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ABSTRACT

Minimum Wage Effects on Human Capital Accumulation: Evidence from Canadian Data*

This paper investigates the impact of the minimum wage on individuals' schooling decisions and the type of human capital acquired by students. Using Canadian longitudinal data, we explore 136 minimum wage amendments across provincial jurisdictions, and find three novel results. First, the minimum wage affects both the quantity and the type of human capital acquired by individuals. High minimum wages stimulate the accumulation of occupation-specific human capital at community colleges but discourage enrollment in academic programs offered by universities. Quantitatively, a 10% increase in the minimum wage increases community-college enrollment by 6% and reduces university enrollment by 5%. Second, high minimum wages strengthen the link between parental background and children educational attainment, worsening the university participation gap between individuals with high and low parental education. Finally, minimum wages also affect whether students dropout of post-secondary education or return to school later in life as mature students.

JEL Classification: J31, J38, J24, I23

Keywords: minimum wage, post-secondary enrollment, post-secondary dropouts

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1 Introduction

In North America, approximately 50% of minimum-wage workers are between ages 17-29. Within this group, half are students.[1] Therefore, it is natural to wonder whether minimum wage policies affect post-secondary education (PSE) decisions. High minimum wages could discourage enrollment by raising the opportunity cost of education and reducing the education wage-premium. However, the minimum wage may also create some unemployment and encourage individuals to stay in school or return to school to acquire additional skills. In turn, by influencing schooling decisions, the minimum wage may have long-term effects on individuals' income and productivity.

While the literature has extensively analyzed the disemployment effects of the minimum wage,[2] little is known about the effects on human capital accumulation. This paper investigates the impact of minimum wage policies on PSE enrollment, persistence in PSE (i.e. whether students stay enrolled) and the type of skills acquired by students. Our findings show that the minimum wage has a stronger impact on education decisions compared to employment.

We use Canadian longitudinal data from the Survey of Labour and Income Dynamics (SLID) and explore variation in the minimum wage across different jurisdictions. Provincial governments in Canada set their minimum wages autonomously generating great variation both across provinces and over time. During the period we analyze, Canadian provinces enacted 136 changes to their minimum wages over the course of 19 years. Since there are 10 provinces, this implies that each jurisdiction enacted 13.6 changes on average. Exploring this variation across jurisdictions, we show that the effects of the minimum wage on education decisions are highly heterogeneous. Our results reveal, for the first time, that high mini-

[1] Authors' calculations based on 2019 Current Population Survey (CPS) for the US and 2019 Labour Force Survey (LFS) for Canada. All 12 months were used for these calculations. LFS variables: age (age_6), school enrollment (schooln), hourly wage (hrlyearn). CPS variables: age, hourly wage (hourwage), school enrollment (schlcoll).

[2] See Wascher and Neumark (2006), Neumark et al. (2014) and Rybczynski and Sen (2018) for reviews of the literature, and Wang et al. (2019) and Cengiz et al. (2019) for recent results.

mum wages encourage the accumulation of occupation-specific human capital at community colleges but discourage the accumulation of general human capital at universities. We then explore the panel dimension of our dataset to examine why.

The negative effect on university enrollment is driven by high-school students with low levels of parental education, who are less likely to attend university if the minimum wage is high upon graduation from high school. For this group of students, the increase in the opportunity cost of education caused by the minimum wage appears to discourage enrollment. On the contrary, individuals whose parents completed university are not sensitive to changes in the minimum wage. It is widely known that students from low socio-economic backgrounds are less likely to participate in university. Our results suggest that an increase in the minimum wage worsens this participation gap. Nonetheless, the choice not to participate in university when the minimum wage rises may be rational if the student lacked the motivation and ability to complete university education, as we discuss more in detail in the paper.

The positive effect on community-college enrollment is driven by older students. As the minimum wage increases, students already enrolled in community college are less likely to drop out, and workers who separate from their job are more likely to return to community college to acquire additional skills. These results are consistent with Brochu and Green (2013) showing that an increase in the minimum wage reduces hiring rates. Minimum-wage hikes can make finding a new job harder and can increase competition in the labor market, which in turn may persuade individuals, who recently separated from a job, to return to school and acquire additional skills.

We focus on Canada for several reasons. First, the frequency of minimum wage changes is high compared to other countries, as also pointed out by Campolieti et al. (2005b, p. 83) and Wascher and Neumark (2006, p. 19). Further, among OECD countries, Canada has the highest percentage of individuals with a tertiary degree, with university and community college being equally popular choices. Currently, 26% of individuals aged 25-64 living in

Canada have a community-college degree while 32% have a university degree (OECD, 2019). In comparison, the OECD averages are 7% for community college and 17% for university.[3] Therefore, Canada represents an ideal case study of minimum wage impacts on different PSE pathways.

This paper contributes to the literature in several ways. First, existing studies investigate the impact of the minimum wage on enrollment in high school[4] or community college (Lee, 2020), and on overall school enrollment which combines high school and post-secondary education together (Baker, 2005; Pacheco and Cruickshank, 2007). We are the first ones to provide estimates for university enrollment, to compare enrollment in academic programs versus vocational programs, and to study persistence in PSE thanks to the longitudinal nature of our dataset. The studies mentioned above use cross-sectional data and investigate enrollment only. However, it is important to know whether changes to the minimum wage affect only entry into PSE or also persistence. In the latter case, the minimum wage will have a stronger impact on individuals' income and career. Further, by comparing academic and vocational programs, we are able to show that the minimum wage affects the type of skills and human capital acquired by students. Pooling different types of programs together masks differences between enrollment in vocational and academic programs. Finally, we find for the first time that the effects of the minimum wage on schooling are highly heterogeneous and differ by parental education. The reduction in university enrollment in response to an increase in the minimum wage is only observed among students from less educated families.

The dataset we use is particularly suited for the analysis also because it contains informa-

[3]The importance of post-secondary education in Canada relative to other countries is not a recent phenomenon. We refer the reader to Skolnik (2020) for an analysis of the reasons why Canada has high educational attainments compared to other OECD countries, especially with respect to community-college education.

[4]Most papers find that high minimum wages reduce high-school enrollment in the US, Canada and New Zealand. See Crofton et al. (2009), Neumark and Wascher (2003), Chaplin et al. (2003), Neumark and Wascher (1995a), Neumark and Wascher (1995b), Ehrenberg and Marcus (1982), Ehrenberg and Marcus (1980) for the US; Landon (1997) for Canada; Pacheco and Cruickshank (2007) for New Zealand. While most papers find negative effects of the minimum wage on high-school enrollment, it is important to mention that there are also studies in the literature that reached different conclusions: Mattila (1978) finds a positive effect in the US and Campolieti et al. (2005a) find no effect in Canada.

tion on monthly enrollment. In turn, this allows us to investigate for the first time how long it takes for a minimum wage amendment to have an effect on education decisions. We find that enrollment at the beginning of the academic year (i.e. in the Fall) is mainly affected by changes in the minimum wage that were announced by November during the prior calendar year. The effect on Fall enrollment progressively diminishes if the minimum wage change was announced later on.

Important policy implications arise from our findings. Over time, several economies have enhanced minimum wage provisions to reduce inequality and fight poverty. In the US, several municipalities have introduced and then substantially increased their city-level minimum wages in recent years (e.g. Seattle, New York City, Washington D.C. and Chicago). The states of California, Illinois, Massachusetts, New Jersey and New York have approved scheduled increases that will bring their state minimum wages to $15/hour by year 2025. Germany introduced a national minimum wage in 2015, which is currently set at approximately 11.40 USD/hour. In Canada, provincial nominal minimum wages have increased by 3.3% annually since 1990. As a result of these changes, the fraction of workers affected by the minimum wage has risen substantially across countries over time. For example, the percentage of minimum-wage workers in Canada more than doubled from roughly 4% to 10% in the last 30 years. Hence, having a complete understanding of the economic implications of minimum wage policies is more important now than ever. Our findings can inform policymakers regarding the spillover effects of minimum wage regulations on human capital accumulation and the unintended consequences on educational attainment. Governments provide substantial funding to support post-secondary education: the Canadian government spends approximately 25,000 USD per student in tertiary education, while the OECD average is 16,000 USD.[5] Therefore, it is important to know whether minimum wage policy works against or in favor of concurrent education policies.

[5]Source: Education at a Glace 2020, OECD Indicators, Figure C1.3.

2 Previous studies

The present paper contributes to two main streams of literature. The first stream studies the economic consequences of minimum wage regulations. The most studied outcome is certainly employment. Card and Krueger (1995), Wascher and Neumark (2006), Neumark et al. (2014) provide extensive reviews of the literature. The results regarding the US economy range from negative effects on teenage employment to positive impacts. The Canadian literature is more conclusive and finds that an increase in the minimum wage by 10% typically reduces teens' employment by 1-3% (e.g. Rybczynski and Sen, 2018; Brochu and Green, 2013; Shannon, 2011; Campolieti et al., 2005b; Baker et al., 1999).[6]

The minimum wage literature has also investigated outcomes other than employment such as workers' health (e.g. Horn et al., 2017), inflation (e.g. Campos-Vazquez and Esquivel, 2020) and economic growth (e.g. Askenazy, 2003; Chu et al., 2020). More relevant for our work are studies focusing on high-school education. Most papers find that high minimum wages reduce high-school enrollment in the US, Canada and New Zealand.[7] Some work has also been done with respect to training offered by employers. Using Japanese data, Hara (2017) shows that imposing a minimum wage on employers can make them less likely to sponsor formal training for their employees. However, evidence based on British data finds no effect of the minimum wage on employer-sponsored training (Arulampalam et al., 2004).

Regarding PSE, little is known despite the fact that many minimum-wage workers are in the same age group as post-secondary students. Pacheco and Cruickshank (2007) and Baker (2005) study school enrollment among 15-24 year-olds in New Zealand and Canada, respectively. However, their enrollment measure combines high school and post-secondary

[6]The meta-analysis conducted by Campolieti (2020) indicates that there is no evidence of publication bias in the Canadian literature.

