Why More Education Will Not Solve Rising Inequality (and May Make It Worse)

Kelly Foley and David A. Green

Probably the most commonly proposed and the most commonly agreed upon policy response to rising income inequality is to increase the level of human capital in the economy. This consensus likely arises because increasing human capital in general, and education in particular, has the appearance of a silver bullet. The specific people who get the added skills benefit directly from extra income. But, it is commonly argued, there are also what economists call general equilibrium effects, in the sense that each added person who gets more education is one less person to compete with low-skilled workers and one more to compete with the higher-skilled. In a basic economic model, the result is an increase in the wages of the low-skilled relative to those of the high-skilled. Moreover, raising aggregate education levels has potential beneficial effects far beyond battling inequality — including increased economic growth, improved health and a more resilient democracy (Oreopoulos and Salvanes 2011). It does all of this while reinforcing the virtue of self-reliance and promoting feelings of self-worth, since the largest investment required in acquiring human capital is in the form of time and effort, for which the individual expects to reap a well-deserved reward.

Whether education policy can really deliver on these promises, of course, depends on the other forces that affect the economy and on the way education policy is implemented. If declining union membership and power have driven inequality trends, then it is not clear that more education is the natural policy response. If instead technological change has increased demand for skills associated with higher education, then more education might be the right response. Even here, though, more education could have counterproductive effects on inequality if employers respond to a more-educated workforce by adopting new technologies. In that case, less-educated workers who are unable to work with the

new technologies essentially would be left behind, and inequality could increase (Beaudry and Green 2005). In addition, regardless of what drives increasing inequality, if education policy is implemented in a way that perpetuates the income differences of the parents' generation among their children, more education ultimately could lead to more inequality. The relationship between human capital policy and inequality is far from straightforward.

Our goal in this chapter is to take a step toward a better understanding of the relationship between human capital and income inequality in Canada. We begin that process by first documenting what has been going on with returns to various levels of education in this country in recent decades. One could ask many questions about the impact of education policy on inequality, but given limited space, we have chosen to investigate two of the most important. First, what has been the impact of education on Canada's wage and earnings structure in recent decades, and what is it likely to be in the near future? In economists' jargon, what are the general equilibrium effects of education policy? Does it really act as a sort of automatic stabilizer for inequality? Second, what role have education and more broadly defined "human capital" policy played in either exacerbating or reducing inequality trends? To foreshadow our discussion, our main conclusion is that human capital policy cannot be counted on to reduce inequality in the near term. Indeed, directing more resources to university education, especially if within the current system, could increase inequality; moreover, increased spending on colleges and apprenticeships might not be much better. On the other hand, expenditures on early childhood, elementary and secondary education could have positive longer-term impacts on income inequality for future generations.

Recent Trends in Education and Inequality

In characterizing how trends in education during the period from 1980 to 2013 relate to changes in earnings and inequality, it will become apparent that the years before 2000 are qualitatively different from the years that follow.

Data and methodology considerations

The data we use come from two sources. The first is the census returns for 1981, 1986, 1991, 1996 and 2001. Both Frenette, Green and Milligan (2007) and Boudarbat, Lemieux and Riddell (2006) argue that census data are the best for

studying inequality and returns to education because of their high coverage rate. Census data, however, have two drawbacks. First, they stop in 2006.[1] Second, the definition of the education categories changed twice over our sample period. The first change, in 1991, represented more of a consolidation of questions than a radical change in what was asked, and so did not cause us substantial problems. The change in 2006, however, was substantial, which makes it difficult to compare the results from that census with those from earlier censuses.

Our second source of data is Statistics Canada's Labour Force Survey (LFS), a large, representative survey collected each month to produce labour force measures such as the unemployment rate. The LFS has a lower response rate than the census, but, as we will see, the patterns in the LFS for the late 1990s are similar to those in the census data. The main disadvantages of the LFS are its sample size, which is much smaller than the census, and the fact that it included questions on wages starting only in 1997. On the positive side, the LFS extends to 2013, it has a consistent education question from 1990 onward, and the categories in that question are reasonably comparable to the pre-2006 census categories. Plots of wage patterns and numbers of workers in education categories from both the censuses and the LFS from the mid-1990s onward suggest that the change in the education questions in the 2006 Census makes it noncomparable both to earlier censuses and to the LFS. For this reason, we present plots of censuses up to 2001 combined with those of the LFS from 1990 to 2013.[2]

We focus on weekly wages, which in the census are constructed by dividing earned income in the calendar year prior to the census by the number of weeks worked in that year. In the LFS, weekly wages are obtained by multiplying the usual hourly wage on the main job by the number of usual hours worked per week in all jobs.[3] It is common in examinations of education differentials to restrict attention to full-time workers (see, for example, Boudarbat, Lemieux and Riddell 2006). The idea is to try to examine a relatively homogeneous category of workers, at least in terms of their commitment to the labour market. Doing this allows researchers to focus on composition-constant wages, which correspond more closely to the price of labour and can be related more directly to factors, such as technological change, that drive labour demand. Moreover, since the census does not include measures of hourly wages, restricting attention to full-time workers is a way of approximately controlling for hours worked.

In this chapter, we take a broader view by examining the weekly wages of all employed workers. Using a broader set of workers implies that some wage movements observed might reflect changes in the proportion of full- and part-time workers in the labour force, rather than movements in the underlying wages themselves. Part of the return to education — and part of its impact on overall income inequality — can come from the fact that better educated individuals are more likely to work full time and, indeed, to work at all. We also show some results using weekly earnings for everyone, including those with zero earnings, to further investigate the extent to which human capital affects the earnings distribution by increasing the likelihood of employment.[4]

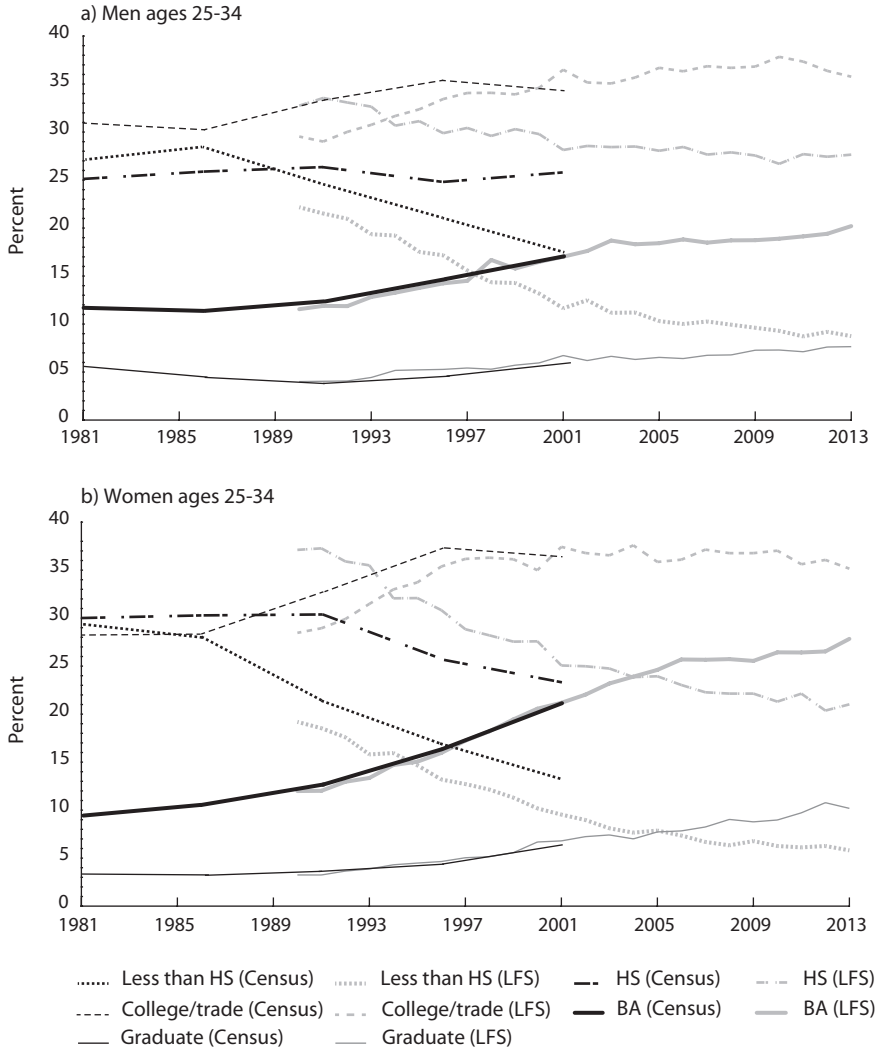
Movements in simple mean earnings by education category might reflect the shifting age composition of the labour force as the smaller, less-educated cohorts who preceded the baby boom retire and the large, well-educated baby boom generation moves up through the age structure. To correct for this, we present earnings differentials between education categories based on regressions of log weekly wages on a set of education dummy variables and a set of dummy variables corresponding to five-year age categories. We report the coefficients on the education variables that correspond to earnings differentials between a given education group and the base group (high school graduates), holding constant the age composition of the workers. That is, the reader should think of the movements in education-related earnings differentials that we report as the ones that would happen if we could follow a group of workers with exactly the same age composition through time.

We focus on five categories of education corresponding to the highest level of schooling attained: (1) less than high school; (2) high school diploma; (3) a college or trade certificate; (4) a bachelor's degree; and (5) a graduate degree. The college and trades category includes individuals with trades and certificates and, in Quebec, those with a CEGEP education. Individuals in the graduate category have master's, doctoral or professional degrees, such as those in law and medicine. For the exact categories, see table A1 in the appendix.

Changing returns to education and earnings inequality

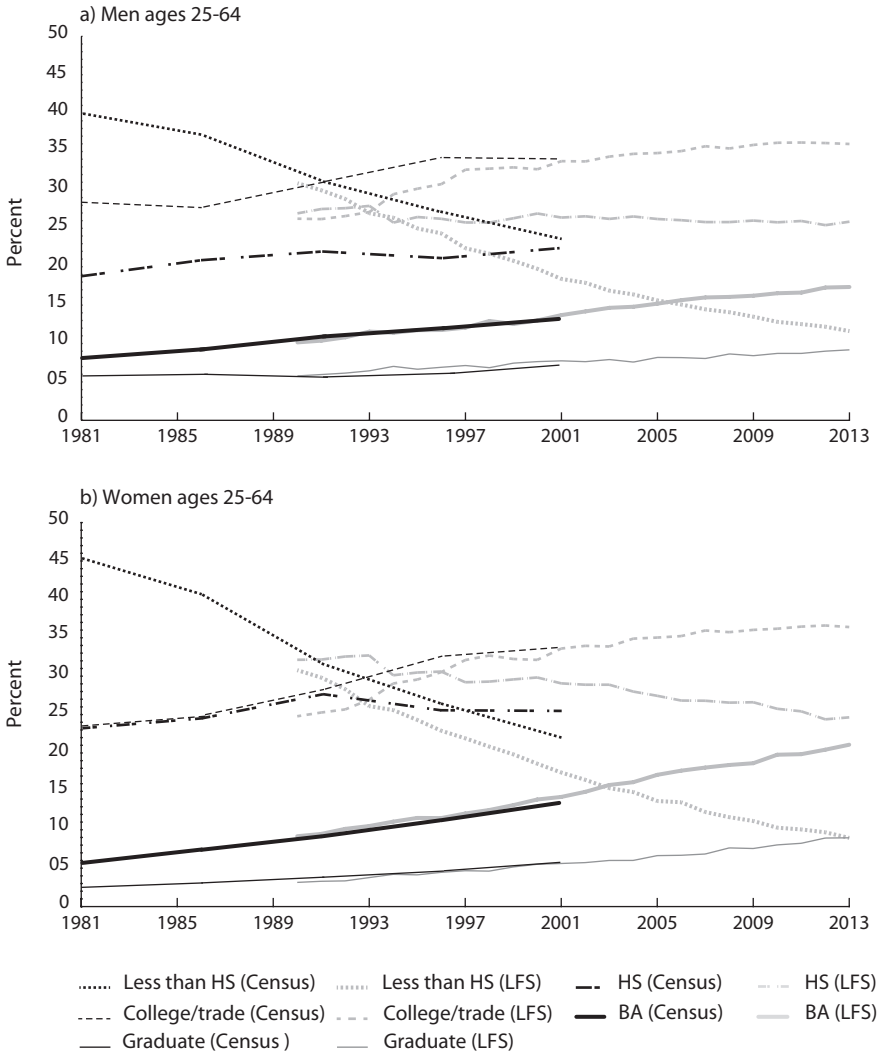
The aggregate level of education among Canadians ages 25 to 34 has been rising consistently, in both relative and absolute terms, since 1981 (see figure 1). This age group can be thought of as the flow of potential new workers entering the

Figure 1
Educational attainment, men and women ages 25-34, Canada, 1981-2013



Source: Authors' calculations based on Statistics Canada, Census of Canada, 1981-2001, and Labour Force Survey (LFS), 1990-2013.
HS = high school
BA = bachelor's degree

Figure 2
Educational attainment, men and women ages 25-64, Canada, 1981-2013



Source: Authors' calculations based on Statistics Canada, Census of Canada, 1981-2001, and Labour Force Survey (LFS), 1990-2013.
HS = high school
BA = bachelor's degree

labour market. High school dropouts constituted more than one-quarter of the age cohort in 1981, but by 2013 they had fallen below 10 percent for both men and women. Among women, the share of high school graduates also declined substantially, while the share of university graduates rose rapidly after 1990. By 2013, over a quarter of Canadian women ages 25 to 34 had a bachelor's degree and roughly another 10 percent had a graduate degree. In contrast, among men, the share of high school graduates remained fairly constant and the share of university graduates grew more slowly. The college and trades share also expanded between 1981 and 2013, and represents the largest education category for both men and women in the 25-to-34 age cohort. As the education level of each new cohort has increased and older, less-educated workers have retired, the education level of the whole working-age population (shown in figure 2) also has risen.

