**	**1980-2002**	**1980/02 support**	**1980-2002**
log_tuition	-	-	-	-0.450	1.813	1.723
	-	-	-	(0.672)	(1.023)	(1.027)
Female	-0.002	-0.001	-0.001	0.938***	0.719***	0.717***
	(0.001)	(0.002)	(0.002)	(0.126)	(0.149)	(0.149)
Married	0.015***	0.003	0.003	0.768*	0.882**	0.887**
	(0.003)	(0.003)	(0.003)	(0.319)	(0.340)	(0.340)
minimum_wage	-0.063***	-0.105***	-0.114***	-0.208	0.124	0.058
	(0.002)	(0.002)	(0.002)	(0.142)	(0.207)	(0.203)
Unemplhs	0.005***	-0.004***	-0.004***	-0.085*	-0.093*	-0.095*
	(0.000)	(0.000)	(0.000)	(0.035)	(0.041)	(0.041)
Unemplu	0.028***	0.033***	0.035***	-0.067	-0.187	-0.166
	(0.001)	(0.001)	(0.001)	(0.095)	(0.114)	(0.117)
student_support	-	0.000***	-	-	0.001	-
	-	(6.41E-06)	-	-	(0.001)	-
fam_unemployed	0.005*	0.003	0.003	-1.230***	-1.529***	-1.527***
	(0.003)	(0.003)	(0.003)	(0.220)	(0.226)	(0.226)
LIB	-0.083***	-0.019***	-0.018 ***	-	-	-
	(0.003)	(.003)	(0.003)	-	-	-
NDP	-0.185***	-0.125***	-0.129***	-	-	-
	(0.003)	(.003)	(0.003)	-	-	-
PQ	-0.353***	-0.164***	-0.158***	-	-	-
	(0.003)	(0.006)	(0.006)	-	-	-
SC	0.312***	0.329***	0.323	-	-	-
	(0.009)	(0.010)	(0.009)	-	-	-
SKP	-0.025***	-	-	-	-	-
	(0.005)	-	-	-	-	-
Observations	46320	31325	31325	46320	31325	31325
R-sq	0.959	0.950	0.950	0.024	0.023	0.023

Table 12. IV and OLS estimates, by sample

	Full sample 1980-2002		1980-2002 with support		1980-2002	
	IV (1) 2SLS	**OLS**	**IV (2) 2SLS**	**OLS**	**IV (3) 2SLS**	**OLS**
log_tuition	-0.450	-0.277	1.813	1.304*	1.723	1.340*
	(0.672)	(0.422)	(1.023)	(0.577)	(1.027)	(0.580)
Female	0.938***	0.938***	0.719***	0.718***	0.717***	0.716***
	(0.126)	(0.126)	(0.149)	(0.149)	(0.149)	(0.149)
Married	0.768*	0.764*	0.882**	0.882**	0.887**	0.887**
	(0.318)	(0.318)	(0.340)	(0.340)	(0.340)	(0.340)
minimum_wage	-0.208	-0.194	0.124	0.050	0.056	-0.000
	(0.142)	(0.134)	(0.207)	(0.160)	(0.203)	(0.149)
Unemplhs	-0.085*	-0.085*	-0.093*	-0.094*	-0.095*	-0.095*
	(0.035)	(0.035)	(0.041)	(0.041)	(0.041)	(0.041)
Unemplu	-0.067	-0.078	-0.187	-0.162	-0.166	-0.146
	(0.095)	(0.087)	(0.114)	(0.102)	(0.117)	(0.103)
student_support	-	-	0.001	0.001	-	-
	-	-	(0.001)	(0.001)	-	-
fam_unemployed	-1.230***		-1.529***	-	-1.527***	
		-1.232***		1.525***		-1.524***
	(0.220)	(0.22)	(0.226)	(0.226)	(0.226)	(0.227)
Province FE	*Yes*	yes	*Yes*	yes	*Yes*	yes
Year FE	*Yes*	yes	*Yes*	yes	*Yes*	yes
Observations	46320	46320	31325	31325	31325	31325
R-sq	0.024	0.024	0.023	0.023	0.023	0.023
Constant	13.555*	7.330*	-7.636	-5.828	-6.080	-5.540

All regressions are weighted by LFS weights. Robust standard errors are presented in parentheses.

* Significant at 5%; ** Significant at 1%; *** Significant at 0.1%

Table 13. IV tests, by sample

	IV			**IV** (no Alberta)
	1980-2011	**1980/02 support**	**1980-2002**	**1980-2011**
Observations	46320	31325	31325	42394
F-test of excluded instruments	4468.11	1458.38	1402.57	4817.50
Prob>F	0.000	0.000	0.000	0.000
Hansen J statistics	9.703	6.201	5.887	10.976
Chi-sq(4) p-value	0.0049	0.102	0.117	0.027

Table 14. Robustness check

	1st Stage	**2SLS**
log_tuition	-	-0.558
	-	(0.663)
female	-0.002	.848***
	(0.001)	(0.133)
married	0.016***	.866*
	(0.003)	(0.344)
minimum wage	-0.044***	-0.239
	(0.002)	(0.146)
unemplhs	0.008***	-.095*
	(0.000)	(0.037)
unemplu	0.029***	-0.028
	(0.001)	(0.098)
fam_unemployed	0.005	-1.272***
	(0.003)	(0.229)
LIB	-0.075***	-
	(0.003)	-
NDP	-0.213***	-
	(0.003)	-
PQ	-0.351***	-
	(0.003)	-
SC	0.280***	-
	(0.008)	-
SKP	-0.048***	-
	(0.005)	-
Province FE	Yes	Yes
Year FE	Yes	Yes
observations	42394	42394
R-sq	0.962	0.024
Constant	8.728	14.675*

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