[7]See Crofton et al. (2009), Neumark and Wascher (2003), Chaplin et al. (2003), Neumark and Wascher (1995a), Neumark and Wascher (1995b), Ehrenberg and Marcus (1982), Ehrenberg and Marcus (1980) for the US; Landon (1997) for Canada; Pacheco and Cruickshank (2007) for New Zealand. While most papers find negative effects of the minimum wage on high-school enrollment, it is important to mention that there are also studies in the literature that reached different conclusions: Mattila (1978) finds a positive effect in the US and Campolieti et al. (2005a) find no effect in Canada.

education together. In addition, they reach mixed results. In New Zealand, an increase in the minimum wage reduces combined school enrollment among 16-19 year olds and has no significant impact on other age groups (Pacheco and Cruickshank, 2007). For Canada, Baker (2005) finds that increases in the minimum wage have a positive effect on combined school enrollment among 20-24 year olds and no significant impact on other age groups. Recently, Lee (2020) uses American data to show that a 10% increase in the minimum wage decreases enrollment in 2-year PSE institutions by approximately 5%. We extend this literature by analyzing a wider range of post-secondary decisions including university enrollment and persistence in post-secondary education. These outcomes have not been studied yet. Our results show for the first time that minimum wage policies have important effects on both the quantity and the type of human capital acquired by individuals. In Canada, a 10% increase in the minimum wage reduces university enrollment by 5% and increases enrollment in community colleges by 6%. The effects on persistence in community college and on the decision to return to PSE as mature student are even larger. In addition, we find that the minimum wage disproportionately affects students with low parental education suggesting that changes to minimum wages worsen the university participation gap among students from different socio-economic backgrounds.

Our results for community college enrollment appear to be in contrast with Lee (2020). However, community colleges in Canada focus almost exclusively on vocational education, while most two-year institutions in the US also provide academic training and are treated as a stepping stone to university (Skolnik, 2020). Therefore, it is not surprising that Lee (2020)'s estimates are more similar to our results for university. In addition, when we restrict our sample to geographic areas in Canada where community colleges provide academic training, we reach the same conclusions as in Lee (2020). An increase in the minimum wage reduces community-college enrollment in areas where these institutions provide academic training. Our findings combined with the existing literature suggest that high minimum wages discourage academic training while encouraging vocational training.

Our paper also relates to studies investigating which factors influence post-secondary education decisions. Based on previous literature, youths are more likely to enroll in PSE during economic downturns, which are typically proxied by the unemployment rate (e.g. Alessandrini, 2018; Méndez and Sepúlveda, 2012), oil-price shocks (e.g. Emery et al., 2012; Neill and Burdzy, 2010; Black et al., 2005) or housing prices (e.g. Charles et al., 2018). Morissette et al. (2015) show that the large increase in oil prices between 2001 and 2008 led to a boost in wages in oil-producing regions of Canada and subsequentially reduced university enrollment. In other words, forgone income is an important barrier to PSE. We contribute to this literature by showing that students not only respond to changes in wages caused by business conditions, but also respond to changes in wages caused by minimum wage regulations. These results contribute to our understanding of the information set used by students when making enrollment and dropout decisions.

3 Education and minimum wage regulations in Canada

The Canadian post-secondary education system comprises universities and community colleges. Universities offer bachelor's and graduate degrees. Bachelor's programs typically last four years and admission to these programs is usually conditional on high-school graduation. Community colleges tend to offer shorter programs (1-2 years) geared towards specific occupations such as law clerk, graphic designer, early childhood educator, massage therapist or hotel manager. These institutions focus almost exclusively on vocational education, and grant diplomas and trade certificates. In some provinces, community colleges can also grant bachelor's degrees but this is rare since only 4.3% of bachelor's degrees are awarded by community colleges (Frenette, 2019).

Universities and community colleges in Canada are usually seen as substitutes: typically students enroll in either one or the other institution. However, the province of Quebec represents an exception since high-school graduates must attend a two-year program at a General and Vocational College (Collège d'Enseignement General et Professionel) before

entering university. Given the peculiarity of the education system in Quebec, our baseline sample will exclude individuals living in this province. However, we also analyze Quebec separately (see Table 4 and related discussion in the text).

The vast majority of post-secondary institutions in Canada are public and fall under provincial jurisdiction. Provincial governments provide funding, and exert control over tuition fees and the approval of new programs. Some financial support is provided by the federal government via research grants and student loans. Provincial governments are also responsible for labor laws including minimum wage regulations.[8] Minimum wages were first established during 1917-1921 in the provinces of Alberta, British Columbia, Manitoba, Ontario and Saskatchewan (Derry and Douglas, 1922), and primarily affected women. However, by 1960, all provinces had a minimum wage legislation in place which applied to both men and women. During the time period we analyze, no economic criteria were used to set minimum wage rates. These rates were arbitrarily determined by the government in power, without targeting macroeconomic indicators.[9] Minimum wage changes are typically announced a few months before they become effective in order to allow businesses to prepare for the change. On average, minimum wage amendments in our sample were announced through press releases 8 months before they became effective. More specifically, 30% of changes were announced with a notice of 3 months or less. An additional 30% was announced with a notice of 4-6 months. The remaining 40% was announced more than 6 months ahead of implementation.

Figure 1 shows the evolution of nominal and real provincial minimum wages over our time period. On average, nominal minimum wages increased by 3.3% per year while average

[8]The only exception regards federally-regulated sectors (e.g. postal service, railway transportation) whose workers are subject to the federal minimum wage. However, only 6% of workers fall under federal jurisdiction. In addition, starting from 1996, the federal minimum wage was harmonized to match the provincial minimum wage in each respective province.

[9]In recent years, provinces have introduced formulas to set their minimum wage rates. These formulas are typically based on inflation, average wages in the economy and the poverty line. However, these changes have been implemented after the time period we consider (1993-2011). The minimum wage has been indexed to inflation or other macroeconomic indicators since late 2011 in the province of Saskatchewan, since 2012 in Nova Scotia, since 2014 in Ontario, since 2016 in New Brunswick, since 2017 in Manitoba, since 2018 in Newfoundland and Labrador, from 2011-2014 in Alberta, and from 2015-2018 in British Columbia.

annual inflation was 1.9%. In comparison, average nominal hourly wage for all employees increased by 2.8% annually.[10] Currently, some provinces set different rates for different workers. For example, liquor servers receive a lower minimum wage in the provinces of Ontario and British Columbia. These lower rates tend to increase over time at the same pace as the general minimum wage in the province. For this reason, the literature typically uses the general rate that applies to most workers. Our analysis will follow the same approach.

4 Data and methodology

We use data from the Survey of Labour and Income Dynamics (SLID), which was conducted by Statistics Canada from 1993-2011.[11] Every three years, 17,000 households were selected from the Labour Force Survey and followed annually. The survey is representative of the Canadian population and contains detailed information on educational and employment activities. SLID is well suited for the analysis in this paper because of its longitudinal coverage of several cohorts over a relatively long period of time.[12]

We restrict attention to individuals aged 18-45 with at least a high-school diploma (or GED equivalent)[13] and exclude residents of Quebec as previously mentioned. In Section 5 we also study Quebec separately. Our analysis starts at age 18, when most Canadian students

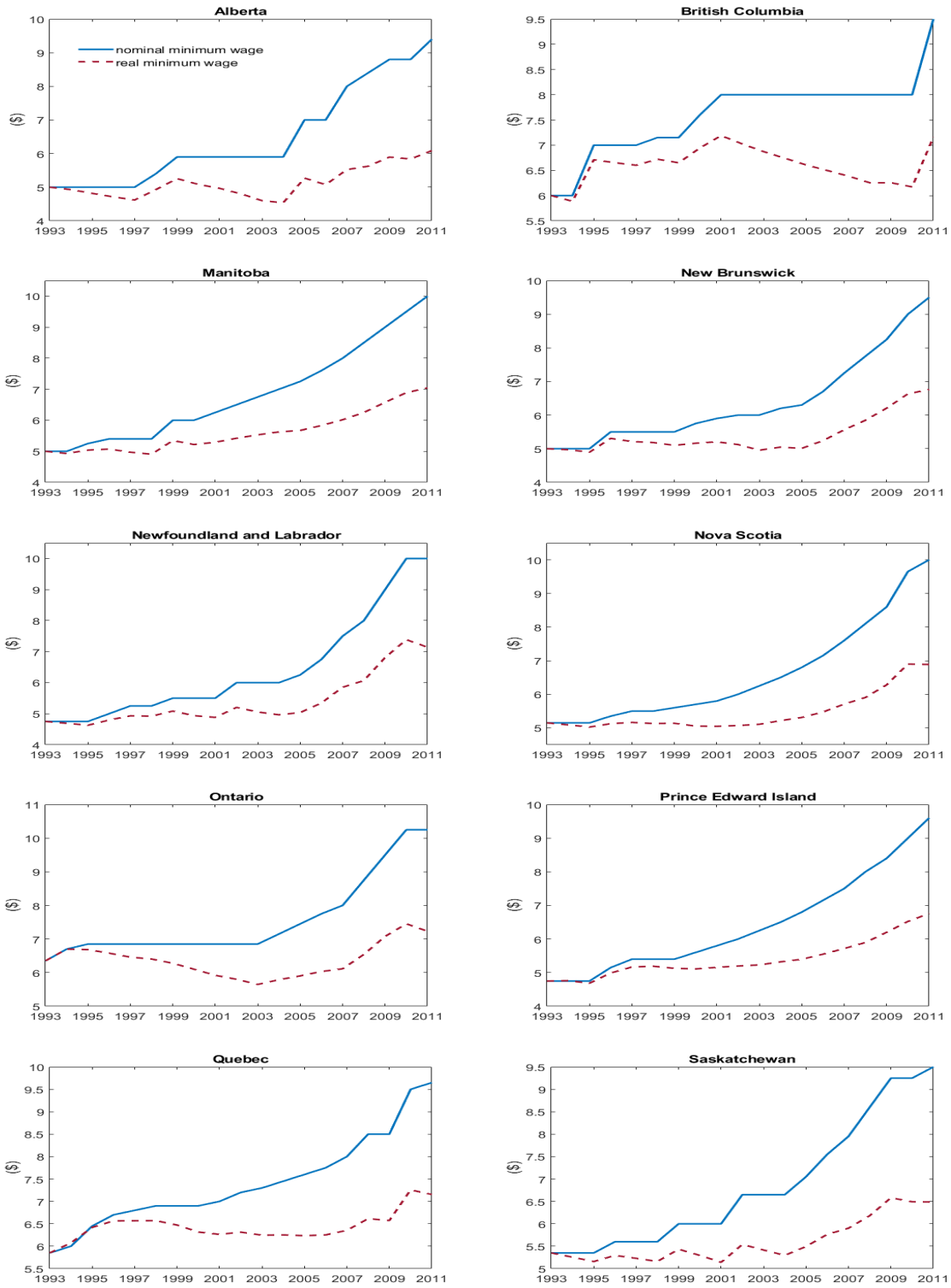
[10] Average nominal hourly wages are taken from Statistics Canada Table: 14-10-0064-01.

[11] Note that, in 2012, SLID was replaced by the Longitudinal and International Study of Adults (LISA). While LISA asks similar questions to SLID, this new survey is conducted every two years rather than annually. The lower frequency of data collection makes it difficult for us to study outcomes requiring annual panel data: e.g. persistence in PSE and the decision to return to school after separating from a job. For this reason, we end our time period in 2011.