Although the share of Canadians with postsecondary credentials has been increasing, the quality of skills represented by these credentials is not necessarily constant. Bowlus and Robinson (2012) examine the implications of rising educational attainment for estimates of education-specific wages in the United States. They argue that the sizable increase in the proportion of the population with a university degree implies that the average ability level of university graduates has also changed over time. They also point out that more recent graduates have a different set of skills that could be valued differently. Taking account of these changes, they obtain estimates of underlying wages (or "prices" of human capital) that do *not* show a strong increase in education-related wage differentials in the United States.

In Canada, immigration constitutes an important source of educated workers, which also affects the type of human capital represented in these education shares. There is evidence that the quality of human capital obtained abroad is, on average, lower than that of native-born Canadians (see, for example, Ferrer and Riddell 2008). Thus, although our focus is on human capital policy, it is worth keeping in mind that changes in the composition of Canadian immigrants are also helping to determine the wage patterns we observe (on this topic, see Picot and Hou, and Warman and Worswick, in this volume).

We begin to describe these wage patterns in tables 1 and 2, which report the mean of log weekly wages of employed high school graduates and the relative wage gap between them and employed people in other education categories, separately by gender.[5] In these tables, we consider individuals ages 25 to 64, who might be thought of as the labour force "stock." The reported numbers are coefficients from regressions

Table 1
Education-based wage gaps[1] relative to high school graduates by education level, employed men ages 25-64, Canada, selected years

Census	**1980**	**1985**	**1990**	**1995**	**2000**
Mean wage ($)	851.670	939.617	959.425	930.325	980.242
	(2.051)	(3.333)	(2.422)	(2.629)	(2.552)
Mean log wage, high school graduates	6.609	6.659	6.643	6.570	6.594
	(0.004)	(0.004)	(0.003)	(0.003)	(0.003)
Wage gaps					
Less than high school	– 0.143***	– 0.134***	– 0.114***	– 0.106***	– 0.112***
	(0.005)	(0.005)	(0.004)	(0.005)	(0.005)
College and trades	0.062***	0.073***	0.089***	0.097***	0.107***
	(0.005)	(0.005)	(0.004)	(0.004)	(0.004)
Bachelor's degree	0.213***	0.229***	0.252***	0.269***	0.303***
	(0.007)	(0.007)	(0.005)	(0.006)	(0.005)
Graduate degree	0.319***	0.337***	0.333***	0.351***	0.365***
	(0.008)	(0.008)	(0.006)	(0.007)	(0.007)
Labour Force Survey		**1998**	**2003**	**2008**	**2013**
Mean wage ($)		808.148	816.882	861.021	844.435
		(1.861)	(1.972)	(2.110)	(2.236)
Mean log wage, high school graduates		6.509	6.487	6.533	6.530
		(0.004)	(0.004)	(0.005)	(0.005)
Wage gaps					
Less than high school		– 0.146***	– 0.126***	– 0.139***	– 0.110***
		(0.007)	(0.008)	(0.009)	(0.010)
College and trades		0.098***	0.130***	0.110***	0.133***
		(0.006)	(0.006)	(0.006)	(0.006)
Bachelor's degree		0.246***	0.265***	0.257***	0.254***
		(0.007)	(0.007)	(0.007)	(0.008)
Graduate degree		0.408***	0.383***	0.346***	0.334***
		(0.010)	(0.010)	(0.009)	(0.010)

Source: Authors' calculations based on data from the Census of Canada, 1981-2001, and the Labour Force Survey, 1998-2013.
[1] Wage gaps are estimated in a regression of log weekly wages on dummies for education and age group. Wages are measured in real 2000 Canadian dollars.
***p < .01

in which we also control for age using dummy variables corresponding to five-year age groups. The wage gaps in the top panels are estimated for the years 1980 to 2000 using census data,[6] and in the bottom panels for 1998 to 2013 using the LFS.

For men, the gap in the average weekly wages of the least- and most-educated widened throughout the 1980s and 1990s (see table 1). In

Table 2

Education-based wage gaps[1] relative to high school graduates by education level, employed women ages 25-64, Canada, selected years

Census	1980	1985	1990	1995	2000
Mean wage ($)	516.482 (2.770)	582.444 (2.766)	620.358 (2.006)	632.584 (2.051)	677.759 (2.108)
Mean log wage, high school graduates	6.012 (0.005)	6.100 (0.004)	6.138 (0.003)	6.113 (0.003)	6.160 (0.003)
Wage gaps					
Less than high school	– 0.173*** (0.006)	– 0.181*** (0.006)	– 0.168*** (0.005)	– 0.167*** (0.005)	– 0.164*** (0.005)
College and trades	0.122*** (0.006)	0.118*** (0.006)	0.127*** (0.004)	0.134*** (0.004)	0.133*** (0.004)
Bachelor's degree	0.407*** (0.010)	0.400*** (0.009)	0.402*** (0.006)	0.425*** (0.006)	0.424*** (0.005)
Graduate degree	0.549*** (0.013)	0.532*** (0.012)	0.555*** (0.008)	0.565*** (0.008)	0.559*** (0.007)
Labour Force Survey		**1998**	**2003**	**2008**	**2013**
Mean wage ($)		562.046 (1.527)	586.347 (1.587)	636.425 (1.662)	673.397 (1.818)
Mean log wage, high school graduates		6.077 (0.005)	6.072 (0.005)	6.129 (0.005)	6.153 (0.006)
Wage gaps					
Less than high school		– 0.250*** (0.009)	– 0.227*** (0.010)	– 0.221*** (0.011)	– 0.215*** (0.013)
College and trades		0.109*** (0.007)	0.149*** (0.007)	0.152*** 0.007)	0.160*** (0.007)
Bachelor's degree		0.404*** (0.009)	0.416*** (0.008)	0.400*** (0.008)	0.392*** (0.008)
Graduate degree		0.582*** (0.013)	0.570*** (0.012)	0.548*** (0.011)	0.576*** (0.010)

Source: Authors' calculations based on Statistics Canada, Census of Canada, 1981-2001, and Labour Force Survey, 1998-2013.

[1] Wage gaps are estimated in a regression of log weekly wages on dummies for education and age group. Wages are measured in real 2000 Canadian dollars.

***$p < .01$

particular, the wages of men in the college and trades category and both university categories increased relative to those of high school graduates. Moreover, the average wages of men with bachelor's and graduate degrees were substantially higher — in 2000, roughly 20 and 25 percent higher, respectively — than those of men with college or trade certificates. At the

other end of the educational range, high school dropouts earned between 11 and 14 percent less than high school graduates during this period.[7] After 2000, returns to a college or trade education continued to grow relative to returns to a high school education, but returns to a university degree began to fall. As we discuss in more detail in the next section, such movements in relative wages can occur because the wages of high school graduates are rising, the wages of university graduates are falling, or both.

To explore the extent to which these shifts in the wage structure were driven by young men, we plot relative wages of men ages 25 to 34 in figure 3a. In the early part of the 2000s, returns to a bachelor's or graduate degree began to fall, while the returns to a college or trade education rose slightly. By 2013, young men with a bachelor's degree earned on average 4 percent more than those with a college or trade education, compared with 13 percent more in 1998.[8] As we discuss in more detail below, however, the mean patterns in figure 3 mask substantial regional variation linked to resource-driven growth.

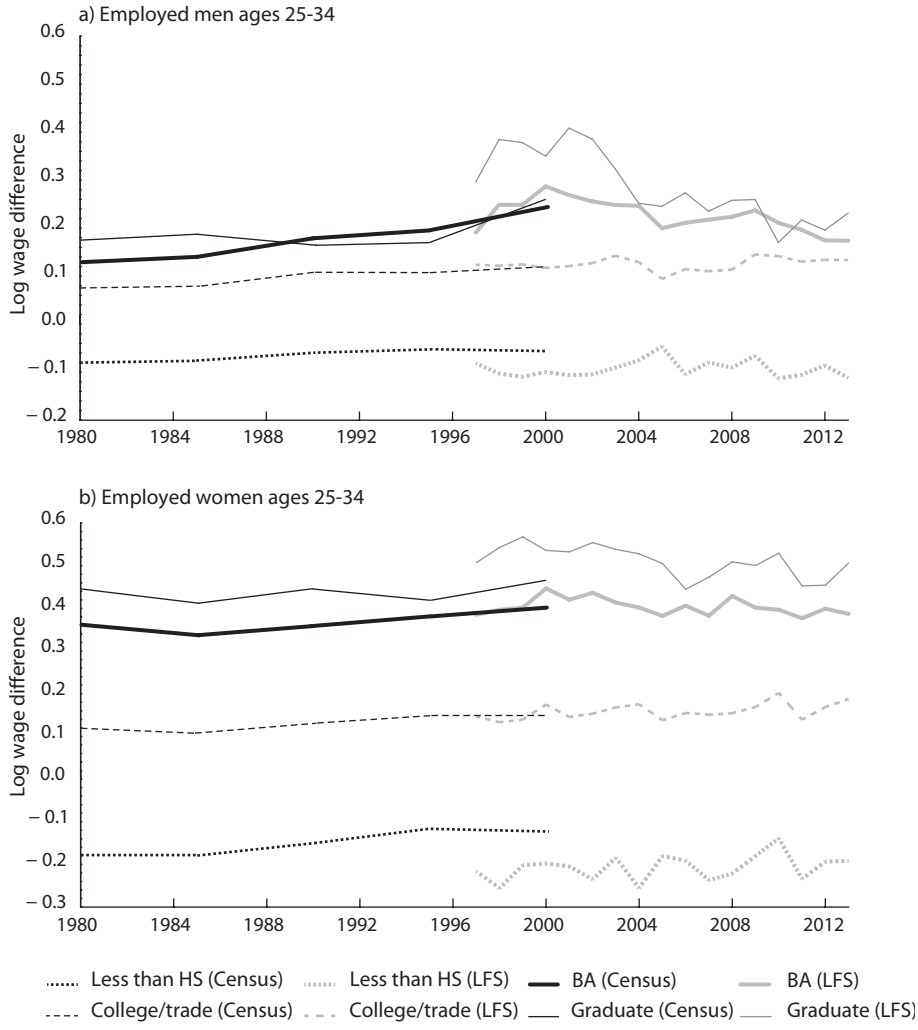
The pattern for women over the period has been far more stable than that for men, as table 2 shows. Among the sample of women, differences in the LFS and census estimates in the years they overlap are even more apparent than for men. This is likely because the LFS wage definition depends on variation in hours worked per week, while the census definition relies on weeks worked per year, and there tends to be more variation in part-time or part-year work among women. With this in mind, the returns to education among women ages 24 to 65 changed very little between 1980 and 2013.

Figure 3b shows that, for younger women, the relative wage of those with a graduate degree fell slightly in the 2000s, although this decline is not as pronounced as that among men. Moreover, in contrast to the men, by 2013 there remained a substantial gap (over 20 percent) between the average wages of female college and trades graduates and those of university graduates.