[12] Alternatively, one could use data from the Canadian Labour Force Survey or the Canadian Youth in Transition Survey. However, the former only follows individuals for six months. Therefore, studying persistence in PSE is difficult given the short window. The latter surveyed a sample of 15 year-old high-school students in 1999 and followed them every two years until 2009. Given this survey design, the sample size is small and the sample covers one cohort only. SLID also has advantages over the datasets previously used in other studies (e.g. the American Current Population Survey or jurisdiction-level enrollment rates) because it follows individuals over time, and has detailed information about individuals' educational and employment activities as well as parental background. For example, the American Current Population Survey reports parental education and enrollment status only for young individuals living with their parents. In SLID, instead, enrollment and parental background questions are asked in all interviews.

[13] Since high-school education is typically required to enroll in university, we focus on individuals with at least a high-school diploma or GED (General Educational Development) equivalent. However, the results are qualitatively the same if we relax this restriction and include those who did not complete high school.

FIGURE 1
Minimum wages in Canadian provinces



Source: Provincial Consumer Price Index from Statistics Canada (Table 18-10-0005-01) and provincial minimum wages from the Government of Canada.
Notes: Real minimum wages are in 1993 dollars.

graduate from high school, and stops at age 45 since enrollment after this age is very low. Given our interest in the decision to return to PSE late in life, the age range considered is fairly wide but the results are robust if one focuses on individuals aged 18-24 instead, as shown in Section 5.2. The final dataset consists of 77,527 individuals followed on average for 3.2 years.

The impact of the minimum wage on education likely diminishes as education increases since there is a limit to how much the minimum wage can promote/discourage enrollment. Consistent with other minimum wage studies (e.g. Brochu and Green, 2013; Dube et al., 2010; Pacheco and Cruickshank, 2007), we approximate this nonlinear relationship with a logarithmic function:

$$Y_{ipt} = \alpha_0 + \alpha_1 ln(MW_{pt}) + \boldsymbol{\alpha_2}\mathbf{X'_{ipt}} + \boldsymbol{\alpha_3}\mathbf{Z'_{pt}} + u_{ipt} \tag{1}$$

where Y is an educational outcome, $ln(MW_{pt})$ is the natural logarithm of the real minimum wage in province p at time t, $\mathbf{X_{ipt}}$ is a vector of control variables for individual i, $\mathbf{Z_{pt}}$ is a vector of provincial control variables, $u_{ipt} = v_t + v_p + \epsilon_{ipt}$, $\epsilon_{ipt} \sim \mathcal{N}(0,1)$, v_t and v_p represent year and province fixed effects respectively. Equation 1 is estimated using a linear probability model. However, a logistic model yields remarkably similar marginal effects (see Section 5.2).

In the Appendix, we also experiment by including provincial time trends as suggested by Dube et al. (2010). Appendix Tables A1-A2 show that the inclusion of provincial time trends in equation 1 does not change the estimated coefficients but reduces the standard errors. Therefore, in the main text, we present the most conservative estimates, which exclude provincial time trends. Our results are also robust to the inclusion of nonlinear region-specific time effects. We refer the reader to the Appendix for more details on these robustness checks. Also note that the error term, ϵ_{ipt}, is clustered by province and year to account for correlation over time and across provinces. Clustering only by province typically generates smaller standard errors, see Appendix Tables A3-A4.

We study three binary outcomes (Y_{ipt}) separately for university and community college: (1) being enrolled, (2) having dropped out, (3) having returned to school:

- $Enrolled_{ipt}$ is set to one if respondent i was enrolled in university (community college) at any point during year t, and zero if the respondent was not in school.

- $Dropped_{ipt}$ is set to one if respondent i was enrolled in university (community college) in year $t-1$, did not graduate and is no longer a student at time t. The variable is equal to zero if the student is still enrolled.

- $Returned_{ipt}$ is set to one if respondent i worked at least 1040 hours at time $t-1$, separated from the job between time $t-1$ and time t, and is now enrolled in university (community college). The variable is set to zero if the individual separated from the job but is not in school.

When constructing the *Returned* variable, we only consider individuals who have worked for at least 1040 hours in the prior year (i.e. an average of 20 hours per week). This requirement is used to exclude students who worked during holiday breaks or the summer, and returned to school at the start of the academic term. Including these students would bias our results since we are only interested in mature students who enroll after acquiring some labor market experience. In the Appendix, we experiment with a broader definition of *Returned* by relaxing the condition that the individual must have separated from a job to be considered a *Returned* student (see Appendix Table A5).

The vector $\mathbf{X_{ipt}}$ includes age, age squared, gender, marital status, aboriginal background, province of residence, real family income, family size, binary indicators for parental education,[14] and a binary indicator for residence in rural areas. $\mathbf{Z_{pt}}$ includes provincial variables that affect enrollment decisions and may be correlated with minimum wage policies: de-

[14]We include three binary indicators for paternal education and three for maternal education. The binary indicators correspond to the following categories: high-school education or less, post-secondary education without a university degree, university degree.

trended provincial (real) GDP,[15] university tuition, the percentage of individuals living in rural areas and the post-secondary wage premium.[16] Table 1 reports mean values and data sources.

TABLE 1
Variables, mean values and data sources

Variable	Mean value (1993-2011)	Data source
Dependent variables		
Enrolled, university	0.154	SLID
Dropped, university	0.093	SLID
Returned, university	0.028	SLID
Enrolled, community college	0.113	SLID
Dropped, community college	0.258	SLID
Returned, community college	0.063	SLID
Individual control variables		
Age	31.7	SLID
Female (%)	51.0	SLID
Married (%)	53.4	SLID
Single (%)	40.2	SLID
Separated (%)	6.4	SLID
Has aboriginal background (%)	3.1	SLID
Family size	3.1	SLID
Adjusted after-tax income* (2011$)	43,710.2	SLID
Live in a rural area (%)	16.1	SLID
Father has university degree	18.7	SLID
Father has PSE degree below university	14.9	SLID
Mother has university degree	13.3	SLID
Mother has PSE degree below university	18.2	SLID
Provincial variables		
Real minimum wage (2011$)	8.8	Govt. of Canada
De-trended provincial GDP	-0.0004	Statistics Canada
Average university tuition (2011$)	4,841.5	TLAC
People living in rural areas (%)	21.9	SLID
PSE wage premium**	0.285	SLID

Notes: SLID is the Survey of Labour and Income Dynamics. TLAC is the Tuition and Living Accommodation Costs survey, which is conducted by Statistics Canada and reports financial information of public degree-granting institutions in Canada. *Household Total - After-tax income, divided by the square root of the household size. ** PSE wage premium=ln(hourly wage PSE graduates) - ln(hourly wage high-school graduates).

[15]We de-trend GDP using the Hodrick-Prescott filter. Following Ravn and Uhlig (2002), we set the smoothing parameter to 6.25, the recommended value for annual data.

[16]The post-secondary wage premium is measured by the difference between logged wages of post-secondary graduates and logged wages of high-school graduates.

We control for de-trended provincial GDP because minimum wage increases may be more likely to be implemented when the economy is expanding, which is typically associated with lower PSE enrollment. This implies that α_1 in equation 1 represents the impact of the minimum wage holding macroeconomic conditions constant. However, it is worth noting that we find little correlation between the time of implementation of a minimum wage change and de-trended provincial GDP in Canada.[17]

In addition to the education outcomes listed above, we also estimate the impact of the minimum wage on employment. We do so in order to confirm that our sample generates labor market effects consistent with previous studies. We find employment elasticities of -0.19 for teenagers (age 15-19) and -0.02 for young adults (age 20-24), see Appendix Table A4. These values are consistent with previous Canadian studies. For example, the Canadian meta-analysis conducted by Campolieti (2020) shows that employment elasticities for teenagers are typically between -0.1 and -0.3. Further, the recent estimates produced by Rybczynski and Sen (2018) display an elasticity of -0.17 for female teenagers and -0.09 for male teenagers. Among 20-24 year olds, they find 0.03 for women and 0.01 for men.[18] We conclude that our sample generates employment elasticities consistent with previous Canadian studies.

5 Results

This section analyzes our main findings regarding education outcomes. Table 2 reports $\hat{\alpha_1}$ (from equation 1) for university decisions, together with clustered standard errors in parenthesis and elasticities in the bottom panel. Column 1 shows that, when the minimum

[17]Reich (2009) documents that, in the US, minimum wage increases are usually implemented when employment is growing. To verify whether this is also true in Canada, we constructed an indicator for each province and each year equal to one if the province changed its minimum wage rate during that year, and zero otherwise. We then computed the correlation coefficient between this indicator and de-trended provincial GDP. The correlation coefficient is -0.07. We conclude that there is little correlation between minimum wage changes and business cycles when measured by HP-filtered GDP. Nevertheless, we acknowledge that the accuracy of this correlation coefficient depends on whether the HP trend is a good approximation for the actual trend in GDP.

[18]These numbers refer to their estimations without provincial time trends, which match our baseline specification. See column 1 of Tables 2-3 in their paper.

TABLE 2
The impact of the minimum wage on university decisions

Dependent variable:	Enrolled_{ipt}	Enrolled_{ipt}	Enrolled_{ipt}	Enrolled_{ipt}	Dropped_{ipt}	Returned_{ipt}
Sample:	All	Father has university degree	Father does not have univ. degree	All	All	All
	(1)	(2)	(3)	(4)	(5)	(6)
$\ln(\text{MW}_{pt})$	-0.079***	0.025	-0.113***	-0.075***	0.029	0.057***
	(0.015)	(0.036)	(0.018)	(0.016)	(0.037)	(0.021)
$\ln(\text{MW}_{pt})\times\text{RecentHS}_{ipt}$				-0.054		
				(0.033)		
RecentHS_{ipt}				0.428***		
				(0.061)		
Elasticity of the dependent variable with respect to the minimum wage:						
All	-0.52	0.06	-0.92	-0.52	0.32	1.79
Recent high-school graduates				-0.78		
Non-recent high-school graduates				-0.45		
N	220,518	30,655	189,863	220,518	16,963	19,658
R^2	0.322	0.434	0.244	0.329	0.070	0.026

Source: Survey of Labour of Income Dynamics (1993-2011).
Notes: Clustered standard errors in parenthesis. Each regression includes the following control variables: year fixed effects, province fixed effects, age, age squared, gender, marital status, aboriginal background, province of residence, family income, family size, parental education, a binary indicator for residence in rural areas, de-trended provincial GDP, average university tuition in the province, the percentage of individuals living in rural areas in the province and the provincial post-secondary wage premium. p<0.1*; p<0.05**; p<0.01***.

wage increases by 10%, the likelihood of attending university decreases by 0.008 units. This is a 5.2% decrease from the mean value of the dependent variable, implying an elasticity of -0.52.[19] We find a similar elasticity when restricting the sample to individuals aged 18-24 as shown in Section 5.2. The estimate in column 1 is consistent with studies in the literature showing that schooling decisions are sensitive to labor market information. For example, Morissette et al. (2015) show that a 10% increase in average wages in the Canadian economy leads to a 5 to 6% reduction in school enrollment among 17-24 year olds. High-school

[19]The impact of a 10% increase in the minimum wage is computed as $\ln(1.1)\times\hat{\alpha_1}$. From this, it is possible to compute the elasticity of university enrollment with respect to the minimum wage using the midpoint method: $\%\Delta Enrolled \;/\; \%\Delta MW = \frac{-0.008/0.154}{0.1} = -0.52$, where 0.154 is the mean value of the variable *Enrolled* in university as shown in Table 1.

students in the US display a similar elasticity with respect to average wages (Black et al., 2005). Our results combined with the existing literature suggest that schooling decisions are equally sensitive to minimum wages as they are to market wages.

In addition, the results presented so far indicate that enrollment elasticities are larger than the employment elasticities estimated in the literature. For the US, Neumark and Wascher (1995b) find an elasticity of -0.8 for high-school enrollment, while Lee (2020) finds an elasticity of approximately -0.5 for enrollment in 2-year PSE institutions. We find an elasticity of university enrollment with respect to the minimum wage of -0.52. In comparison, employment elasticities for North America are usually between 0 and -0.3. Taken together, these results imply that schooling is more sensitive to the minimum wage than employment.

The comparison between columns 2 and 3 reveals that the impact of the minimum wage on enrollment is driven by individuals whose father does not have a university degree. Among these individuals, the elasticity is -0.92. Using mother's education leads to similar results. Individuals with low levels of parental education are typically less likely to enroll in university compared to individuals whose parents graduated from university (Christofides et al., 2010; Belley et al., 2014). An increase in the minimum wage strengthens the link between parental education and university enrollment. One possible explanation is that individuals with less educated families tend to be at the margin between going and not going to university, and are more sensitive to the increase in the opportunity cost of education generated by higher minimum wages. Students with lower parental education also tend to have access to fewer savings and are therefore more sensitive to financial considerations. In addition, they may be more likely to decide about university attendance late in their high-school years and therefore may be more responsive to labor market information received in their last year of high school. Finally, another possible explanation for this heterogeneity is that parents with low levels of education are more likely to be paid at the minimum wage. Thus, their children may be more informed on, and more sensitive to, minimum wage changes.

Nonetheless, our results suggest that the minimum wage worsens the participation gap

among individuals with different levels of parental education. However, the decision to not participate in university when the minimum wage rises may be rational if these students did not have the motivation and ability to complete university. Finnie and Qiu (2008) show that the Canadian university dropout rate is 13% among students whose parents completed university and approximately 16% among students whose parents completed high school or a community-college degree at most. We find the same differential in our dataset. Therefore, some of the students who choose not to participate in university when the minimum wage rises might have dropped out of university anyway. As discussed in Ferrer and Riddell (2002), Canadian estimates show that each additional year of schooling increases male wages by 6% and female wages by 9%. These percentages drop to 3% and 6% respectively when controlling for sheepskin effects (i.e. dummy variables indicating whether individuals have completed a university degree or other credential). This implies that choosing not to participate in university when the minimum wage rises is a rational choice if the minimum wage increases by more than 3% for males or 6% for females, and if these students would have dropped out of university at the end of the first year. In addition, while average private returns to university education are positive, the dispersion is quite large and some students experience negative or null private returns (e.g. Henderson et al., 2011; Harmon et al., 2003). Therefore, the choice to not participate in university when the minimum wage is high may be optimal for some individuals.

In column 4, we interact the minimum wage with a binary indicator, $RecentHS_{ipt}$, equal to one if the respondent graduated from high school within the last year and zero otherwise. The interaction term in column 4 shows that the effect of the minimum wage is stronger among recent high-school graduates. Reasonably, high-school students who are about to graduate and have to choose between entering the labor market or pursuing post-secondary education should be more sensitive to labor market information. Our results suggest that high minimum wages raise the opportunity cost of education and encourage recent graduates to enter the labor market upon graduation rather than enrolling in university. Once students

have made their decision about university attendance, they appear to be less sensitive to labor market information. In addition, high minimum wages have a positive but insignificant effect on the likelihood to drop out of university (column 6). This result confirms that once students have enrolled in university and made their PSE decisions, labor market information does not play a key role anymore. In fact, in Canada, the most common reasons to drop out of university are whether students liked their program and whether they thought it was for them (Finnie and Qiu, 2008). Financial considerations and the desire to work affect access to university but do not strongly affect persistence in university.

Column 7 investigates the decision to return to university as mature student. Workers, who separate from their job, are more likely to return to school if the minimum wage is high. On average, these workers have some post-secondary education below university. Separating from a job when the minimum wage is high encourages them to advance their studies. A 10% increase in the minimum wage raises the likelihood to return to university by 0.005. This is an 18% increase from the mean, implying an elasticity of 1.8. This result is consistent with the hypothesis that the minimum wage increases competition in the labor market, which may persuade individuals to return to school and acquire new skills. According to Brochu and Green (2013), an increase in the minimum wage reduces both layoffs and hiring rates. In high minimum-wage regimes, employers are less likely to hire and they are also less likely to lay off existing workers. For the workforce as a whole, these effects offset each other leaving employment unchanged. For young workers, the hiring effect dominates leading to a reduction in youth employment. In other words, although the minimum wage reduces youth employment only, hiring rates and layoffs decline for all ages implying that there are fewer jobs available in the economy and these jobs are more stable (Brochu and Green, 2013). Therefore, individuals who separate from their employers in high minimum-wage regimes will face more competition in the labor market when searching for a new position. This in turn may persuade them to return to school and acquire additional skills. Consistently, the Appendix shows that an increase in the minimum wage encourages individuals to return to

TABLE 3
The impact of the minimum wage on community-college decisions

Dependent variable:	Enrolled_{ipt}	Enrolled_{ipt}	Enrolled_{ipt}	Enrolled_{ipt}	Dropped_{ipt}	Returned_{ipt}
Sample:	All	Father has university degree	Father does not have univ. degree	All	All	All
	(1)	(2)	(3)	(4)	(5)	(6)
$\ln(\text{MW}_{pt})$	0.066***	0.112**	0.056***	0.065***	-0.260	0.147***
	(0.016)	(0.043)	(0.019)	(0.016)	(0.203)	(0.042)
$\ln(\text{MW}_{pt})\times\text{RecentHS}_{ipt}$				-0.086*		
				(0.048)		
RecentHS_{ipt}				0.700***		
				(0.095)		
Elasticity of the dependent variable with respect to the minimum wage:						
All	0.56	0.71	0.49	0.56	-0.96	2.22
Recent high-school graduates				-0.18		
Non-recent high-school graduates				0.55		
N	211,790	23,866	187,924	211,790	9,499	20,431
R^2	0.179	0.257	0.163	0.194	0.064	0.041

Source: Survey of Labour of Income Dynamics (1993-2011).
Notes: Clustered standard errors in parenthesis. Each regression includes the following control variables: year fixed effects, province fixed effects, age, age squared, gender, marital status, aboriginal background, province of residence, family income, family size, parental education, a binary indicator for residence in rural areas, de-trended provincial GDP, average university tuition in the province, the percentage of individuals living in rural areas in the province and the provincial post-secondary wage premium. p<0.1*; p<0.05**; p<0.01***.

university only if they lost their job. An increase in the minimum wage does not encourage individuals with continuing work experience to return to university (see Section A.4 in the Appendix).

The results are strikingly different for community college, as shown in Table 3. As the minimum wage increases, individuals are more likely to attend community college (column 1), less likely to drop out of community college (column 5) and more likely to return to community college when separating from a job (column 6). These effects are not driven by recent high-school graduates: the interaction term in column 4 is negative. Rather, they are driven by fewer dropouts and more mature students returning to school. The most affected variable is *Returned*: a 10% increase in the minimum wage raises the likelihood to return to

community college by 0.014. This is a 22% increase from the mean, implying an elasticity of 2.2. We conclude that the minimum wage has a strong impact on the decision to return to community college.

These findings should not be interpreted as evidence of substitution between community-college education and university education. The students who choose not to go to university when the minimum wage is high are not the same students who choose to attend community college in high minimum-wage regimes. On the one hand, as the minimum wage rises, students who are completing high school and have low parental education choose to enter the labor market rather than enrolling in university. In this case, a higher opportunity cost of education reduces the incentive to study. On the other hand, students who are already enrolled in community college are more likely to stay enrolled, and individuals who separate from a job are more likely to return to school to advance their studies. In this case, difficulties in finding a job appear to dominate the increase in the opportunity cost of education.

When combining university and community college together we find that the minimum wage has a modest negative effect on overall PSE enrollment: a 10% increase in the minimum wage reduces the likelihood of being enrolled in post-secondary education by 1%. This elasticity is similar to what Pacheco and Cruickshank (2007) find for overall school enrollment (high-school and PSE together) in New Zealand.

As previously mentioned, our results with respect to community college differ from those found in Lee (2020) for the US. One possible explanation is that community colleges in the US and Canada differ in terms of students and programs offered. Skolnik (2020) provides an extensive analysis of the differences between the Canadian and American PSE systems. In summary, community colleges in Canada almost exclusively provide vocational education and very few community-college students transfer to university. A community-college degree is considered a terminal degree by most students, with the exception of students in Quebec. Instead, in the United States, 67% of 2-year institutions provide academic training (National Center for Education Statistics). In addition, 2-year institutions are more likely to be seen as

TABLE 4
Enrollment in CEGEPs in the province of Quebec

Dependent variable:	Enrolled$_{it}$	Enrolled$_{it}$
Institution:	CEGEP	CEGEP
Age group:	18-45	18-24
	(1)	(2)
$ln(MW_t)$	-0.010	-0.067
	(0.050)	(0.194)
N	48,010	9,476
R^2	0.441	0.359

Source: Survey of Labour of Income Dynamics (1993-2011).
Notes: Clustered standard errors in parenthesis. Each regression includes the following control variables: linear time trend, age, age squared, gender, marital status, aboriginal background, family income, family size, parental education, a binary indicator for residence in rural areas, de-trended provincial GDP, average university tuition in the province, the percentage of individuals living in rural areas in the province and the provincial post-secondary wage premium. p<0.1*; p<0.05**; p<0.01***.

a stepping stone to university: approximately 22% of individuals with a community-college degree in the US also earned a bachelor's degree within 6 years (Skolnik, 2020, p. 11). Taken together, these differences suggest that 2-year institutions in the US should be more comparable to Canadian universities than Canadian community colleges. Not surprisingly, our elasticity for university enrollment (-0.52) is very similar to the estimates in Lee (2020) ranging from -0.44 to -0.49.