Another way human capital can affect the wage structure is by changing the relative chances of working. Thus, even though wage differentials based on education were falling after 2000, individuals might have been responding to favourable employment rates when they decided to pursue postsecondary credentials. As figure 4 shows, while young men with postsecondary credentials had employment rates that ranged from 5 to 15 percent higher than those of high school graduates, young women with postsecondary education had employment

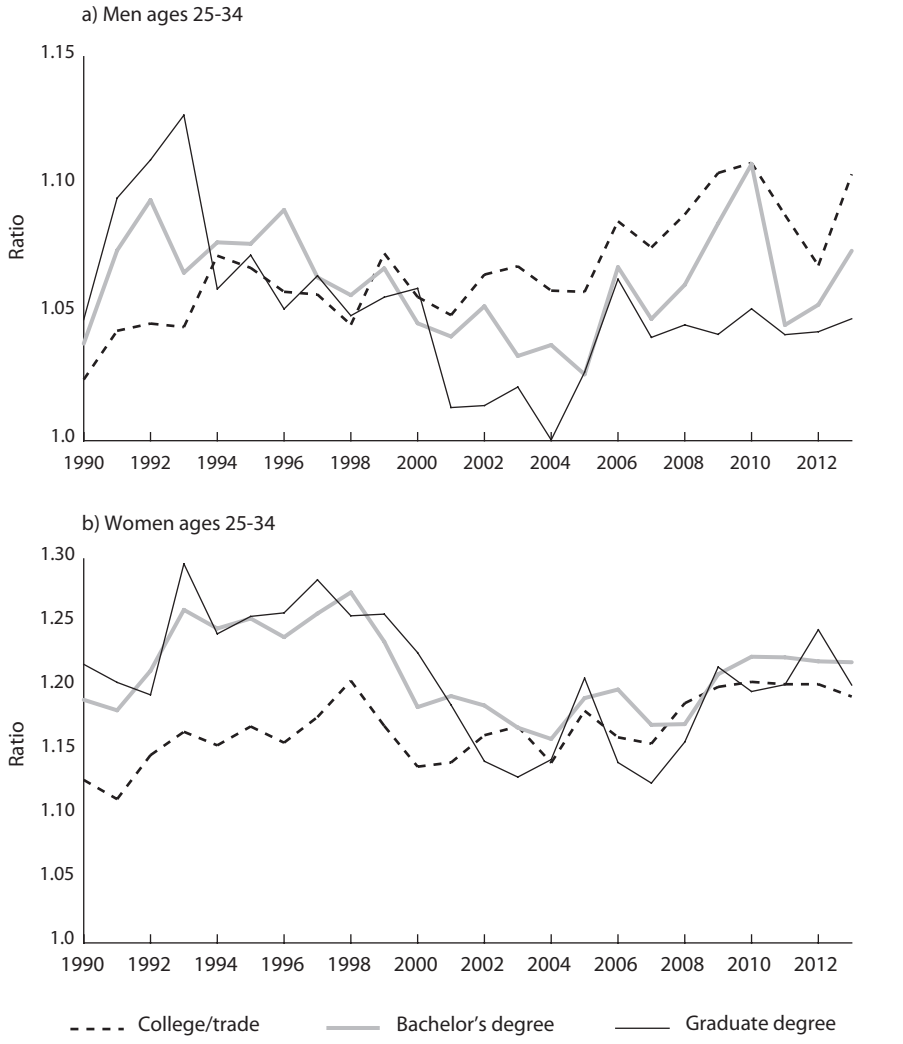
Figure 3

Education-based wage gap relative to high school graduates, by education level, Canada, 1980-2013



Source: Authors' calculations based on Statistics Canada, Census of Canada, 1981-2001, and Labour Force Survey, 1997-2013.
Note: Coefficients are from a regression of log weekly wages on dummies for education and age group.
HS = high school
BA = bachelor's degree

Figure 4
Employment rate of men and women ages 25-34 relative to high school graduate employment rate, by education level, Canada, 1990-2013



Source: Authors' calculations based on Statistics Canada, Labour Force Survey, 1990-2013.

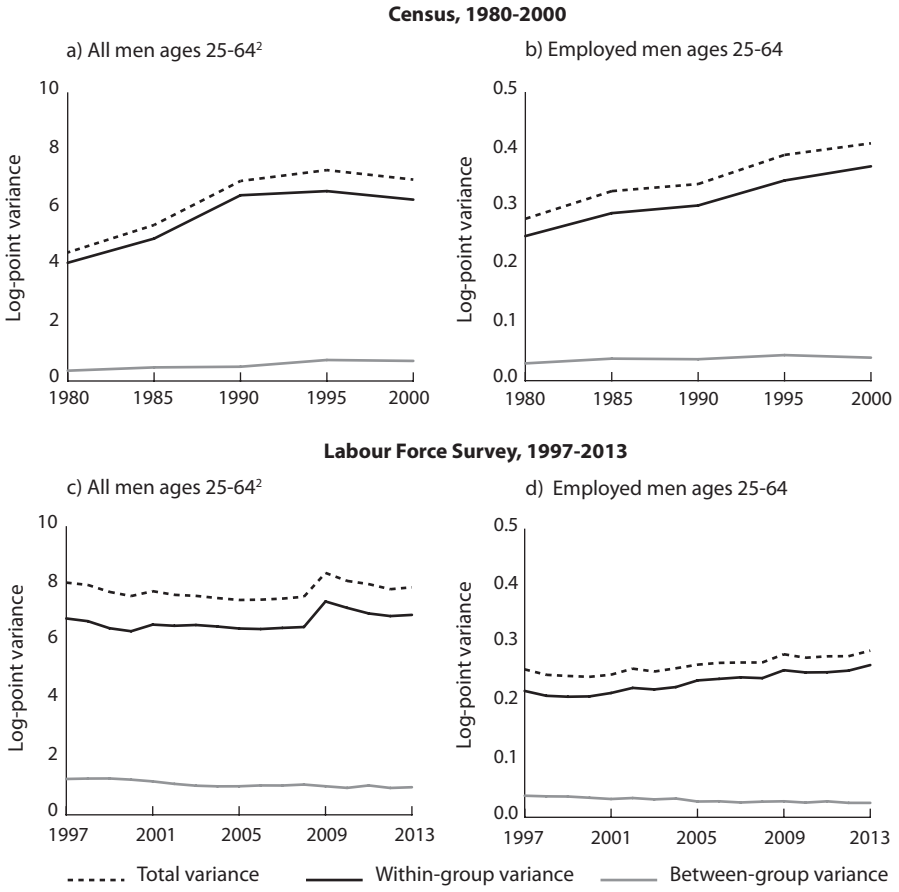
rates that were 15 to more than 25 percent higher than those of female high school graduates. Prior to 2000 for women and slightly earlier for men, having a university degree substantially increased the probability of working relative to

the chances for those with a college or trade education. After 2000, employment rates of women converged among the various categories of postsecondary education. Initially, the employment rates of women with university degrees fell to levels similar to those of college and trades graduates; then, after the middle of the 2000s, employment rates among all three postsecondary categories rose steadily. Among men, a similar pattern is evident except during the 2008 recession, when the employment advantage over high school graduates increased for men with a college or trade certificate or an undergraduate degree.

The other main dimension of human capital that is typically examined is postschooling work experience and training, often using movements in cross-sectional differences in earnings between more- and less-experienced workers. It is well recognized, however, that such movements represent a combination of differences in earnings across different cohorts of labour market entrants and differences in how cohorts' earnings grow as they gain experience. Beaudry and Green (2000) show that apparent increases in returns to experience measured in the cross-section before 2000 were due, in fact, to declining earnings levels across successive cohorts of labour market entrants. There is no evidence of increasing returns to experience in the sense of more recent cohorts having faster earnings growth with time in the labour market. In examining cohort patterns in the 2000s using LFS data, we find that the slopes of the cohort-specific earnings-experience profiles remained relatively constant over the period. Thus, shifts in returns to experience do not appear to be a main determinant of the inequality patterns we are observing.

Measuring directly how changes in the distribution of education, relative wages and employment rates relate to patterns of inequality is far from straightforward. Nonetheless, we present simple decompositions of the variance in log weekly earnings to gauge how much of the variability in earnings can be attributed to education, and whether this relationship has changed over time. In figures 5 and 6 we plot the total variance of the log of weekly wages for men and women, respectively. The variance, which is a way of measuring the spread or range of earnings, depends on the distance between individuals' earnings and the mean. If most people in a dataset have very similar earnings, the variance will be relatively small. The variance is larger if there are more people with earnings that are substantially higher or lower than the average. Thus, a larger variance implies more inequality.

Figure 5
Between-group and within-group[1] variance in men's log weekly wages, Canada, 1980-2013

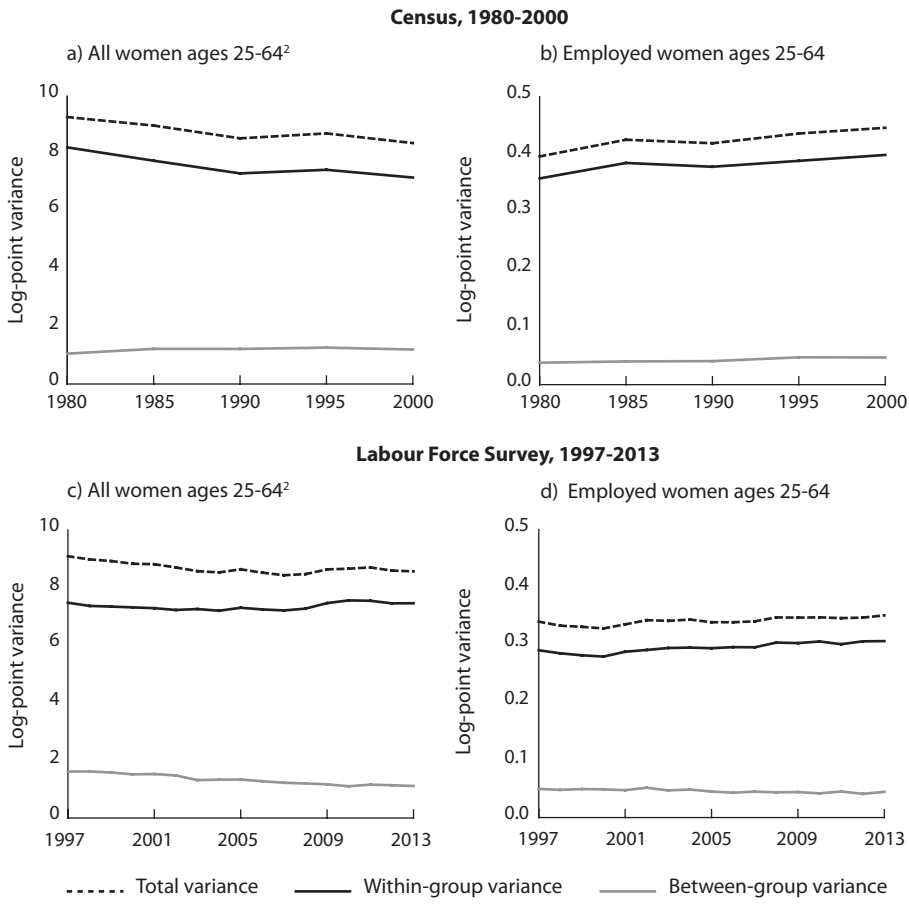


Source: Authors' calculations based on Statistics Canada, Census of Canada, 1981-2001, and Labour Force Survey, 1997-2013.
[1] Individuals are categorized by educational attainment (five levels) and in five-year age groups.
[2] The unemployed and those out of the labour force are included and their earnings are set to zero.

We decompose the variance of wages into what are commonly termed the "between-group" and "within-group" components. To understand this decomposition, think of an example with two education levels, high and low. If all workers at the high level earn the same wage and all those at the low level also earn the same wage (but lower than those at the high level), then the overall wage variance would approximately equal the square of the difference between the two wages.

Figure 6

Between-group and within-group[1] variance in women's log weekly wages, Canada, 1980-2013



Source: Authors' calculations based on Statistics Canada, Census of Canada, 1981-2001, and Labour Force Survey, 1997-2013.
[1] Individuals are categorized by educational attainment (five levels) and in five-year age groups.
[2] The unemployed and those out of the labour force are included and their earnings are set to zero.

This corresponds to the between-group component in the decomposition. In reality, wages of workers at both levels will vary around the average wage for each group. That variation corresponds to the within-group component. Variations in earnings within a group can occur for a host of reasons, including differences in individuals' union status, job-finding networks or ability to learn on the job. In our case, the between-group component is related to differences in average wages

between groups defined by age and education, while the within-group component reflects the variation within those groups.[9]

We use two measures of weekly wages that capture different sources of inequality.[10] One measure is the same weekly wages among all employed men and women we used previously; the second measure adds the unemployed and those out of the labour force, and sets their wages at zero. The latter definition of wages provides a way to gauge how education affects inequality through movements in and out of employment.

The trends in inequality in men's earnings reported in figure 5 are largely consistent with those found by Boudarbat, Lemieux and Riddell (2006), although we use a different measure of employment. In the census estimates, weekly earnings inequality of men increased steadily during the 1980s and 1990s, yet very little of that increasing inequality can be attributed to the dispersion of wages between education groups, whether or not we exclude those without earnings. For example, among employed men ages 25 to 64, the variance in log weekly earnings increased by 0.071 between 1990 and 2000 (figure 5b). Roughly 10 percent of that increase can be attributed to changes in the earnings differential between education groups, while the remaining 90 percent is due to within-group variations. Boudarbat, Lemieux and Riddell (2006) find that within-group variation plays a similarly large role in the variance of earnings among full-time workers.

For employed women, inequality increased more modestly, according to the census data (figure 6b). For all women ages 25 to 64, shown in figure 6a, inequality declined between 1980 and 2000 — a trend that can be explained by the increasing labour force participation of women during that period. Although the trends are somewhat different for women than for men, education and age explain a similarly small fraction of the variance in women's earnings.

Turning to the LFS data presented in figures 5c, 5d, 6c and 6d, we can see that earnings inequality among women was remarkably stable from the late 1990s to 2013. Among men, inequality increased only modestly during that period. The effect of the 2008 recession, however, is quite evident in figure 5c, where we include men without earnings. Employment losses during the recession increased the fraction of individuals without earnings, and thus increased total and within-group wage variance even if the structure of wages among those working had not changed. By 2013, the variability of men's earnings, including those with

no earnings, had nearly returned to its pre-recession level. As was the case with the census data, most of the variability in the log weekly earnings in the LFS was within the age-education groups.[11]

To summarize, during the 1980s and 1990s, while the share of Canadians with postsecondary credentials was expanding, the returns to education were also increasing, particularly for young men. At the same time, the variance and hence inequality in earnings were widening. Yet the increases in inequality occurred mostly within groups of individuals with similar levels of education. This suggests that the increased returns to education were not large enough, or the timing of the various changes was not sufficiently aligned, to account for the overall increase in inequality. After 2000, inequality stabilized, while the returns to university education among young men fell. In contrast, for women, the returns to education were relatively unchanged.