To verify that our interpretation of the results is correct, we re-estimate the impact of the minimum wage on enrollment in Collèges d'Enseignement General et Professionel (CEGEPs) in the province of Quebec. These community colleges differ from the typical community college in Canada because they offer both vocational and academic training. In fact, high-school graduates who wish to attend university in Quebec must complete a two-year program in a CEGEP before enrolling in university. Approximately 50% of CEGEP students are enrolled in these pre-university programs.[20] This feature makes them more similar to community colleges in the US. Table 4 investigates how the minimum wage in

[20]https://fedecegeps.ca/en/a-few-figures-on-cegeps/

Quebec affects the likelihood of being enrolled in a CEGEP. The dependent variable is equal to one if the individual is enrolled in a CEGEP and zero if the individual is not a student. The regression includes all variables included in our baseline specification (see equation 1) except for province fixed effects and time fixed effects since only one province offers CEGEPs (i.e. Quebec). In place of year fixed effects, we include a linear time trend. For the same reason, the standard errors are clustered by year, instead of year and province. As expected, the number of observations drops substantially and the standard errors are large. However, the sign of the main coefficient of interest is consistent with our expectations. An increase in the minimum wage reduces the likelihood of attending a CEGEP program.

In summary, our findings combined with existing studies in the literature suggest that vocational training responds differently to the minimum wage compared to academic training. When the minimum wage increases, individuals are less likely to attend academic programs but they are more likely to attend vocational programs. We conclude that looking at a pooled PSE enrollment measure masks interesting dynamics such as the positive effect on vocational education and on the decision to return to community college.

5.1 **Exploring the timing of minimum wage changes**

A plausible concern regarding our results is that minimum wage increases may be correlated with other provincial policies taking place during the same year, which in turn could affect education decisions. For example, provincial governments in favor of raising the minimum wage may also be likely to implement education policies. In order to address this concern, we exploit the timing of school enrollment decisions and the timing of minimum wage changes.

Enrollment at the beginning of the year, say in January, should not be significantly affected by minimum wage changes occurring later that year because January enrollment depends on schooling decisions made during the prior year. Since SLID reports detailed information on monthly enrollment for each respondent, we can directly test whether enrollment at the beginning of the year is affected by minimum wage changes that take place later

in the same calendar year. If our minimum wage variable captures the effect of the minimum wage only, we should not see any impact. In particular, we estimate the following model:

$$Enrolled^{m}_{ipt} = \beta_0 + \beta_1 ln(MW_{pt}) + \beta_2 ln(MW_{pt}) \times June_{pt} + \boldsymbol{\beta_3 X'_{ipt}} + \boldsymbol{\alpha_4 Z'_{pt}} + u_{ipt}. \quad (2)$$

Here, $Enrolled^{m}_{ipt}$ is equal to one if individual i living in province p in year t was enrolled in university during month m, and zero if the individual was not a student. We create a similar variable also for community college. $June_{pt}$ is a binary indicator equal to one if the minimum wage in province p in year t was in effect by June, and zero otherwise. The remaining variables have the same interpretation as in equation (1). Tables 5-6 report the estimated coefficients $\hat{\beta}_1$ and $\hat{\beta}_2$ for university and community college, respectively. We report the results for enrollment in two separate months, January and September, and in two clusters, January-April and September-December. The two clusters correspond to the Winter and Fall terms in the Canadian higher education system.[21] We do not consider summer months because few students are enrolled in the summer.

We use June as threshold because, on average, minimum wage changes in our sample were announced with a notice of 8 months to allow businesses to prepare for the change. Therefore, the minimum wage rates that became effective in June were announced early enough to affect Fall enrollment of the same calendar year but not soon enough to affect Winter enrollment of the same calendar year.

The coefficient β_1 represents the impact of minimum wages that became effective after June. Instead, the sum $\beta_1 + \beta_2$ represents the impact of minimum wages effective on or before June; these minimum wages may have been in place since the previous year (if there was no legislative change) or may have become effective on or before June that year. As one would expect, $\hat{\beta}_1$ is very close to zero when studying university enrollment in January or January-April, see columns 1-2 in Table 5. This coefficient becomes negative only when we

[21] In Canada, the Fall term starts in September and ends in December, the Winter term starts in January and ends in April.

TABLE 5
University enrollment at different points in time

Dependent variable:	Enrolled$^{\mathbf{m}}_{ipt}$	Enrolled$^{\mathbf{m}}_{ipt}$	Enrolled$^{\mathbf{m}}_{ipt}$	Enrolled$^{\mathbf{m}}_{ipt}$
m:	**January**	**Jan-Apr**	**September**	**Sept-Dec**
Institution:	University	University	University	University
	(1)	(2)	(3)	(4)
$\ln(\text{MW}_{pt})$	0.002	0.006	-0.026	-0.021
	(0.041)	(0.042)	(0.048)	(0.050)
$\ln(\text{MW}_{pt})\times\ June_{pt}$	-0.107***	-0.117***	-0.101**	-0.104**
	(0.040)	(0.042)	(0.049)	(0.051)
N	91,894	92,199	92,708	92,948
R^2	0.301	0.296	0.359	0.355

Source: Survey of Labour of Income Dynamics (1993-2011).
Notes: Clustered standard errors in parenthesis. Each regression includes the following control variables: year fixed effects, province fixed effects, age, age squared, gender, marital status, aboriginal background, province of residence, family income, family size, parental education, a binary indicator for residence in rural areas, de-trended provincial GDP, average university tuition in the province, the percentage of individuals living in rural areas in the province and the provincial post-secondary wage premium. p<0.1*; p<0.05**; p<0.01***.

consider Fall enrollment (i.e. September and September-December). These results suggest that minimum wages becoming effective after June do not impact enrollment early in the year, while they have a slightly negative impact on enrollment late in the year.

Instead, $\hat{\beta}_1 + \hat{\beta}_2$ is always negative. In other words, minimum wages that were already effective in the first half of the year, including minimum wages that did not change from the previous year, have a negative effect on enrollment in every month. We reach similar conclusions for community college enrollment, as shown in Table 6. Minimum wages already in place by June have a positive impact on enrollment in every month (i.e. $\hat{\beta}_1 + \hat{\beta}_2$ is positive). Instead, minimum wages effective after June have a positive impact only on Fall enrollment (i.e. $\hat{\beta}_1$ is positive only when considering enrollment late in the year). Taken together, these results confirm that our minimum wage variable behaves as one would expect and does not appear to inadvertently pick up other factors. Also note that the standard errors are larger when estimating the coefficients for community college compared to university. This could

TABLE 6
Community-college enrollment at different points in time

Dependent variable:	Enrolled$^m_{ipt}$	Enrolled$^m_{ipt}$	Enrolled$^m_{ipt}$	Enrolled$^m_{ipt}$
m:	**January**	**Jan-Apr**	**September**	**Sept-Dec**
Institution:	College	College	College	College
	(1)	(2)	(3)	(4)
ln(MW$_{pt}$)	-0.012	-0.011	0.047	0.041
	(0.039)	(0.045)	(0.034)	(0.033)
ln(MW$_{pt}$)× $June_{pt}$	0.066*	0.064	0.035	0.043
	(0.037)	(0.044)	(0.029)	(0.030)
N	85,248	85,863	85,917	86,495
R^2	0.196	0.145	0.199	0.151

Source: Survey of Labour of Income Dynamics (1993-2011).
Notes: Clustered standard errors in parenthesis. m stands for month(s). Each regression includes the following control variables: year fixed effects, province fixed effects, age, age squared, gender, marital status, aboriginal background, province of residence, family income, family size, parental education, a binary indicator for residence in rural areas, de-trended provincial GDP, average university tuition in the province, the percentage of individuals living in rural areas in the province and the provincial post-secondary wage premium. p<0.1*; p<0.05**; p<0.01***.

be due to the fact that starting dates are somewhat flexible in community colleges, whereas universities typically have a stricter admission cycle. Thus, our assumptions regarding the timing of education decisions are more likely to fit the university environment than community colleges. In addition, as discussed in previous sections, the results for community college are strongly affected by dropouts, who can respond to changes in the minimum wage at any point in time. This can explain why the coefficients for $ln(MW_{pt}) \times June_{pt}$ have similar magnitudes as those for $ln(MW_{pt})$ in columns 3 and 4.

5.2 **Robustness analysis**

In this section, we further investigate the robustness of our results using sensitivity checks that are common in the literature. Previous papers used different minimum wage variables without reaching a consensus on a preferred measure. Therefore, we replace the real minimum wage with alternative variables and report the results for university enrollment in

TABLE 7
Robustness analysis - University enrollment

Dependent variable:	Enrolled_{ipt}	Enrolled_{ipt}	Enrolled_{ipt}	Enrolled_{ipt}	Enrolled_{ipt}	Enrolled_{ipt}
Model:	LPM	LPM	LPM	Logistic	LPM	LPM
Sample:	Full	Full	Full	Full	Selected provinces	Age 18-24
	(1)	(2)	(3)	(4)	(5)	(6)
$\ln(\text{Nominal MW}_{pt})$	-0.079***					
	(0.015)					
$\ln(\frac{NominalMW_{pt}}{Mean\ wage_{pt}})$		-0.183***				
		(0.053)				
$\ln(\text{MW}_{pt})$			-0.071*	-0.077***	-0.099***	-0.197***
			(0.038)	(0.014)	(0.017)	(0.040)
$\ln(\text{MW}_{p,t-1})$			-0.029			
			(0.038)			
$\ln(\text{MW}_{p,t-2})$			0.044			
			(0.034)			
$\ln(\text{MW}_{p,t+1})$			-0.019			
			(0.034)			
$\ln(\text{MW}_{p,t+2})$			-0.007			
			(0.038)			
N	220,518	220,518	220,518	220,518	127,591	45,069
R^2	0.322	0.322	0.327	0.338	0.321	0.255

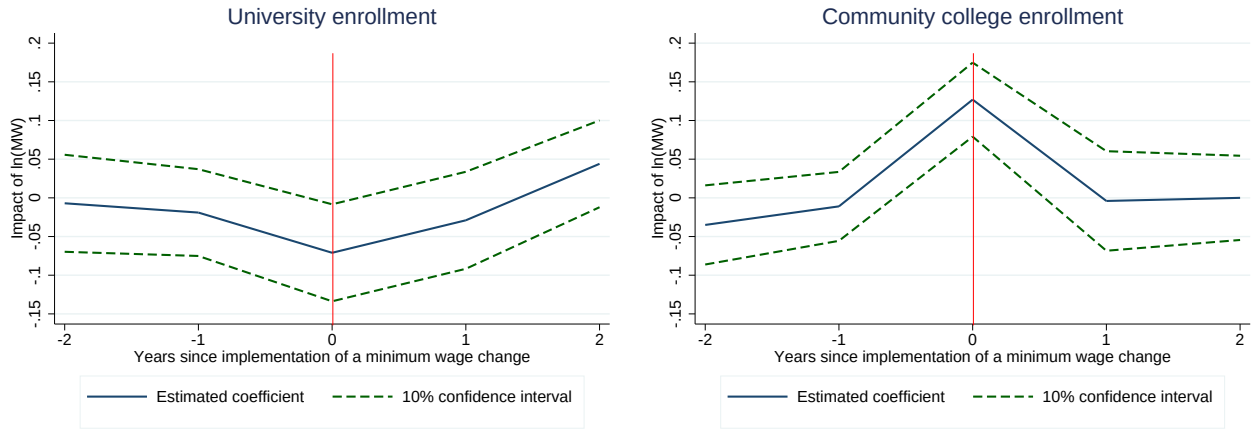
Source: Survey of Labour of Income Dynamics (1993-2011).
Notes: Clustered standard errors in parenthesis. LPM = linear probability model. Each regression includes the following variables: year fixed effects, province fixed effects, age, age squared, gender, aboriginal background, residence in rural areas, family income, parental education, marital status, family size, number of earners in the family, de-trended provincial GDP, provincial post-secondary wage premium, fraction of people living in rural areas in the province, average tuition in the province. p<0.1*; p<0.05**; p<0.01***.

Table 7 and for community college in Table 8. In both tables, we replace the real minimum wage with the nominal minimum wage (column 1) and with the ratio between the nominal minimum wage and the average wage in the economy (column 2). The latter measure is also known as the Kaitz index, and was used in Burkhauser et al. (2000) and Neumark and Wascher (1995a) among others.[22] The results are robust in all specifications.

Column 3 estimates a distributed-lag model to investigate the timing of minimum wage effects. Distributed-lag models have been used in several minimum wage studies (e.g. Cengiz

[22]It is common in the American literature to multiply this ratio by the minimum-wage coverage rate. However, in Canada, coverage is nearly universal. For this reason, we do not adjust for coverage, which is consistent with other Canadian studies on the minimum wage (see e.g. Baker et al., 1999; Campolieti et al., 2005b).

FIGURE 2 Distributed lag model



et al., 2019; Meer and West, 2016). To ease the interpretation of the results, the coefficients from this column are plotted in Figure 2. Note that the minimum wage has a contemporaneous (i.e. within the year) effect on university and community college enrollment. This is in line with Neumark and Wascher (1995a) who find a contemporaneous effect of the minimum wage on American high-school enrollment. In Canada, student surveys reveal that about 25% of high-school students do not make their post-secondary decisions until grade 12 or later (King and Warren, 2006). Even among those who make PSE decisions early on, many change their preferences along the way.[23] Therefore, it is not surprising that the minimum wage has a contemporaneous impact on schooling decisions. In addition, the one-year lag coefficient in column 3 reveals that the impact on university enrollment lasts up to the following year, although this effect is small and insignificant compared to the contemporaneous effect (i.e. -0.029 compared to -0.071 respectively). The impact on community college enrollment is more short-lived and disappears quickly within a year. Further, the minimum wage does not encourage enrollment before the new rate is implemented, as one would expect.

Column 4 reports the marginal effect of the real minimum wage when the baseline specification is re-estimated using a logistic model instead of a linear probability model. The logistic model generates marginal effects that are very similar to those generated by the

[23]In the province of Ontario, 55% of grade-10 students report that they would like to attend university, but the percentage drops to 33% by grade 12 (King and Warren, 2006).

TABLE 8
Robustness analysis - Community college enrollment

Dependent variable:	Enrolled_{ipt}	Enrolled_{ipt}	Enrolled_{ipt}	Enrolled_{ipt}	Enrolled_{ipt}	Enrolled_{ipt}
Model:	LPM	LPM	LPM	Logistic	LPM	LPM
Sample:	Full	Full	Full	Full	Selected provinces	Age 18-24
	(1)	(2)	(3)	(4)	(5)	(6)
$\ln(\text{Nominal MW}_{pt})$	0.066***					
	(0.016)					
$\ln(\frac{NominalMW_{pt}}{meanwage_{pt}})$		0.185***				
		(0.050)				
$\ln(\text{MW}_{pt})$			0.127***	0.070***	0.074***	0.107**
			(0.029)	(0.016)	(0.017)	(0.047)
$\ln(\text{MW}_{p,t-1})$			-0.004			
			(0.039)			
$\ln(\text{MW}_{p,t-2})$			-0.000			
			(0.033)			
$\ln(\text{MW}_{p,t+1})$			-0.011			
			(0.027)			
$\ln(\text{MW}_{p,t+2})$			-0.035			
			(0.031)			
N	211,790	211,790	211,790	211,790	125,545	36,950
R^2	0.179	0.179	0.186	0.204	0.189	0.145

Source: Survey of Labour of Income Dynamics (1993-2011).
Notes: Clustered standard errors in parenthesis. LPM = linear probability model. Each regression includes the following variables: year fixed effects, province fixed effects, age, age squared, gender, aboriginal background, residence in rural areas, family income, parental education, marital status, family size, number of earners in the family, de-trended provincial GDP, provincial post-secondary wage premium, fraction of people living in rural areas in the province, average tuition in the province. p<0.1*; p<0.05**; p<0.01***.

linear probability model.

Next, we test the robustness of the results to the exclusion of provinces that change their minimum wage very frequently. One may be concerned that with frequent changes individuals are able to anticipate future increases, which would make the interpretation of the results difficult since individuals may be adjusting today to minimum wage changes that will happen in the future. For this reason, we restrict the sample to provinces that implement infrequent changes to their minimum wage: British Columbia, Alberta and Ontario. Approximately 60% of the Canadian population lives in these provinces. Column 5 shows that the results are robust when restricting the sample to these provinces.

Finally, column 6 estimates the results on the subset of individuals aged 18-24. We find

that a 10% increase in the minimum wage reduces the likelihood of being in university by 0.019. The mean value of the dependent variable for this subset is 0.5251, which implies an elasticity of university enrollment with respect to the minimum wage of approximately -0.4. This elasticity is similar to that estimated from the full sample. With respect to community college, instead, the elasticity changes from 0.56 to 0.25 when restricting the sample to young individuals.[24] This confirms our previous findings suggesting that the impact of the minimum wage on community college enrollment is mainly driven by mature students.

Another plausible concern regarding our results is that an increase in the minimum wage in one province could attract workers from nearby provinces. This migration would bias our results if migrants were less likely to enroll in university and more likely to enroll in community college compared to incumbents. However, it is worth noting that interprovincial migration in Canada is very low. During the time period considered, the highest emigration rate was experienced by Newfoundland and Labrador in 1997 when 3% of residents moved out of province. All other emigration rates were less than 3%. We report migration rates in Appendix Table A6. In addition, we test whether the decision to migrate affects our results in Table 9. Specifically, we construct a binary indicator ($Migrated_{ipt}$) equal to one if individual i living in province p at time t changed province of residence between time $t-1$ and time t, and zero otherwise. We include this indicator in our regressions together with all variables present in our baseline specification, see columns 1 and 3. We also re-estimate equation 1 using the sub-sample of individuals who did not migrate, see columns 2 and 4. As shown in Table 9, our results are not driven by migration patterns. Note that when restricting the sample to non-migrants only, we are indirectly introducing a selection bias in our sample since there are systematic differences between non-migrants and migrants. Therefore, the coefficient of $ln(MW_{pt})$ should be interpreted with caution in this case. Nevertheless, we use this sample restriction to verify that our results are not driven by migrants.

Finally, we conduct an additional test in the Appendix using provincial-level data rather

[24]The mean value of college enrollment among 18-24 year olds is 0.40. Thus, the elasticity is given by $0.107 \times ln(1.1)/0.40/0.1$.

TABLE 9
Controlling for migration decisions

Dependent variable:	Enrolled$_{ipt}$	Enrolled$_{ipt}$	Enrolled$_{ipt}$	Enrolled$_{ipt}$
Institution:	University	University	Community College	Community College
Sample:	All	Non-migrants	All	Non-migrants
	(1)	(2)	(3)	(4)
ln(MW$_{pt}$)	-0.079***	-0.100***	0.066***	0.100***
	(0.016)	(0.013)	(0.016)	(0.014)
$Migrated_{pt}$	✓		✓	
N	212,640	153,563	203,924	147,746
R^2	0.325	0.338	0.184	0.193

Source: Survey of Labour of Income Dynamics (1993-2011).
Notes: Clustered standard errors are in parenthesis. Each regression includes the following variables: year fixed effects, province fixed effects, age, age squared, gender, aboriginal background, residence in rural areas, family income, parental education, marital status, family size, number of earners in the family, de-trended provincial GDP, provincial post-secondary wage premium, fraction of people living in rural areas in the province, average tuition in the province. p<0.1*; p<0.05**; p<0.01***.

than individual-level data. As pointed out by Glaeser et al. (2003), when studying individual responses to a policy, individual-level data should be preferred to aggregate data if social multiplier effects are present. If a policy affects an individual's schooling decisions, which in turn affect peers' schooling decisions, aggregate data will overestimate individual elasticities because of this social interdependence. Therefore, individual-level data should be used if available.[25] Nevertheless, policy makers may be more interested in the effects of the minimum wage on aggregate enrollment than on individual behavior. Therefore, Section A.6 of the Appendix investigates the impact of the minimum wage on provincial enrollment rather than on an individual's likelihood to be in school. The results are qualitatively the same. However, the magnitude of the effects is larger when using provincial data, which is consistent with the presence of social effects. For example, a 10% increase in the minimum wage reduces university enrollment by 5.2% when using individual data and by 7.7% when using aggregate data. We refer the reader to the Appendix for more details on the provincial-level analysis.

[25]This approach was also followed by Neumark and Wascher (1995b), Campolieti et al. (2005b) and Brochu and Green (2013), among others.

6 Conclusions

Existing studies show that minimum wages could affect individuals' careers by increasing the chances of unemployment. Our results show that minimum wages can affect careers also by influencing education decisions. A 10% increase in the minimum wage reduces post-secondary enrollment by 1%. However, this modest impact on overall PSE enrollment masks more pronounced effects: a 10% increase in the minimum wage reduces university enrollment by 5% and increases community-college enrollment by 6%. We find even larger effects on the decision to drop out of community college and the decision to return to post-secondary school as mature student. Note that, in Canada, universities offer academic programs while community colleges offer almost exclusively occupation-specific training. Therefore, high minimum wages discourage enrollment in academic programs but stimulate enrollment in vocational programs.

Our estimates suggest that the elasticity of enrollment with respect to the minimum wage is larger than the employment elasticities estimated in the literature, which are typically below 0.5 in absolute value (Wascher and Neumark, 2006). Typically, a 10% increase in the minimum wage reduces teenage employment by less than 5%. In other words, minimum wage policies have stronger effects on education than employment.