The Role of Human Capital in Recent Inequality Trends

With the data patterns from the previous section in hand, we can now examine alternative explanations of inequality patterns in Canada. Understanding what forces have been driving income inequality in the recent past and how they interact with inequality is an important first step in deciding the role that human capital policy should play in addressing inequality in the future. One key point that emerges from the data (especially from the return-to-education patterns) is that the 1980s and 1990s appear to be quite different from the post-2000 period.

The situation before 2000

Before 2000, the Canadian labour market was characterized by rising returns to education, a rising share of the population with all types of postsecondary education and a rising variance in earnings. These findings fit with the initial body of work on changes in the wage structure in developed economies after 1980. To understand the conclusions of that literature, we begin with a simple yet powerful neoclassical model of human capital and production. In particular, assume that the different levels of education all generate the same types of skills but in different quantities — for example, a university graduate might have twice the cognitive skills of a high school graduate on average, but what the two graduates

can do with those skills is the same. This is a demonstrably false assumption — one cannot, for example, get the equivalent of one brain surgeon by employing, say, five high school dropouts — but it allows us some insights, and it is the type of model often assumed in the existing literature.

In the context of this model, movements in the wages and employment of workers with different education levels are the outcome of differential shifts in the supply of and demand for skills. When, as we have seen for Canada before 2000, both the employment and the wages of more-educated workers increase relative to those of less-educated workers, the relative demand for skills must have increased compared with the relative supply. The idea that the developed economies were facing a skill-biased demand shift is the key conclusion from the first wave of the literature on changes in the wage structure. Much of the discussion in this literature then focused on what underlay this relative shift. Three main contenders were considered: institutional factors such as minimum wages and changes in unionization (see, for example, DiNardo, Fortin and Lemieux 1996); globalization — that is, the effects of trade and foreign direct investment (see, for example, Berman, Bound and Griliches 1994); and technological change (see Acemoglu and Autor 2011). The debate about which of these was the primary driving force is important because each has potentially different implications for the impact of human capital policy.

A broad consensus formed among economists that institutional and globalization factors could account for only a small portion of observed wage shifts. This left the third option — skill-biased technological change — as the preferred explanation. It is useful to keep in mind that the cards were stacked in favour of this conclusion from the outset, since the globalization and institutional determinants were evaluated using specific measures of each, while technological change was the residual explanation to which was attributed any movement that could not be linked explicitly to a measure of trade or institutional change. There is, however, reason to question the small role assigned to globalization and institutional determinants, as we will see. Nonetheless, the conclusion that changes in the returns to education and shifts in the wage structure more broadly were driven by technological change had a powerful appeal, particularly when paired with the obvious changes in the economy associated with the computer revolution.

Working from this consensus, consider what happens to returns to education and to inequality more generally if we introduce the computer revolution

into our supply-and-demand model. In the simplest model, computers are complements of skills, making human skills more productive regardless of the sector in which they are employed. In that case, the introduction of computers raises the return to education and leads to a straight increase in inequality, with the wages of those with the most skills rising relative to the wages of those with less. The appropriate policy response, then, is to increase the amount of skills in the economy through human capital policy. This both increases the ability of the economy to take advantage of the technological advances and reduces inequality, since the relative supply shift induced by policy serves to offset the relative demand shift for skills. In essence, upgrading the skills level of the workforce increases competition among high-skilled workers and reduces the competition faced by low-skilled workers. This is what underlies Tinbergen's famous claim that the evolution of the wage structure reflects a race between technological change and education. Thus, education policy is a "silver bullet," both allowing an increase in total output and instituting a more balanced distribution of the economy's rewards. It is worth noting that the form of the education policy does not matter: increasing the supply of skills through increased education at any level has the same influence.

The conclusion that the best response to inequality is more human capital has appeal across the political spectrum. Politicians and policy analysts of all stripes have advocated more human capital as the best response to inequality, at least in the long run. But there are reasons to question the analytical and policy consensus, even working with the very data patterns upon which that consensus was based. In Canada's case, the periods with the largest increases in returns to education (the late 1980s and late 1990s) coincided with the largest increases in the proportion of the population with postsecondary education. In a supply-and-demand model, one typically would expect the opposite: increases in the relative supply of skills should reduce the returns from skills. One might argue that the increased education levels were in response to the increased education-related wage differentials, but education stocks in the population move too slowly for this to be the case in five-year periods.

A potential response to this puzzle comes from switching our perspective on technological change. In the standard model of technology and human capital, the technological change is *exogenous* — that is, the introduction of computers that are complementary to skills just happens on its own accord, and without reference to the amount or type of skills in the economy. Several papers show,

however, that when technological innovation or adoption is *endogenous*, in the sense of being related to the supply of skills available in the economy, then the conclusion that education policy necessarily reduces inequality can be reversed (Acemoglu 2002; Beaudry and Green 2005). Beaudry and Green (2005), for example, propose a model in which firms can choose between an older technology that uses physical capital and makes intensive use of unskilled labour and a newer (computer-related), technology that uses more-skilled labour. In this case, as the amount of skills in the economy increases, more firms choose the newer technology and, during the transition period to the new technology, unskilled workers' wages fall. Essentially, unskilled workers find themselves with less capital to work with and, as a result, are less productive. The authors show that this model fits US data patterns in the 1980s and 1990s well, and in earlier work they also show that it fits with Canadian patterns in these decades (Beaudry and Green 1998). The key point for our purposes is that, even while continuing to work within a neoclassical model in which the economy is undergoing skill-biased technological change, these models imply that increased spending on human capital can lead to an increase in returns to skills and, potentially, to an increase in inequality. Thus, the relationship between human capital policy and inequality is more complex than it first appears.

A growing acknowledgement that what Acemoglu and Autor (2011) call the "canonical" skill-biased technological change model did not fit the data, particularly after 1990, led to the development of a more subtle perspective on the effect of computer technology on the wage structure (see also Card and DiNardo 2002; Beaudry and Green 2005). At the heart of this more recent literature (most often associated with David Autor and coauthors) is the notion that production occurs through combinations of workers and machines carrying out specific types of tasks. In broad terms, tasks are broken down into three groups: *cognitive tasks* that require abstract thinking and, often, independent decision making; *routine tasks* that involve repetitive actions and little decision making; and *manual or service tasks* that often involve personal interactions and are nonrepetitive but do not involve abstract thinking. The first group of tasks tends to be associated with management and professional occupations, and computers make people with such occupations more productive. The second group is associated with white-collar occupations such as clerical or secretarial work and blue-collar occupations in manufacturing; it is this group whose jobs people tend to think of as being replaced by computers. The third group is associated

with personal services and manual labour; computers tend not to be able to replace this latter group, but they also do not make people with such jobs more productive.

Given these relationships, the increasing power and accessibility of computers should lead to increased demand for cognitive tasks and reduced demand for routine tasks. This, in turn, implies rising wages and employment for occupations associated with cognitive tasks, and declining wages and employment for routine occupations. The impact on services and manual occupations is less clear, but Autor and Dorn (2013), among others, argue that rising earnings of top management and professional workers spill over to generate increased demand for services. Overall, the implication is that both the wage and the employment distributions should "polarize," or see increases in high-paying cognitive and low-paying services occupations relative to routine occupations, which tend to be found in the middle of the wage distribution. This is exactly what Acemoglu and Autor (2011) and others argue is found in US data beginning in the 1990s, although, as we will see, there is reason to question the timing of these shifts.[12]

Examinations of data from other developed countries lead to conclusions similar to that for the United States in some ways, but more doubtful in other critical dimensions. Both Dustmann, Ludsteck and Schönberg (2009) and Kampelmann and Rycx (2011) show that employment has also polarized in Germany in recent decades. Like the United States, Germany has seen growth in employment in high- and low-wage occupations relative to those in the middle of the wage distribution. Goos, Manning and Salomons (2009) examine employment in 16 European economies between 1993 and 2006 and find similar patterns. There are, however, two key differences relative to the results Autor, Katz and Kearney (2006), Acemoglu and Autor (2011) and others find for the United States. First, in both Germany and the United Kingdom, the employment polarization trend existed at least as far back as the 1980s; Autor and coauthors argue that it did not emerge in the United States until the 1990s. Second, unlike the results for the United States, the evidence for Europe does not show a polarization in wages — that is, more real wage growth in high- and low-wage occupations than in middle-wage occupations. Instead, it shows a simple increase in inequality, with high-end wages growing faster than those in the middle, and middle-occupation wages growing faster than those at the bottom.

Turning to Canada, Green and Sand (forthcoming) use census and LFS data to investigate whether the labour market has polarized since 1971, and compare their results with their own calculations for the United States (see the summary

in this volume). Before 2000, Canadian patterns resembled those in Europe. Employment in both services occupations and management and professional occupations grew faster than employment in routine occupations starting in the early 1980s, while wage changes look like a straight increase in inequality, with wages in low-end occupations declining relative to those in middle occupations. Green and Sand also show that, in the 1980s, the situation in the United States was not very different from that in Canada or Europe: polarization in employment and a straight increase in wage inequality.[13] In the 1990s, in contrast, the labour market in the United States did experience some wage polarization, and in this way differed both from that in Canada and European countries and from its own in the 1980s, although it is not clear why.

None of this is to say that technological change could not have played an important role in the evolution of the Canadian wage structure before 2000. For example, based on a model of endogenous technological change similar to that proposed by Beaudry and Green (2005), increasing education levels in the 1980s and 1990s would have led to the adoption of technology — particularly computers — that favoured more-educated workers at the expense of traditional, unskilled, labour-intensive approaches to production. Additionally, technology might have impacted Canadian wages if there were downward wage rigidities in middle-earning jobs such as those in the manufacturing sector, and if older unionized workers maintained their wages and benefits at the expense of younger workers. In this case, a technology-induced decline in demand for routine-task occupations would have pushed such workers into services and manual labour jobs. The result would have been to increase employment in the latter jobs relative to that in manufacturing, with wages for services and manual labour falling relative to wages in higher-paid occupations. In this scenario, however, one can no longer talk about human capital policy in general but must consider different types of policies aimed at different types of task-related skills.

The situation after 2000

After 2000, the situation in Canada becomes more complex. As discussed in much more detail in Fortin and Lemieux (forthcoming), the complexity arose partly out of substantial regional differences (see the summary in this volume). As figure 3 shows, for both young men and women, all the education wage differentials remained essentially unchanged until about 2004, approximately when oil prices

began to surge. After that, the wage differentials between those with bachelor's and graduate degrees and high school graduates declined. For men, the overall decline was substantial but, as table 3 shows, not for men in Ontario and Quebec; moreover, the wages of high school graduates in those provinces stayed roughly constant over the period from 1998 to 2013. In the western provinces, the average wage of men with a bachelor's degree also stayed relatively constant and, although not shown in the table, was approximately equal to that of such graduates in central Canada throughout the period. Thus, the reduction in the wage differential between bachelor's graduates and high school graduates for the country as a whole occurred because the wages of male high school graduates rose in western Canada and the Atlantic provinces. At the same time, the penalty for dropping out of high school essentially evaporated for young men in the western provinces, while the increase in the wages of those with a college or trade education kept up with the increase in the wages of high school graduates. This fits with Fortin and Lemieux's finding that the resource boom had a substantial impact on cross-provincial differences in average earnings, particularly after one takes account of spillover effects as workers in nonresource sectors were able to use the higher wages in the resource sector as a reference point in their own wage bargaining.

In general, for men, the earnings outcomes in Ontario and Quebec were much like what was observed in the United States during this period, with limited movement in wages or education differentials. Male high school graduates in both Atlantic Canada and the West experienced substantial increases in their wages that might have been related to the resource boom. For women, in comparison, some of the same patterns are evident, but to a much more muted degree. Interestingly, for both young men and women, the overall trend toward increased educational attainment stalled to some degree at the same time as the wage differentials declined, perhaps also in response to the resource boom (see Fortin and Lemieux, forthcoming, and the summary in this volume).

Given the similarities of the patterns in Ontario and Quebec to those in the United States, it is interesting to consider the applicability of explanations developed for that country to the Canadian situation. Beaudry, Green and Sand (2013) present evidence that, after several decades of continual increase, the proportion of the US population employed in cognitive task occupations stagnated after 2000. They argue that, combined with the continuing increase in the proportion of the population with a university degree, this implies decreasing demand for these skills. The authors

show that this is associated with successive cohorts of new university graduates being less likely to obtain management and professional jobs and more likely to end up in services or clerical jobs, thereby pushing less-educated workers to even lower-paying occupations or out of employment altogether.