The effect on university enrollment is driven by high-school graduates with low paternal education, who are generally less likely to attend university and are even less likely to enroll when the minimum wage rises. Instead, the positive effect on community-college enrollment is driven by older students. As the minimum wage increases, students already enrolled in community college are less likely to drop out, and workers who separate from their job are more likely to return to community college to advance their studies.

These results indicate that the impacts of the minimum wage are highly heterogeneous. When considering increases in the minimum wage, policy makers face a trade-off in terms of educational outcomes. An increase in the minimum wage stimulates the accumulation of occupation-specific human capital among mature students but discourages the accumula-

tion of general human capital among recent high-school graduates from low socio-economic backgrounds. Overall, the net impact on post-secondary enrollment is negative but modest. Thus, from an education standpoint, whether a minimum wage increase is desirable or not mainly depends on the political weight assigned to each effect.

Our findings also raise the possibility that minimum wage policy may affect intergenerational mobility since the minimum wage strengthens the link between parental education and university enrollment. Students with low levels of parental education are generally less likely to enroll in university, and even less likely to do so when the minimum wage rises. This may or may not be concerning, depending on the returns to education that those students would have achieved. Studying the long-run effects of the minimum wage on social mobility is beyond the scope of this paper but represents an important direction for future research.

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Online Appendix for "Minimum wage effects on human capital accumulation: Evidence from Canadian data"

This Online Appendix is organized as follows. Section A.1 provides details on the construction of the variables used in our analysis. Section A.2 tests the robustness of our main results to the inclusion of time trends and to clustering. Section A.3 shows that our sample generates employment elasticities with respect to the minimum wage that are consistent with the literature. Section A.4 runs sensitivity tests on the decision to return to school as mature student. Finally, Section A.5 reports migration rates in Canada while Section A.6 repeats the main analysis using provincial-level data.

A.1 Data sources

The majority of variables were obtained directly or derived from confidential files of the Survey of Labour and Income Dynamics (SLID). The files were accessed through Statistics Canada Research Data Centers. The data dictionary can be found at

https://www150.statcan.gc.ca/n1/pub/75f0026x/2011000/alpha-eng.htm

Specifically we used the following variables: age26, sex99, mards26, eoabor15, edmoth21, edfath21, hhsz25, adsain25, urbrur25, minwag1, minwag28, wagune1, pvreg25, atuniv20, atcc20, cmphi18, cmphi20, rcuniv20, rccoll20. Additionally, we incorporated data on: annual university tuition by province from Statistics Canada "Tuition and living accomodation costs for full-time students at Canadian degree granting institutions"; provincial GDP from Statistics Canada (Table: 36-10-0222-01); provincial minimum wages from the Government of Canada; and the Consumer Price Index from Statistics Canada (Table 18-10-0005-01) used to transform nominal variables into real variables. The baseline sample includes all individuals aged 18-45 with a high-school degree living in any Canadian province except for the province of Quebec. As specified in the main text, this province is excluded from the main analysis because its education system differs substantially from that in other provinces.

TABLE A1 Provincial linear time trends

Dependent variable:	Enrolled$_{ipt}$	Dropped$_{ipt}$	Returned$_{ipt}$	Enrolled$_{ipt}$	Dropped$_{ipt}$	Returned$_{ipt}$
Institution:	University	University	University	Comm. college	Comm. college	Comm. college
	(1)	(2)	(3)	(4)	(5)	(6)
ln(MW$_{pt}$)	-0.080***	0.095*	0.109***	0.071***	-0.445*	0.154***
	(0.019)	(0.055)	(0.028)	(0.020)	(0.246)	(0.055)
N	220,518	16,963	19,658	211,790	9,499	20,431
R^2	0.322	0.070	0.026	0.179 0.065	0.041	

Clustered standard errors in parenthesis. Each regression includes the following control variables: linear provincial time trends, year fixed effects, province fixed effects, age, age squared, gender, marital status, aboriginal background, province of residence, family income, family size, parental education, a binary indicator for residence in rural areas, de-trended provincial GDP, average university tuition in the province, the percentage of individuals living in rural areas in the province and the provincial post-secondary wage premium. p<0.1*; p<0.05**; p<0.01***.

A.2 **Additional robustness tests**

In Table A1, we report the effects of the provincial real minimum wage $ln(MW_{pt})$ on university and college decisions respectively, when provincial linear time trends are included in the main specification:

$$Y_{ipt} = \alpha_0 + \alpha_1 ln(MW_{pt}) + \boldsymbol{\alpha_2}\mathbf{X'_{ipt}} + \boldsymbol{\alpha_3}\mathbf{Z'_{pt}} + v_p + v_p \times t + v_t + u_{ipt} \tag{A1}$$

where Y is an educational outcome, $ln(MW_{pt})$ is the natural logarithm of the real minimum wage in province p in year t, $\mathbf{X_{ipt}}$ is a vector of control variables for individual i, $\mathbf{Z_{pt}}$ is a vector of provincial control variables, $u_{ipt} = v_t + v_p + \epsilon_{ipt}$, $\epsilon_{ipt} \sim \mathcal{N}(0,1)$, v_t and v_p represent year and province fixed effects respectively.

Table A1 shows that adding provincial linear time trends does not affect the results, consistent with previous Canadian studies on the employment effects of the minimum wage (Baker et al., 1999; Rybczynski and Sen, 2018). However, the standard errors tend to be smaller. For this reason, in the main text, we present the most conservative estimates that exclude provincial time trends.

Next, we include nonlinear region-specific time effects as in Dube et al. (2010). These

TABLE A2 Nonlinear region-specific time effects

Dependent variable:	Enrolled$_{ipt}$	Dropped$_{ipt}$	Returned$_{ipt}$	Enrolled$_{ipt}$	Dropped$_{ipt}$	Returned$_{ipt}$
Institution:	University	University	University	Comm. college	Comm. college	Comm. college
	(1)	(2)	(3)	(4)	(5)	(6)
ln(MW$_{pt}$)	-0.098***	0.082*	0.053**	0.073***	-0.311	0.166***
	(0.016)	(0.042)	(0.023)	(0.018)	(0.221)	(0.046)
N	220,518	16,963	19,658	211,790	9,499	20,431
R^2	0.322	0.072	0.027	0.179	0.066	0.042

Clustered standard errors in parenthesis. Each regression includes the following control variables: region-specific time effects, province fixed effects, age, age squared, gender, marital status, aboriginal background, province of residence, family income, family size, parental education, a binary indicator for residence in rural areas, de-trended provincial GDP, average university tuition in the province, the percentage of individuals living in rural areas in the province and the provincial post-secondary wage premium. p<0.1*; p<0.05**; p<0.01***.

time trends are more flexible since they do not assume linearity. Note that we cannot include nonlinear time effects at the provincial level since this is the level of variation of our main variable of interest, the minimum wage. Regions have been created by grouping Canadian provinces together: Region 1 (Newfoundland and Labrador, Nova Scotia, New Brunswick, Prince Edward Island), Region 2 (Saskatchewan, Manitoba), Region 3 (Ontario, Alberta, British Columbia). Region time effects are then introduced as follows:

$$Y_{ipt} = \alpha_0 + \alpha_1 ln(MW_{pt}) + \boldsymbol{\alpha_2}\mathbf{X'_{ipt}} + \boldsymbol{\alpha_3}\mathbf{Z'_{pt}} + v_p + \gamma_{region} \times v_t + u_{ipt} \tag{A2}$$

where γ_{region} are regional binary indicators and the remaining variables have the same interpretation as before. The results are reported in Table A2. Introducing region fixed effects tends to increase the magnitude of the coefficients slightly, leaving our conclusions unchanged.

We also experiment with clustering. In the main text, the standard errors are clustered by year and province. Here we report standard errors clustered by province only. Note that there are 10 provinces in Canada. As discussed by Cameron et al. (2008), clustered standard errors are biased downwards if the number of clusters is small, e.g. 10 provinces. In this case, wild-cluster bootstrap inference is typically used to correct the bias caused by a small

TABLE A3 Clustering by province only

Dependent variable:	Enrolled$_{ipt}$	Dropped$_{ipt}$	Returned$_{ipt}$	Enrolled$_{ipt}$	Dropped$_{ipt}$	Returned$_{ipt}$
Institution:	University	University	University	Comm. college	Comm. college	Comm. college
	(1)	(2)	(3)	(4)	(5)	(6)
ln(MW$_{pt}$)	-0.079***	0.029	0.057***	0.066**	-0.260***	0.147***
	[0.002]	[0.668]	[0.000]	[0.016]	[0.002]	[0.008]
N	220,518	16,963	19,658	211,790	9,499	20,431
R^2	0.322	0.072	0.027	0.179	0.066	0.042

Clustered standard errors in parenthesis. Each regression includes the following control variables: time fixed effects, province fixed effects, age, age squared, gender, marital status, aboriginal background, province of residence, family income, family size, parental education, a binary indicator for residence in rural areas, de-trended provincial GDP, average university tuition in the province, the percentage of individuals living in rural areas in the province and the provincial post-secondary wage premium. p<0.1*; p<0.05**; p<0.01***.

number of clusters. In Table A3 we report the main coefficients of interest together with wild-cluster bootstrapped p-values in squared brackets. Clustering by province increases the significance level of our estimates, but leaves our conclusions unchanged. For this reason, in the main text, we present the most conservative estimates based on clustering by province and time.

A.3 **The effect of the minimum wage on employment**

In this section, we test whether our sample generates labor market effects consistent with previous studies in the literature. We estimate the following specification:

$$Employed_{ipt} = \alpha_0 + \alpha_1 ln(MW_{pt}) + \boldsymbol{\alpha_2} \mathbf{X'_{ipt}} + \alpha_3 \widetilde{GDP_{pt}} + u_{ipt} \tag{A3}$$

where $Employed_{ipt}$ is equal to one if individual i living in province p was employed at any time during year t, and 0 otherwise. Note that the zero category includes both unemployed and individuals out of the labor force. $ln(MW_{pt})$ is the natural logarithm of the real minimum wage in province p at time t. The vector X'_{ipt} contains the following individual-level control variables: age, age squared, gender, marital status, aboriginal status, years of schooling,

TABLE A4 Minimum wage effects on employment

Dependent variable:	Employed_{ipt}	Employed_{ipt}	Employed_{ipt}
Age group:	15-19	20-24	18-45
	(1)	(2)	(3)
$\ln(\text{MW}_{pt})$	-0.084*	-0.018	0.013
	(0.044)	(0.045)	(0.022)
[Elasticity]	[-0.186]	[-0.025]	[0.016]
N	39,727	44,875	279,000
R^2	0.118	0.033	0.064

Clustered standard errors in parenthesis. Each regression includes the following control variables: year fixed effects, province fixed effects, age, age squared, gender, marital status, aboriginal background, province of residence, family income, family size, parental education, a binary indicator for residence in rural areas, de-trended provincial GDP, average university tuition in the province, the percentage of individuals living in rural areas in the province and the provincial post-secondary wage premium. p<0.1*; p<0.05**; p<0.01***.

parental education, and an indicator for residence in a rural area. $\widetilde{GDP_{pt}}$ is de-trended GDP and captures business conditions. As explained in the main text, governments may be more likely to approve minimum wage changes during expansions, which are associated with a higher level of employment. Since this correlation would bias $\hat{\alpha_1}$ upward, we include GDP de-trended with an HP filter and a smoothing parameter of 6.25 following (Ravn and Uhlig, 2002). $u_{ipt} = v_t + v_p + \epsilon_{ipt}$, $\epsilon_{ipt} \sim \mathcal{N}(0,1)$, v_t and v_p represent year and province fixed effects respectively.