Do the same patterns hold for Canada? Riddell and Song (2011) show that in Canada increased levels of formal education have led to the increased use of more-sophisticated technologies. To get a picture of employment changes by education group, we used LFS data to plot the change in the proportion of workers in 10 occupation groups ranked by wage in each of our 5 education groups (see figure 7). We formed the occupation groupings by obtaining the average wage in each of 47 occupations in 1998, ranking the occupations by their wage and then grouping them

Table 3
Education-based wage gaps[1] relative to high school graduates by education level, employed men ages 25-34, Canada, selected years

	1998	2003	2008	2013
Canada				
Mean log wage, high school graduates	6.343 (0.008)	6.345 (0.009)	6.421 (0.009)	6.445 (0.009)
Wage gaps				
Less than high school	– 0.103*** (0.014)	– 0.090*** (0.017)	– 0.091*** (0.019)	– 0.112*** (0.021)
College and trades	0.122*** (0.010)	0.143*** (0.011)	0.114*** (0.012)	0.134*** (0.012)
Bachelor's degree	0.249*** (0.012)	0.248*** (0.013)	0.224*** (0.014)	0.174*** (0.014)
Graduate degree	0.385*** (0.020)	0.323*** (0.020)	0.258*** (0.020)	0.231*** (0.019)
Western provinces				
Mean log wage, high school graduates	6.399 (0.013)	6.370 (0.014)	6.518 (0.013)	6.578 (0.013)
Wage gaps				
Less than high school	– 0.074** (0.025)	– 0.041 (0.029)	– 0.011 (0.028)	– 0.067* (0.034)
College and trades	0.122*** (0.018)	0.156*** (0.019)	0.137*** (0.017)	0.155*** (0.018)
Bachelor's degree	0.161*** (0.022)	0.193*** (0.023)	0.201*** (0.021)	0.041* (0.021)
Graduate degree	0.331*** (0.038)	0.295*** (0.036)	0.183*** (0.032)	0.156*** (0.034)

Table 3 (cont.)
Education-based wage gaps[1] relative to high school graduates by education level, employed men ages 25-34, Canada, selected years

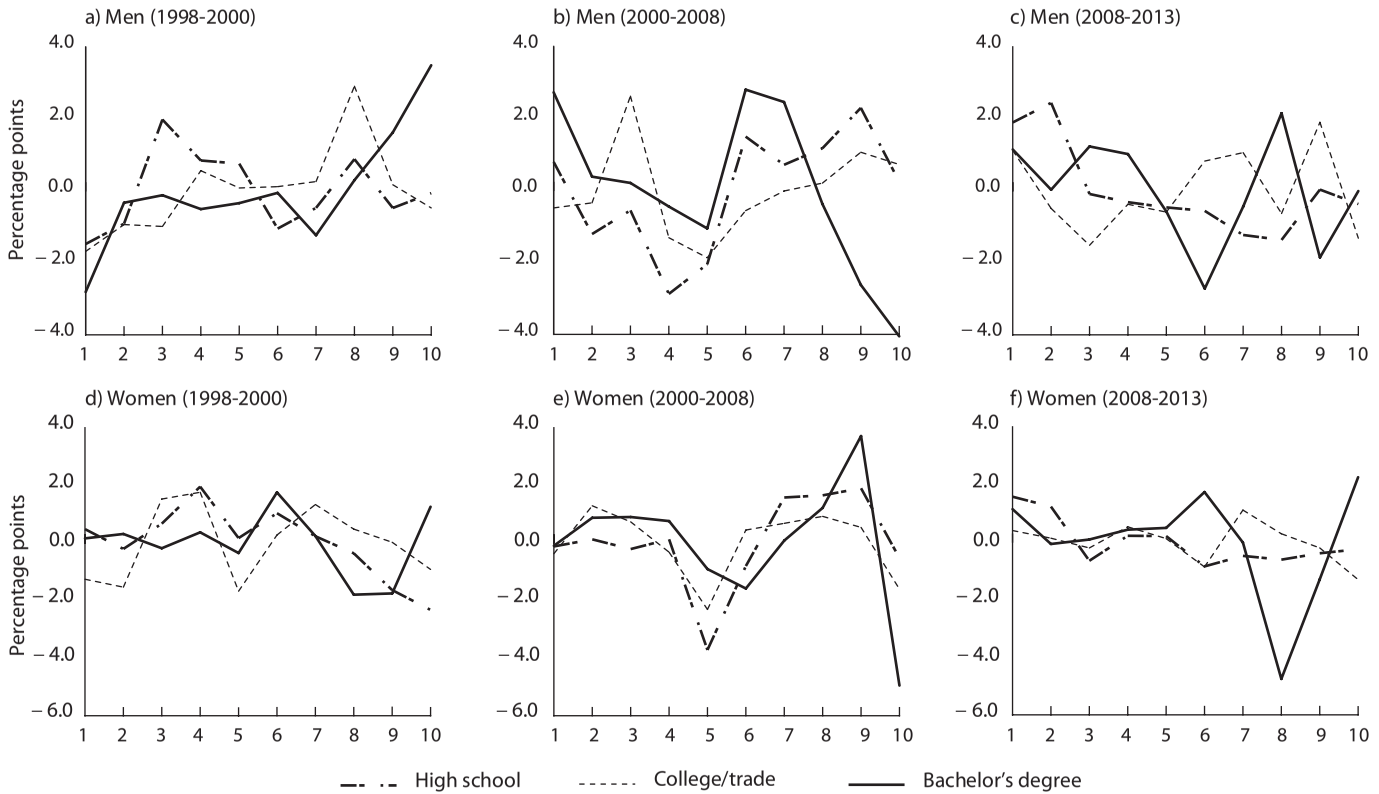
	1998	2003	2008	2013
Ontario and Quebec				
Mean log wage, high school graduates	6.333 (0.011)	6.348 (0.012)	6.373 (0.014)	6.356 (0.014)
Wage gaps				
Less than high school	– 0.112*** (0.020)	– 0.111*** (0.024)	– 0.129*** (0.028)	– 0.095** (0.030)
College and trades	0.128*** (0.014)	0.146*** (0.016)	0.116*** (0.017)	0.148*** (0.018)
Bachelor's degree	0.290*** (0.017)	0.273*** (0.019)	0.248*** (0.020)	0.267*** (0.021)
Graduate degree	0.405*** (0.026)	0.326*** (0.026)	0.295*** (0.028)	0.300*** (0.027)
Atlantic provinces				
Mean log wage, high school graduates	6.142 (0.021)	6.178 (0.025)	6.228 (0.026)	6.300 (0.027)
Wage gaps				
Less than high school	– 0.076* (0.037)	– 0.106* (0.049)	– 0.081 (0.058)	– 0.122* (0.060)
College and trades	0.158*** (0.027)	0.107*** (0.032)	0.212*** (0.034)	0.274*** (0.034)
Bachelor's degree	0.261*** (0.034)	0.252*** (0.039)	0.301*** (0.044)	0.285*** (0.041)
Graduate degree	0.445*** (0.059)	0.409*** (0.064)	0.456*** (0.067)	0.390*** (0.059)

Source: Authors' calculations based on Statistics Canada, Labour Force Survey, 1998-2013.
[1] Wage gaps are estimated in a regression of log weekly wages on dummies for education and age group. Wages are measured in real 2000 Canadian dollars.
*$p < .1$ **$p < .05$ ***$p < .01$

together into 10 equal-sized groups or deciles.[14] Then, for each education category, we generated the changes in the distribution of workers by occupation decile between 1998 and 2000, between 2000 and 2008, and between 2008 and 2013, choosing these three intervals because of the 2008 recession and because Beaudry, Green and Sand (2013) argue that the downward trend in the demand for cognitive skills in the United States began in 2000. To make the panels of figure 7 easier to read, we have plotted only three education categories — high school graduates, college and trades graduates and bachelor's graduates — which represent the largest fractions of workers.

Figure 7

Changes in occupational-wage-decile shares by educational level, men and women ages 25-34, Canada, selected years



Source: Authors' calculations based on Statistics Canada, Labour Force Survey, 1998-2013.

For men with a bachelor's degree, we observe either near-zero changes or declines in the proportion of workers in occupations in the top three deciles between 2000 and 2008. These are largely management, professional and some technical occupations. This fits with the pattern described in Beaudry, Green and Sand (2013). In that same period, there was an increasing proportion of high school graduates in the top occupations, although they represented only a small percentage of workers in these occupations. Interestingly, the proportion of high school graduates in the two lowest-paid occupation categories — mainly services and manual labour jobs — declined between 1998 and 2000 but increased in the two later periods. That is, there is evidence of a shift toward lower-paid occupations over time for all education groups. Again, this fits with the characterization in Beaudry, Green and Sand (2013) of the post-2000 US labour market, with higher-educated workers "cascading" down the occupational structure and pushing other education groups down with them. For women, the changes were more muted (see figures 7d, 7e and 7f), but there is still evidence of movement away from the two highest occupation deciles and toward lower ones.

Beaudry, Green and Sand (2013) suggest that the difference in employment patterns before and after 2000 came about because computer-related technological change, which fuelled the increasing demand for cognitive skills in the 1990s, slowed down after 2000, as evidenced by the dramatic slowing and even reversal of the growth path of investment in computer software and hardware after that date. They argue that computers and their related organizational structures are a form of general-purpose technology (GPT) — a technology that is used across virtually all sectors in the economy. As with all GPTs, there is an initial period of high investment when the technology is being put in place — in the case of computerization, the period when fibre optic cable was laid and the Internet consolidated. During this core investment period, there is a high demand for workers with skills to install and work with the new technology, but thereafter the demand declines. Still, the productivity gains from the new technology must go somewhere. If, in this case, they went to a combination of senior managers (especially chief executives) and capital income, this would also fit with the rising earnings of the 1 percent and the declining share of labour income in total income.

This explanation and those in the polarization literature from which it is derived are premised on the idea that technological change ultimately is the prime driver of changes in the structure of wages and employment. There are reasons to

believe, however, that this premise understates the importance of institutional and trade forces. Most obviously for Canada, the wage and education patterns that seem to be related to the resource boom are ultimately a trade effect, although one that increases labour demand rather than leading to outsourcing. Fortin and Lemieux (forthcoming) show that the effects of the resource boom likely spilled over to wages in nonresource occupations (see the summary in this volume). Essentially, the idea is that workers in occupations such as construction or food services were able to bargain for higher wages since they could always take higher-paying jobs in the resources sector as an alternative. To the extent these spillovers existed, the impact of trade-induced changes in other sectors, such as the movement of high-paying manufacturing jobs overseas, might have been larger than thought. As for institutional factors, Fortin and Lemieux show that increases in the minimum wage have played an important role in raising lower-end wages since 2000, particularly in the Atlantic provinces. More generally, lower levels of unionization among young workers, especially if one takes into account spillover effects on the wages of nonunion workers, also might have played a significant role in changing wage patterns.

Overall, a simple skill-biased technological change model — one in which an increase in education levels is the obvious policy response to rising income inequality — appears to have limited applicability to Canada either before or after 2000. Although a task-based model fits the data better, the implied technology-induced increase in demand for the lowest-paid occupations is not particularly evident in the Canadian data. Moreover, as in the United States, there appears to have been a slowdown or reversal in demand for the highest-paid occupations in Canada after 2000. Layered on top of the effects of technological change is a wage pattern associated with the resource boom, which induced a decline in the returns to education and a stagnation of the trend toward higher education, particularly in the western provinces. The resource boom might have prevented the demand for labour in general from declining in Canada as much as in the United States, and lower-skilled workers in western Canada, in particular, appear to have benefited.

The Potential Impact of Human Capital Policy on Canadian Inequality

WHAT DO THESE DATA PATTERNS AND ASSOCIATED MODELS IMPLY FOR THE USE OF human capital policy to combat inequality, and, if appropriate, what form

should policy take? One key point to emerge from our examination of post-2000 patterns in particular is that the resource boom has played a strong role in shaping Canada's wage structure in recent years. This immediately raises the spectre of the human capital dimension of what is commonly called the "resource curse," or "Dutch Disease." As we have seen, the trend toward increasing education has stalled since the start of the resource boom in the mid-2000s, suggesting that young men in particular might be forgoing education in order to take advantage of high wages in the resource sector.

The existing literature on the impact of resource booms does indicate a cause for concern. Black, McKinnish and Sanders (2005) examine the effect of the oil crisis in the 1970s on youth employment and high school completion in coal-mining regions of the United States. The rapid rise in the price of oil during the 1970s led to increased demand for coal and for the mostly low-skilled workers employed in coal mining. The authors' analysis shows that, relative to otherwise similar areas, local areas with a substantial coal-mining industry exhibited a considerable increase in employment during the coal boom of the 1970s, and a reduction in the high school dropout rate during the subsequent bust. More generally, a number of studies — for example, Beaudry, Lemieux and Parent (2000) and Rees and Mocan (1997) — have found that, when economic conditions improve for less-educated workers, the propensity to drop out of high school increases. These results raise concerns that Canada's level of human capital could suffer because of the resource boom and that policies should be enacted to offset this effect.

Emery, Ferrer and Green (2012) use the same methodology as Black, McKinnish and Sanders (2005) to examine the impact of the Alberta oil boom of the late 1970s and early 1980s on educational outcomes. They find that the high school dropout rate for young men increased during the boom, although the proportion who completed high school but did not proceed to postsecondary education did not change. The reason is that the increase in high school dropouts was offset by a reduction in the proportion of individuals who continued to postsecondary education. That is, at both the secondary and postsecondary levels, young men in Alberta left school to find employment during the oil boom. However, later in life many went back to school to obtain postsecondary degrees, with the result that men who went to high school in Alberta during that period were as likely to have a postsecondary degree as men educated elsewhere in the country. In other words, the oil boom altered the timing of the acquisition of human capital but not the ultimate amount acquired.

More recently, Lu, Chan and Morissette (2014) have investigated how young men responded to higher wages driven by the post-2000 boom in oil prices. In line with the evidence from the earlier oil boom, they show that university enrolment declined in response to higher wages. In contrast to the previous findings, however, the authors find no evidence that young men were less likely to complete high school. Since their sample period was 2001 to 2008, it was not possible for Lu, Chan and Morissette to analyze the long-run effects of the current resource boom. However, if the enrolment effects of the current boom are also temporary in the longer run, then the rationale for trying to divert young men from the oilfields to school is much weaker: it makes sense for them to earn money when wages are high and complete their education later. In this context, education policy would have no real role in addressing the consequences of one of the main drivers of recent Canadian wage patterns. The situation is worth monitoring, however, particularly given that the price of crude oil has fallen significantly since the latter part of 2014, potentially signalling the end of the resource boom.[15]

Putting aside the effects of the resource boom, our somewhat nuanced view of the determinants of Canada's wage structure calls for a similarly nuanced analysis of human capital policy. Indeed, different policies could have quite different effects on income inequality in the current environment. The potential effects of three broad types of policies are of particular interest: policies to promote the obtaining of a university degree; policies aimed at apprenticeships and college education; and early childhood education policies and other policies aimed at young children and teenagers. What does the evidence suggest that such policies achieve? Who in the income distribution would they affect? What do the answers to the first two questions suggest about their impact on inequality? We readily admit that the literature associated with these policies is not our area of expertise, and readers are encouraged to read the references in the ensuing discussion (and the papers they in turn reference) to form their own opinions on the issues we raise here. Our goal is to make a first attempt to relate this literature to that on the determinants of the wage structure.

Policies promoting university education

Discussions of how education policy can be used to mitigate income inequality often seem to centre on policies aimed at increasing the number of university graduates. As we have seen, the idea is to increase competition among, and hence reduce the wages of, top-earning workers. In Canada, such policies take

a number of forms. The policy with the broadest effects is probably the effective subsidization of the costs of postsecondary education for students through the setting of tuition. With undergraduate tuition fees for universities in Quebec and Newfoundland and Labrador half or less than half those for universities in other parts of Canada, the extent of this subsidization varies considerably.[16] What are the implications of this subsidization for inequality?

A key factor in answering this question is that the likelihood of participating in postsecondary education increases with family income. Belley, Frenette and Lochner (2014) show that, relative to children from families with incomes under $20,000, children from families with annual income between $60,000 and $80,000 are about 12 percentage points more likely to participate in postsecondary education, whereas those from families with incomes over $100,000 are about 25 percentage points more likely to do so. Thus, in Quebec and Newfoundland and Labrador, subsidization disproportionately benefits students from middle- and upper-income families. Essaji and Neil (2012) use tax data to show that the same is true for education-related tax credits, use of which rises strongly with family income.

Another set of policies aimed at increasing participation in postsecondary education is grants and loans to students. Although postsecondary institutions themselves provide some of this type of aid, the main sources are the Canada Student Loans program and its companion programs in the provinces.[17] In comparing Canadian programs in place in the mid-2000s with those in the United States, Belley, Frenette and Lochner (2014) point out that features of these programs can have a significant effect on the net education costs students face. As an important example, in Canada students are expected to make minimum contributions and to contribute the majority of their summer earnings to cover the cost of their postsecondary education. In contrast, in the United States, no minimum contributions are expected, and students can earn more than $2,000 in the summer before contributions are expected. As a result of such differences, Belley, Frenette and Lochner conclude that Canada's grant and loan systems are less generous than those in the United States for students from low-income backgrounds. Moreover, the net cost of postsecondary attendance rises much more rapidly with family income in the United States than in Canada. In many ways, Canada's systems appear to help the middle class more than lower-income families.

A third set of policies aimed at postsecondary participation is those that encourage saving for that purpose, the most notable of which is the Registered Education Savings Plan (RESP). Whatever their initial rationale, these policies, too, tend to be used most heavily by higher-income families (Milligan 2005). In 2004, the federal government initiated the Canada Learning Bond program, under which the government would contribute $500 directly to RESPs opened for children from lower-income families and another $100 per year for each year thereafter, regardless of whether the family made a contribution. Essaji and Neil (2012) find, however, that only 15 percent of children eligible under this program had accounts in their name by 2008. Thus, even with this mitigation initiative, RESPs continue to be of disproportionate benefit to better-off families.

Implications of university-participation policies for inequality

What would happen if these programs were expanded to increase the number of Canadians with a university degree? One answer to this question involves a long-term focus on how education policies can undo or reinforce the tendency for income and status to be handed down from one generation to the next. Corak (2013) provides an excellent discussion of these issues and we highlight some of his key points here. As we have seen, many existing policy measures in the postsecondary financing system (the combination of tax credits, grants, loans and RESPs) are used more heavily by students from middle- and upper-income families than by those from lower-income families. In this sense, the system appears to reinforce the tendency toward the cross-generational persistence of income status and thus income differentials. But how simply expanding existing programs or cutting tuition in general would affect these cross-generational correlations depends on two factors: whether low-income families are credit constrained, and the extent to which children from low-income families have a lower propensity to participate in postsecondary education regardless of credit constraints.

The existence and importance of credit constraints in determining education outcomes is an issue on which there has been much debate in economics. Carneiro and Heckman (2002), for example, argue that the correlation between family income and the probability of attending a postsecondary institution reflects a correlation in ability across generations. They find support for this in US data, where adding controls for student ability eliminates any relationship between family income and postsecondary education. Belley and Lochner (2007), however, show

that in a later wave of the same longitudinal dataset, a correlation between income and postsecondary education does exist, even after controlling for measures of underlying ability. Belley, Frenette and Lochner (2014) estimate comparable specifications with Canadian and US data in which they control for observable characteristics such as parental education and cognitive test scores, and find that Canadian children from families with annual income under $20,000 are about 5 percentage points less likely to attend a four-year university program than children from a family with annual income over $100,000. Interestingly, this is only about a third of the corresponding difference in the US data.[18] The difference in the postsecondary participation rate of the Canadian children from these two family income groups — when not controlling for background characteristics or test scores — was 25 percentage points. Since the participation gap was much smaller (5 percentage points) when controlling for parental education and test scores, the implication is that although credit constraints are relevant, they are not the main driver of family income differentials in university participation in Canada.

Several papers, such as Corak, Curtis and Phipps (2011) and Finnie (2012), conclude that family attitudes toward education are a key determinant of ultimate education decisions. Foley, Gallipoli and Green (2014) find no relationship between dropping out and family income once they control for parents' educational attainment and children's test scores. Moreover, they argue that the effect of the level of parents' education, which is largest among lower-ability students, can be attributed to the value parents place on education. Belley, Frenette and Lochner (2014) note that, in the United States, the link between family income and postsecondary attendance is much stronger than would be expected based on how sharply costs decline for low-income students. They suggest this pattern is potentially attributable to the relationship between family income and parental attitudes to education.

Overall, therefore, expanding existing programs to encourage university enrolment or implementing a general tuition cut could perpetuate and perhaps further increase existing patterns of intergenerational inequality in Canada. In any case, the key to addressing such inequality likely lies outside straightforward financing solutions.

What about the more direct effect of increased postsecondary graduation rates on earnings inequality in the relatively near future? As policies are currently designed, such an expansion seems more likely to draw new students from

middle- and upper-income families, which is relevant in a world where university graduates are less likely to obtain management and professional jobs. The additional students from these income groups likely would come from the lower part of the cognitive ability distribution, since those with greater ability are already more likely to attend university, so selecting more from that pool would mean inducing the participation of children who formerly would not have attempted to pursue this avenue. These marginal graduates could end up competing for clerical and services jobs, which would reduce the relative access to these jobs by less-educated individuals. This could increase inequality in the lower part of the earnings distribution. If, alternatively, policies were implemented to encourage children from lower-income backgrounds to attend university, we might tap into a pool of individuals with unrealized ability who would compete more directly for management and professional jobs, thus lowering inequality.

On the whole, we do not view policies to increase the number of individuals with university degrees in the economy as potent tools for reducing income inequality since, in Canada, very little of the overall movement in inequality in recent decades is explained by changes in education differentials. As well, the simple human capital and technology models, which imply that increasing education levels is the antidote to inequality, do not fit the Canadian data well. Moreover, it is far from obvious that increasing the supply of bachelor's degrees would necessarily reduce education differentials. Rather, in a context where technological innovation or adoption is related to the skills available in the economy, doing so could have the opposite effect. Although we are pessimistic about the role that university education can play in mitigating inequality in the current wage structure, appropriately crafted education policies could be key to reducing inequality across generations.

College, trades and apprenticeship policies

Quite often policy discussions on the role of education lump all the types of schooling that follow high school together as postsecondary education. Although many policies regarding postsecondary education do overlap, it is useful to separate the discussion of university education policies from college, trades and apprenticeship policies, since the people affected by them, and consequently the implications for inequality, can differ across the types of postsecondary education. Other reasons to pay particular attention to college, trades and apprenticeships include the fact that these categories of education represent a large and diverse

group,[19] and the recent emphasis in the media and on the part of the current federal government on trades and skills shortages.

Students attending community colleges in Canada are eligible for most of the same provincial and federal student aid programs, tax rebates and savings incentives as university students. The fees college students pay are also effectively subsidized through institutional funding from public sources. Yet the impact of these policies on college students and on university students might differ because of important differences in the direct costs the two types of students face. Usher, Lambert and Mirzazadeh (2014) calculate that the average "sticker price" for the 2013-14 academic year (including tuition and other ancillary fees) ranged from $250 for colleges in Quebec to $4,963 for colleges in Saskatchewan, while university fees were as low as $2,772 in Newfoundland and Labrador and as high as $6,957 and $11,157 in Ontario for arts and engineering students, respectively.[20] Since it generally does not take as long to obtain a certificate or college diploma as it does to complete a university degree, this also makes these programs cheaper than university.

Recent Canadian evidence suggests that university participation rates respond to differences in tuition fees (Coelli 2009), but there are no comparable studies that examine college attendance in particular. Belley, Frenette and Lochner (2014) take a comprehensive look at parental income and financial aid and examine the impact on participation at all levels of postsecondary education in the United States. Evidence suggests that students from higher-income families are more likely to attend a four-year university program than a two-year college program (Belley and Lochner 2007). As noted above, interpreting the correlation with family income as reflecting the affordability of college education depends on the extent to which low-income families are constrained in their borrowing.

Beyond tuition and fees, college programs are less costly along another dimension perhaps particular to Canada: Canadians are more likely to live near a college than near a university. Living within commuting distance reduces monetary costs in the sense that students might be able to live at home while studying. It might also lower psychological barriers associated with moving to a new place and leaving behind established social networks. Frenette (2004) estimates that 13.5 percent of young Canadians live within 80 kilometres of a college, but not a university, and 3.4 percent do not live near either. Proximity to a university differs markedly across provinces. In Saskatchewan and Newfoundland and Labrador, only 49 percent and 58 percent, respectively, live near a university.[21] In contrast,

in more densely populated Ontario and Quebec, more than 90 percent live within commuting distance of a university. This matters, because, as Frenette shows, even after accounting for family income, students are less likely to go to university and more likely to attend college if they live in a community with a college but not a university. Moreover, the impact of living near a college but not a university is largest for students from lower-income families.

Within the category of nonuniversity postsecondary education, apprenticeships are distinct in their own right. Although apprenticeship programs vary from province to province, typically they provide the opportunity to obtain trade certification by combining on-the-job training with schooling. Thus, apprenticeships directly involve an employer in addition to an educational institution, usually a college. Recently, the federal government introduced new aid programs specifically targeting participation in and completion of apprenticeship programs in designated trades, including the $1,000 Apprentice Incentive Grant and the $2,000 Apprentice Completion Grant.

Although apprenticeships might be a promising way to match skills investment with labour demand, completion rates, wherever they are reported, are very low. The Centre for the Study of Living Standards reports that, in 2002, the completion rate relative to new registrations four years earlier was less than 40 percent (Sharpe and Gibson 2005). Using data from the 2007 National Apprenticeship Survey (NAS), Dostie (2010) estimates a completion rate of 56.5 percent. Whether these low rates can be attributed to some feature of apprenticeship programs or to the characteristics of the individuals who participate in them is unclear. It is perhaps telling, however, that, over the 1980s and 1990s, as the number of people participating in apprenticeship programs expanded, completion rates fell (Sharpe and Gibson 2005). Between 1995 and 2007, registrations in apprenticeships doubled, but completions increased by only a third (Laporte and Mueller 2012).

In most trades, after completing their training, apprentices must pass an exam to obtain a certification of qualification and the title of journeyperson. Estimates from the NAS suggest that among those who completed their apprenticeship training, 11 percent did not certify, while three-quarters of noncompleters were uncertified (Ménard, Chan and Walker 2008).[22] Laporte and Mueller (2012) find that, compared with the wages of those who neither completed nor certified, average wages among those who completed their program were 22 percent higher if they also certified and 11 percent higher if they did not.

That apprenticeship completion rates were falling as enrolment rates were rising suggests that simply expanding apprenticeship programs or subsidizing the costs of attending them is unlikely to be a successful route to raising the training level of the Canadian workforce. The Canadian Apprenticeship Forum (2011) has identified the lack of basic skills as a barrier to completion. Indeed, estimates suggest that more than 15 percent of apprentices had not completed high school when they began their training (Ménard, Chan and Walker 2008). It is worth remembering that trades such as plumbing involve the significant use of mathematics. Thus, one interpretation of the low completion rates is that, to be successful, apprentices need more investment in general skills than the elementary and secondary education system currently provides.