The specification is estimated using a linear probability model. For consistency with the literature, we study the following age groups: teenagers (age 15-19) and young adults (age 20-24). The vast majority of studies investigating the employment effects of the minimum wage focused on these two groups, who are more likely to be affected by minimum wage policies. However, we also analyze individuals aged 18-45 since this is the age group we use when studying education outcomes.

Table A4 reports the main coefficient of interest, $\hat{\alpha_1}$, together with standard errors clustered by province and year for consistency with our baseline specification. The table shows that the minimum wage reduces employment among teenagers. The elasticity is -0.19 for teenagers, -0.02 for young adults and 0.02 for age group 18-45. These numbers are in

TABLE A5 The decision to return to school

Dependent variable:	Returned$_{ipt}$	Returned$_{ipt}$	Returned2$_{ipt}$	Returned$_{ipt}$	Returned$_{ipt}$	Returned2$_{ipt}$
Institution:	University	University	University	Community College	Community College	Community College
Age group:	18-45	25-45	18-45	18-45	25-45	18-45
	(1)	(2)	(3)	(4)	(5)	(6)
ln(MW$_{pt}$)	0.057***	0.060**	0.001	0.147***	0.114**	0.063***
	(0.024)	(0.021)	(0.009)	(0.042)	(0.050)	(0.014)
N	19,658	16,362	108,053	20,431	16,818	109,403
R^2	0.026	0.021	0.013	0.041	0.015	0.023

Clustered standard errors in parenthesis. Each regression includes the following control variables: year fixed effects, province fixed effects, age, age squared, gender, marital status, aboriginal background, province of residence, family income, family size, parental education, a binary indicator for residence in rural areas, de-trended provincial GDP, average university tuition in the province, the percentage of individuals living in rural areas in the province and the provincial post-secondary wage premium. p<0.1*; p<0.05**; p<0.01***.

line with existing Canadian studies. The Canadian meta-analysis conducted by Campolieti (2020) shows that employment elasticities for teenagers are typically between -0.1 and -0.3, while those for adults are closer to zero. The most recent estimates produced by Rybczynski and Sen (2018) display an elasticity of -0.17 for female teenagers and -0.09 for male teenagers. Among 20-24 year olds, they find 0.03 for women and 0.01 for men. These numbers are from their estimations without provincial time trends, which match our baseline specifications, see columns 1 in Tables 2 and 3 of their paper. We conclude that our sample generates employment elasticities that are consistent with previous studies on the Canadian economy.

A.4 **Robustness analysis on the decision to return to school**

This section tests the robustness of our results regarding the decision to return to school. Columns 1 and 4 of Table A5 report the estimates from the main text. Columns 2 and 5 show that the estimated coefficients are similar if we restrict the sample to individuals aged 25-45. Since we are interested in individuals who return to school after having acquired some labor market experience, restricting the sample to this age group may be more relevant than using the whole sample (age 18-45). However, we find very similar coefficients. Next, we redefine

our $Returned_{ipt}$ variable. In the main text, an individual is considered a *Returned* student if the person worked at time $t-1$ for at least 1040 hours without being in school, has separated from the job between time $t-1$ and time t, and is enrolled in university (community college) at time t. Instead, in columns 3 and 6, we consider a broader definition by relaxing the condition that the individual must have separated from the job. This new variable, $Returned2_{ipt}$, is equal to one if individual i worked at time $t-1$ for at least 1040 hours without being in school and is enrolled in university (community college) at time t. The variable takes a value of zero if the individual worked in the prior year but is not enrolled in the current year. Column 6 reveals that the results for community college are qualitatively similar while column 3 shows that the coefficient for university becomes very small and insignificant. This change suggests that an increase in the minimum wage encourages individuals to return to university only in the case of a job loss. This job loss can either be voluntary or involuntary. However, it is unlikely that an increase in the minimum wage encourages individuals with continuing work experience to return to university. For community college, instead, departing from a job is not a necessary condition: the minimum wage still has an impact on the decision to return to community college even if the individual is working (see column 6). This reflects the fact that many community-college students are able to work while studying. Therefore, job separation is not necessary to convince individuals to pursue a community-college diploma.

A.5 **Interprovincial migration**

Table A6 reports summary statistics of provincial migration rates and shows that inter-provincial migration in Canada is very low. During the time period considered, less than 2% of individuals living in Canada changed their province of residence. The province of Newfoundland and Labrador tends to have the highest migration rates, but these rates never exceeded 3% during 1993-2011. This table supports our discussion in the main text arguing that selective migration cannot explain our results (see Section 5.2 in the main text).

TABLE A6 Emigration rate by province of origin, 1993-2011

Province	Out-migrants (% of population)		
	Mean value	Minimum value	Maximum value
Newfoundland and Labrador	2.12	1.40	3.00
Prince Edward Island	1.92	1.56	2.38
Nova Scotia	1.79	1.52	2.00
New Brunswick	1.61	1.36	1.86
Quebec	0.40	0.31	0.52
Ontario	0.56	0.47	0.69
Manitoba	1.48	1.16	1.76
Saskatchewan	1.90	1.44	2.31
Alberta	1.61	1.34	1.95
British Columbia	1.14	0.90	1.53

Data source: Statistics Canada, Tables 17-10-0022-01 and 17-10-0005-01.

A.6 **Provincial-level analysis**

The analysis reported in the main text is conducted at the individual level. Using micro-data, we estimated the impact of the minimum wage on an individual's likelihood of being in post-secondary education. Several papers in the minimum wage literature used micro-data to study the impact of the minimum wage on high-school enrollment or employment (e.g. Brochu and Green, 2013; Campolieti et al., 2005b; Neumark and Wascher, 1995b). Alternatively, one could use provincial-level data and study the impact of the minimum wage on provincial enrollment. For example, this approach was used by Baker (2005) and Lee (2020) when studying school enrollment (i.e. high school and PSE combined) and community-college enrollment, respectively. Whether one approach dominates the other depends on the research question. If one is interested in estimating individual elasticities, then using individual-level data is preferable (Glaeser et al., 2003). If one is interested in the impact of the minimum wage on aggregate enrollment, then jurisdiction-level data is more appropriate. In order to test the robustness of our results and to ease the comparison between our findings and some of the studies in the literature, this section repeats the analysis using provincial data. We use enrollment numbers from Statistics Canada Table

37-10-0018-01, which is based on administrative records. That is, the variables we use refer to the entire population. We retrieve provincial enrollment in universities and community colleges separately, for all provinces excluding Quebec (for consistency with our micro-data analysis). We then regress logged provincial enrollment rates on the logged real minimum wage (MW) and control variables (Z):

$$E^i_{pt} = \gamma_0 + \gamma_1 ln(MW_{pt}) + \gamma_2 Z'_{pt} + v_t + v_p + \epsilon_{pt} \tag{A4}$$

where $\epsilon \sim N(0,1)$, v_t represents time effects, v_p represents province fixed effects, $i \in \{UNI, COL\}$ and E is the logarithm of the provincial enrollment rate in university (E^{UNI}_{pt}) or community college (E^{COL}_{pt}). Control variables include de-trended provincial GDP (used as proxy for business cycles), the level of provincial GDP (used as proxy for income), average university tuition in the province, provincial spending on education as a percentage of GDP and the provincial PSE wage premium.

The model specification resembles that used by Baker (2005) who studied the impact of the minimum wage on school enrollment (i.e. high school and PSE combined) among Canadian youths. The main differences are that we look at enrollment in post-secondary education specifically, we distinguish between university and community college, and we use enrollment figures based on administrative data rather than survey data.[26]

Table A7 confirms the results found in the main text. Increasing the minimum wage reduces university enrollment and increases enrollment in community colleges. In column 1 we present the estimated coefficient when only year and province fixed effects are included. Then, we add the control variables in column 2 and linear provincial time trends in column 3. The latter is included following Dube et al. (2010) who advise to include regional time trends when studying the impacts of the minimum wage on regional employment. There is no consensus in the minimum wage literature on whether to include regional time trends (see e.g. Neumark et al. 2014 and Totty 2017 for a review of this debate). However, we

[26]Baker (2005) constructed enrollment rates using data from the Canadian Labour Force Survey.

TABLE A7 The relationship between the minimum wage and provincial enrollment rates

Dependent variable:	E_{pt}^{UNI}	E_{pt}^{UNI}	E_{pt}^{UNI}	E_{pt}^{COL}	E_{pt}^{COL}	E_{pt}^{COL}
	(1)	(2)	(3)	(4)	(5)	(6)
$ln(MW_{pt})$	-0.816***	-0.813***	-0.772***	1.445***	1.292***	1.823***
	(0.200)	(0.188)	(0.211)	(0.283)	(0.354)	(0.471)
Year fixed effects	✓	✓	✓	✓	✓	✓
Province fixed effects	✓	✓	✓	✓	✓	✓
Controls		✓	✓		✓	✓
Provincial linear time trend			✓			✓
Observations	171	171	171	171	171	171
R-squared	0.816	0.929	0.852	0.817	0.837	0.891

Bootstrapped p-values are in squared brackets. Controls include provincial unemployment rate, provincial average level of university tuition, provincial GDP, provincial spending on education, the fraction of workers paid at the minimum wage in the province, and the provincial PSE wage premium. p<0.1*; p<0.05**; p<0.01***.

find that including provincial time trends does not significantly affect the results. We reach this conclusion both when using individual and provincial-level data (Tables A1 and A7 respectively).

Note that the elasticities of enrollment with respect to the minimum wage are higher when using aggregate data compared to individual-level data. A 10% increase in the real minimum wage decreases university enrollment by 8% when using aggregate data and by 5% with individual-level data. Likewise, the elasticity of college enrollment with respect to the minimum wage more than doubles when using aggregate data. The fact that aggregate elasticities are larger than individual elasticities is consistent with the presence of social effects. If a change in the minimum wage affects an individual's schooling level, which in turn affects peers' schooling levels, then provincial data overestimate individual elasticities. Since we are interested in individual responses to the minimum wage, our preferred estimates are those based on micro-data and reported in the main text.