Policies related to the nonuniversity postsecondary education sector also have a gender dimension that is worth noting. Young women with a university degree still earn considerably more, on average, than those with a college or trade certificate, even in the resource regions. This difference likely is due to the types of college and trades programs in which women tend to participate. Gender differences are particularly striking in apprenticeship programs. In 2002, only 9.3 percent of registered apprentices were women, and these women were predominantly training in the food and services sector (Sharpe and Gibson 2005). Unless participation rates of women in trades where they are not traditionally found change substantially, policies geared to expanding nonuniversity postsecondary education might have uneven benefits for men and women.

Implications of college, trades and apprenticeship policies for inequality

One way to read the limited evidence on policies to promote the acquisition of college and trades certificates is that these programs benefit a large proportion of Canadians, particularly those in lower-income families. In that sense, expanding the college and trades sector could be viewed as an equalizing force across generations, providing more opportunities in the form of postsecondary education most accessed by lower-income and rural Canadians. Yet, if public investment were diverted away from the university sector toward the college sector, it is not obvious what patterns of substitution would prevail.

On the one hand, if efforts to increase college education induced Canadians who would otherwise stop at a lower level of education to certify in a trade where labour demand is high, this could tend to reduce inequality at the bottom of the

earnings distribution. On the other hand, a policy that made college relatively more attractive than university would also be more likely to induce lower-income Canadians to choose college over university. This would increase the link between family income and university participation and further perpetuate intergenerational inequality. It is worth reiterating the point that completion rates for apprenticeship programs are very low. In the broader nonuniversity sector, an estimated one in four students leaves college without either obtaining a certificate or transferring to a different postsecondary sector (Finnie and Qiu 2008). Without improvements on that front, there is a risk that attempts to increase participation in college and trades programs could increase the debt burden of students from low-income backgrounds without their obtaining the returns on their investment associated with having the credential.

Discussing the impact on within-generation inequality of a policy to expand the share of college and trades graduates brings us back to the regional nature of the Canadian wage structure. For young men in the resource-rich provinces, college and trades certificates pay as well as a university degree. Thus, it would seem sensible to increase the supply of skilled trades most in demand in the resource sector, while reducing the supply of less-valued skills from the university sector. That type of substitution is unlikely to occur, however, because the specific skills associated with the high-paying occupations are similar across the university and college sectors. For instance, in making the education decision, an individual is more likely to switch from an engineering degree than from a humanities degree to a college electrician's certificate. This probably is not the type of substitution pundits have in mind when they advocate for more investment in skilled trades.

Early childhood development policies

The final set of policies we have in mind is those related to early childhood development and to improving the educational outcomes of children at the primary and secondary levels. Based on the conclusions in papers such as those of Almond and Currie (2011) and Baker (2011), we focus on the human capital effects of three types of early childhood interventions: targeted interventions delivered through child care, universal programs and income transfers to low-income households.

The prime example of a targeted early childhood intervention program is the Perry Pre-School program, in which a sample of low-IQ, low-socio-economic-background African American children were randomized into either getting or

not getting special attention from highly educated practitioners both at school and in home visits. The children entered the program at age three, and it lasted for two years. The program had substantial beneficial impacts on the probability of their completing high school, of their committing a crime and on their earnings at age 40 (Baker 2011). It is important to note that the beneficial education effects were confined almost entirely to girls, while those on boys were limited. Other studies of similar targeted interventions show similar effects. For example, a study of the US Head Start program — which can be seen as a larger rollout of the Perry methodology but with less spent per child and with less-educated providers — finds that it had a positive impact on the probability of these children attending university (Garces, Thomas and Currie 2002). Interestingly, the programs had these effects while having no long-term impact on the children's cognitive skills as measured by IQ test scores. Heckman, Pinto and Savelyev (2010) argue that this is because the main effect of these programs is to improve noncognitive skills related to attention and social behaviour. Similarly, Chetty et al. (2011) find that, although the cognitive test score effects of smaller class size are not persistent, class size is nonetheless related to a higher probability of attending college.

For universally implemented child care programs, the results do not appear to be as favourable. Baker (2011) concludes that it is difficult and perhaps misleading to apply the lessons learned from targeted programs to universal ones. He points out that a common rationale for targeted programs is evidence that, among disadvantaged children, developmental deficits emerge in early life and deepen as the child ages. Baker shows that, although children from more advantaged backgrounds also can have low cognitive scores, these children's scores tend to improve with age, while those of similar children from less-advantaged backgrounds do not. This evidence can be interpreted as favouring a targeted, rather than a universal, policy approach because it implies that children with poor cognitive skills from lower socio-economic backgrounds need interventions, while those from higher socio-economic backgrounds improve under the status quo.

Moreover, there is evidence that universal programs can have negative impacts. Studying the effects of the introduction of $5-a-day daycare in Quebec, Baker, Gruber and Milligan (2008) find that universally available subsidized child care reduces measures of prosocial behaviour. Using rich Norwegian data, Havnes and Mogstad (2010) show that universal child care has positive effects

for children from less-advantaged backgrounds, but negative effects for children from more advantaged backgrounds. Based on this evidence, it could be argued that universal child care policies could have net equalizing effects, but it seems unappealing to pursue an equality goal by making more-advantaged children worse off. Thus, this evidence also points toward targeted early childhood development as an equality-enhancing policy.

Because the evidence on targeted early childhood interventions suggests that they might equalize opportunities, it might be tempting to focus policy efforts on young children, rather than on adolescents, but there might be limits to the capacity of investment in early skills to "level the playing field." Using data from a nationally representative survey of Canadian youth and their parents, Foley, Gallipoli and Green (2014) show that children who perform well on an internationally comparable reading test almost never drop out of high school and that their family background has little effect on this. In contrast, among children whose test scores were at the median and below, family background has effects that are almost as large as those of the test scores. The authors argue that these effects stem from how much parents value education,[23] which suggests that interventions on that front could have an impact even among teenagers.

The human capital outcomes of children could also be affected by family income, both through the ability of families to put direct resources into their children's education and through reduced stress at home. The best evidence of this type of impact for Canadian children comes from Milligan and Stabile (2011), who find that increases in family income and work induced by changes in social assistance policy had substantial positive effects on the cognitive scores, prosocial behaviour and educational attainment of young children. Their results for cognitive test scores are in line with, though smaller than, those found by Dahl and Lochner (2012) for the United States. Given the results from the targeted child care literature, it will be interesting to see if these income-related effects persist.

Putting aside the poor outcomes associated with universal child care policies, the overall conclusion from the literature is relatively optimistic. The evidence suggests that it is possible for early childhood development policies to have positive effects on the skills and educational outcomes of children from disadvantaged backgrounds. Crucially, the persistent effects seem to be related to changing noncognitive, rather than cognitive, abilities. To answer our second

question, targeted child care policies and targeted income support policies help children from lower-income families the most.

Implications of early childhood development policies for inequality

Suppose, then, that we were to implement more extensive, targeted child care policies and/or increase the generosity of social assistance benefits or the Working Income Tax Benefit. What would be the longer-term effects on inequality? It is interesting to consider the answer to this question within the context of the task-and-technology model of wage determination, in which recent demand for cognitive (high-paid) skills is decreasing.

The first point to note in this context is that, for the most part, the types of preschool policies that typically are discussed will not affect the cognitive skills market directly because they do not generate more cognitive skills. They do, however, increase the propensity to get a postsecondary education and so will have an effect on inequality through that channel. What that effect is, though, is uncertain. In an era when a growing share of new university graduates are in services and clerical occupations, what happens to the people added to the ranks of the university-educated because of early childhood development policies will depend on their abilities and how jobs are allocated. If, for example, they tend to have lower ability than other university graduates, they might be more likely to end up with the services or clerical jobs. If, on the other hand, childhood development policies help to realize the potential of people with high ability whose options otherwise would be constrained by their socio-economic background, these graduates might be more likely to get the high-paying management and professional jobs. Competition among graduates with lower ability might suppress wages for middle- and lower-paying jobs, thus increasing inequality, while competition among those with higher ability might keep wages down for top-end jobs, thus reducing inequality. The uncertainty of these general equilibrium effects potentially fits with our earlier finding that changes in educational composition have had only limited effects on overall inequality trends.

It is also interesting to think about the impact of early childhood programs on increasing noncognitive abilities or prosocial behaviour. One way to think about the computerization of routine jobs is that it has made these jobs "cleaner," in the sense that they require less physical strength and exposure to extreme conditions. Such workers are now more engaged in machine tending or, perhaps more

accurately, computer tending. To the extent these cleaner jobs are less demanding — or require skills that can be acquired easily — the relative value of social skills such as showing up on time, being reliable and taking initiative when appropriate should rise. This could be the reason that clerical jobs such as being a bank teller increasingly are filled by the university-educated, rather than by those with lower education: part of what university teaches is the ability to do undirected work — to be a self-starter. If early childhood development policies make those attributes more widely held, the result would be an increase in access to middle-paying jobs for individuals from low socio-economic backgrounds, but also lower wages for those jobs. These outcomes would have opposite effects on overall inequality. Essentially, they could reduce inequality on the left side of the distribution (between, say, the 10th and 50th percentiles of the earnings distribution) but increase inequality on the right side (between the 50th and 90th percentiles). One interesting potential ramification of this could be seen in terms of political economy outcomes. Would middle-class voters support policies to help lift up the poor if the end result were to increase how far they are behind the top-end earners? This could be an important element in the slowly emerging public debate over the role of redistribution policies in Canadian society described by Banting and Myles (in this volume).

Conclusion

When potential remedies are discussed in the current public discourse on rising income inequality, increasing the level of education is often advocated as the perfect antidote. In this chapter, we investigate the role of human capital policy in affecting trends in inequality in Canada and its potential as a tool for mitigating these trends.

We begin by describing changes in returns to education and work experience and how these relate to changes in the level of education in the last three decades. Following earlier authors, we find that the 1980s and 1990s were characterized by rising returns to education and rising educational attainment. In the 2000s, returns to university degrees declined for men, and after the mid-2000s the trend toward higher educational attainment stalled. We present a simple variance decomposition to provide some insight into whether the increasing returns to education were a factor driving the increase in earnings inequality that occurred before 2000 and find that it played only a small role.

We then examine these patterns in light of explanations that have been put forward in the economics literature for understanding movements in wage patterns in general. Chief among these explanations has been one that centres on the idea that Canada and other developed economies have been undergoing a skill-biased technological change associated with the computer revolution since the early 1980s. More importantly for our purposes, if this is so, the clear policy implication is that the education level of Canadian workers needs to increase: if a greater proportion of the workforce had a university degree, the economy would be better able to take advantage of the new technology and inequality would be reduced. A key conclusion from our analysis, however, is that this standard technological change model does not fit the Canadian data well. A more nuanced version, in which the computer revolution increases demand for high-paying management and professional occupations but reduces demand for routine clerical and manufacturing tasks, seems more relevant but still falls short of explaining some of the main movements in Canadian wages, particularly since 2000.

Canada differs from the United States, the United Kingdom and most other developed economies in that the resource boom has generated increased demand for middle- and low-paying occupations, particularly for young men in western Canada. The effects of this resource-based demand shift might partly explain why the trend toward increased educational attainment stalled after the mid-2000s. Thus, our overall picture of shifts in the Canadian wage structure in the past decade is one in which demand for high-end occupations is either stalled or falling and demand is high for middle- and low-skilled workers in key resource areas. In the future, however, since lower oil prices seem to be the new reality, demand for workers in the resource sector is likely to fall. In Alberta, particularly, the overall effect of this on inequality will partly depend on whether the new provincial government increases the minimum wage, as it proposes to do (for a discussion of the impact of the resource boom and minimum wages on inequality, see Fortin and Lemieux, in this volume).

If this shift is what is driving Canadian wages, how can human capital policy affect inequality trends? To answer this question, policies need to be divided into different broad types. Early childhood development policies aimed at children in low-income households could increase education levels. But these policies seem mainly to increase noncognitive abilities and, as such, might increase competition for and reduce wages in middle-paying occupations. In that case, they

might serve to reduce inequality between the lowest-paid and those in the middle of the earnings distribution, but increase it between the middle and the top. College and trades education, including apprenticeships, could reduce inequality because it tends to be more easily accessible to children from lower-income backgrounds and because the resource boom has raised the demand for trades. But the very low completion rates for these programs raise real concerns that spending money blindly in this area could have a very low payoff and increase the debt of those from lower-income backgrounds who choose this option. Finally, policies aimed at reducing the costs of university education likely would help mostly children from middle- and upper-income households, thereby serving to exacerbate, rather than to solve, persistent cross-generational inequality. At the same time, it is simply uncertain if increasing the number of university graduates would increase or decrease current wage inequality.

To sum up, increased education spending, especially at the university level, should not be counted on as a central policy for reducing income inequality. We base this conclusion partly on the small role that changes in the returns to education and educational composition have played in explaining increases in inequality in recent decades, and partly on arguments that the forces that seem to be driving the Canadian wage structure would not be offset by simply increasing the education level of the workforce. It is not that such an increase would be necessarily bad — indeed, it might be desirable in pursuing other social objectives. There certainly are specific education policies that could help reduce inequality, particularly investments targeting young children and secondary schooling, which could have benefits in the longer run. From our reading of the data and the relevant literature, however, we conclude that human capital policy cannot be blindly expected to help on this front. Using human capital policy to address inequality should be done with careful consideration.

Appendix

Table A1
Education classifications

	Labour Force Survey 1990-2013	Census (highest level of schooling and degree level attained) 1981 and 1986	Census (highest level of schooling) 1991 and 2001
Less than high school	0 to 8 years; some secondary	Less than grade 5; grades 5-8; grades 9-13	Less than grade 5; grades 5-8; grades 9-13
High school graduate	Grades 11-13; graduate; some post-secondary	High school graduation; non-university without diploma; university without certificate, diploma or degree	High school graduation; nonuniversity without diploma; university without certificate, diploma or degree
College and trades	Postsecondary certificate or diploma	Trade certificate or diploma; nonuniversity with trade certificate or diploma; nonuniversity with other diploma; university with certificate or diploma	Trade certificate or diploma; nonuniversity with trade diploma; nonuniversity with other diploma; university with certificate or diploma
Bachelor's degree	University: bachelor's degree	University with degree — subcategories: bachelor's degree or first professional degree	University with degree
Graduate degree	University: graduate degree	University with degree — subcategories: degree in medicine, dentistry, veterinary medicine or optometry; master's degree(s) and earned doctorate	University with certificate or diploma above bachelor's; university with master's degree(s); university with earned doctorate

Note: We focus on five categories of education corresponding to the highest level of schooling attained: (1) less than high school; (2) high school diploma; (3) college and trades certificate; (4) a bachelor's degree; and (5) a graduate degree. The college and trades category includes individuals with trades and certificates and, in Quebec, those with a CEGEP education. Individuals in the graduate category have master's, doctoral or professional degrees, such as those in law and medicine.

Notes

1 The public-use microdata files from Statistics Canada's 2011 National Household Survey were not available at the time and, in any case, would have had serious comparability problems with earlier censuses.

2 Although LFS respondents remain in the sample for six months, they are asked about their wages only in the first month or when they change jobs. Since we cannot identify individuals across the survey months, to avoid "staleness" in the wage data, we use data from May and November to ensure that individuals appear only once.

3 This tends to overestimate (underestimate) wages for multiple job holders if their supplementary wages are lower (higher) than their main wages.

4 Human capital could also affect earnings distributions through the hours that employees work. We plotted average hours worked in the LFS, where those data are available, and the proportion working part-time in both datasets separately by education group. We find no noteworthy patterns or differences.

5 Working with the log of wages implies that differences between education groups can be interpreted as percentage differences in wages, or rates of return. This is the standard way to proceed in economics since wage differentials are typically interpreted as returns on human capital investments.

6 In the censuses, data on earnings are collected for the previous year. Thus, for example, the data on earnings collected in the 1981 Census apply to 1980.

7 In Boudarbat, Lemieux and Riddell (2010), the unadjusted wage penalty among high school dropouts is quite small, but when potential experience is taken into account, the gap is between –0.10 and –0.20. Potential experience — which is age minus years of school minus 6 — can be calculated from the census data because that dataset includes measures of years of schooling that are not available in the LFS. To ensure that our estimates are comparable across the two datasets, we use age rather than the potential-experience measure used by Boudarbat, Lemieux and Riddell (2010). However, the general patterns that emerge are similar when controlling for potential experience, rather than age. Figures using potential experience are available from the authors upon request.

8 It is worth noting here that our "college and trades" group includes those who obtained the credential. Individuals with some post-secondary education are included in the high school graduate category.

9 We use the same five education categories that were used in the previous sections and that are described in table A1. Individuals are also categorized into five-year age groups, of which there are eight categories. We then combine the age and education categories to create 40 different age-education groups.

10 Inequality in earnings, while related to inequality in well-being, is not the same. Although market income is arguably better at measuring well-being, García-Peñalosa and Orgiazzi (2013) find that trends in market income inequality largely reflect movements in earnings inequality.

11 Several papers in this literature note that the amount of within-group inequality and its growth are sensitive to the choice of data. Comparing two US datasets, one in which wage data are collected contemporaneously and another in which earnings are based on annual recall, Lemieux (2003) finds that

residual inequality is overstated in the latter dataset. Lemieux (2002) has also argued that, just like between-group wage dispersion, within-group variability is composed of a distribution of skills, which are unobserved in this case, and their prices. He shows, using US data, that controlling for composition effects in the residual variance can change the relative importance of within-group inequality. We use the decomposition method proposed in Lemieux (2002) to investigate that possibility in both the census and LFS data. These decompositions (not reported) also suggest that compositional effects or changes in the returns to observed skills do not explain most of the changes in wage dispersion over time.

12 One reason the first wave of investigations of the wage structure was replaced by a second was that returns to education stopped increasing in the United States in the 1990s. That is, just when computers were becoming ubiquitous, what was supposed to be their main reflection in the labour market stopped (Beaudry and Green 2005; Card and DiNardo 2002). The polarization literature argues that, with a more nuanced view of the impact of technology, the widespread adoption of technology would not necessarily lead to increases in the wage differential between average university and average high school wages if some of the high-school-educated were benefiting from the increase in demand for services jobs.

13 This alternative approach to occupation definitions is based on Lefter and Sand (2011), who show that patterns in other studies arise in part because of a combination of smoothing and how a change in occupational definitions is handled. Green and Sand (forthcoming) make the corrections suggested in Lefter and Sand (2011) to address these problems.

14 The groups are formed such that the lowest-decile group contains 10 percent of all workers in 1998, not 10 percent of the occupations. We thank Ben Sand for the Stata code that creates these occupational deciles. Because there is a link between education and earnings, individuals with a university degree are more likely to work in the highest-paid occupations. Similarly, individuals with less than high school are more likely to work in the lowest-paying occupations. Thus, although 10 percent of all workers in 1998 fall within each decile, within each education category that fraction will vary. For example, in 1998, 24 percent of young men with a bachelor's degree worked in the top-decile occupations. In 2000, 27 percent of young men with a bachelor's degree worked in those same occupations. The difference, 3 percentage points, is what we plot in the figures.

15 In July 2014, the end-day crude oil commodity price on the NASDAQ index was between US$95 and $100; in February 2015, it ranged between US$45 and $55.

16 Usher, Lambert and Mirzazadeh (2014) examine both direct and indirect subsidies to higher education and argue that the size and cross-provincial pattern of net subsidies differs from what is observed by simply looking at tuition.

17 The provinces vary in whether they integrate their programs with the Canada Student Loans. Quebec has its own entirely separate program.

18 It is worth mentioning that overall intergenerational mobility is higher in Canada; see Heisz (in this volume).

19 Indeed, according to a 20-country study conducted by the Organisation for Economic Co-operation and Development (2014), Canada has the largest fraction of adults ages 25 to 45 with vocational and professional training as their highest credential.

20 Usher, Lambert and Mirzazadeh (2014) also make the point that, once all the subsidies inherent in financial aid and tax rebates are accounted for, the net costs of university can be very low, and even zero, for some students.

21 Very few individuals lived near a university but not a college. That more than 80 percent of the young Canadians in the study lived

near a university reflects the fact that most Canadians live in Ontario and Quebec.

22 If a person has sufficient work experience, it is not necessary to complete an apprenticeship to write the certification exam.

23 Foley, Gallipoli and Green (2014) reach this conclusion, essentially, by comparing the probability of dropping out for students with similar scores for cognitive and noncognitive ability but with differences in variables reflecting parental valuation of education. The latter include responses to questions about how far parents hope their children will go in school and if they have saved for their children's education.

References

Acemoglu, D. 2002. "Technical Change, Inequality, and the Labor Market." *Journal of Economic Literature* 40 (1): 7-72.

Acemoglu, D., and D. Autor. 2011. "Skills, Tasks and Technologies: Implications for Employment and Earnings." In *Handbook of Labor Economics*, vol. 4B, edited by D. Card and O. Ashenfelter. Amsterdam: Elsevier.

Almond, D., and J. Currie. 2011. "Human Capital Development before Age Five." In *Handbook of Labor Economics*, vol. 4B, edited by D. Card and O. Ashenfelter. Amsterdam: Elsevier.

Autor, D.H., and D. Dorn. 2013. "The Growth of Low-Skill Service Jobs and the Polarization of the US Labor Market." *American Economic Review* 103 (5): 1553-97.

Autor, D.H., L.F. Katz, and M.S. Kearney. 2006. "The Polarization of the US Labor Market." *American Economic Review* 96 (2): 189-94.

Baker, M. 2011. "Innis Lecture: Universal Early Childhood Interventions: What Is the Evidence Base?" *Canadian Journal of Economics* 44 (4): 1069-105.

Baker, M., J. Gruber, and K. Milligan. 2008. "Universal Child Care, Maternal Labor Supply, and Family Well-Being." *Journal of Political Economy* 116 (4): 709-45.

Beaudry, P., and D.A. Green. 1998. "What Is Driving US and Canadian Wages: Exogenous Technical Change or Endogenous Choice of Technique?" NBER Working Paper 6853. Cambridge, MA: National Bureau of Economic Research.

_____. 2000. "Cohort Patterns in Canadian Earnings: Assessing the Role of Skill Premia in Inequality Trends." *Canadian Journal of Economics* 33 (4): 907-36.

_____. 2005. "Changes in U.S. Wages, 1976-2000: Ongoing Skill Bias or Major Technological Change?" *Journal of Labor Economics* 23 (3): 609-48.

Beaudry, P., D.A. Green, and B.M. Sand. 2013. "The Great Reversal in the Demand for Skill and Cognitive Tasks." NBER Working Paper 18901. Cambridge, MA: National Bureau of Economic Research.

Beaudry, P., T. Lemieux, and D. Parent. 2006. "What Is Happening in the Youth Labour Market in Canada?" *Canadian Public Policy* 26 (s1): 59-83.

Belley, P., M. Frenette, and L. Lochner. 2014. "Post-secondary Attendance by Parental Income in the US and Canada: Do Financial Aid Policies Explain the Difference?" *Canadian Journal of Economics* 47 (2): 664-96.

Belley, P., and L. Lochner. 2007. "The Changing Role of Family Income and Ability in Determining Educational Achievement." *Journal of Human Capital* 1 (1): 37-89.

Berman, E., J. Bound, and Z. Griliches. 1994. "Changes in the Demand for Skilled Labor within U.S. Manufacturing: Evidence from the Annual Survey of Manufactures." *Quarterly Journal of Economics* 109 (2): 367-97.

Black, D., T. McKinnish, and S. Sanders. 2005. "The Economic Impact of the Coal Boom and Bust." *Economic Journal* 115 (503): 449-76.

Boudarbat, B., T. Lemieux, and W.C. Riddell. 2006. "Recent Trends in Wage Inequality and the Wage Structure in Canada." In *Dimensions of Inequality in Canada*, edited by D.A. Green and J. Kesselman. Vancouver: University of British Columbia Press.

_____. 2010. "The Evolution of the Returns to Human Capital in Canada, 1980-2005." *Canadian Public Policy* 36 (1): 63-89.

Bowlus, A., and C. Robinson. 2012. "Human Capital Prices, Productivity and Growth." *American Economic Review* 102 (7): 3483-515.

Canadian Apprenticeship Forum. 2011. *Investigating Apprenticeship Completion in Canada: Reasons for Non-Completion and Suggested Initiatives for Improving Completion*. Ottawa: Canadian Apprenticeship Forum.

Card, D., and J.E. DiNardo. 2002. "Skill-Biased Technological Change and Rising Wage Inequality: Some Problems and Puzzles." *Journal of Labor Economics* 20 (4): 733-83.

Carneiro, P., and J.J. Heckman. 2002. "The Evidence on Credit Constraints in Post-Secondary Schooling." *Economic Journal* 112 (482): 705-34.

Chetty, R., J.N. Friedman, N. Hilger, E. Saez, D.W. Schanzenbach, and D. Yagan. 2011. "How Does Your Kindergarten Classroom Affect Your Earnings? Evidence from Project Star." *Quarterly Journal of Economics* 126 (4): 1593-660.

Coelli, M.B. 2009. "Tuition Fees and Equality of University Enrolment." *Canadian Journal of Economics* 42 (3): 1072-99.

Corak, M. 2013. "Income Inequality, Equality of Opportunity, and Intergenerational Mobility." *Journal of Economic Perspectives* 27 (3): 79-102.

Corak, M., L. Curtis, and S. Phipps. 2011. "Economic Mobility, Family Background, and the Well-Being of Children in the United States and Canada." In *Persistence, Privilege and Parenting: The Comparative Study of Intergenerational Mobility*, edited by T.M. Smeeding, R. Erikson, and M. Jantti. New York: Russell Sage Foundation, 2011.

Dahl, G.B., and L. Lochner. 2012. "The Impact of Family Income on Child Achievement: Evidence from the Earned Income Tax Credit." *American Economic Review* 102 (5): 1927-56.

DiNardo, J., N.M. Fortin, and T. Lemieux. 1996. "Labor Market Institutions and the Distribution of Wages, 1973-1992: A Semiparametric Approach." *Econometrica* 64 (5): 1001-44.

Dostie, B. 2010. "A Competing Risks Analysis of the Determinants of Low Completion Rates in the Canadian Apprenticeship System." CLSRN Working Paper 67. Vancouver: Canadian Labour Market and Skills Researcher Network.

Dustmann, C., J. Ludsteck, and U. Schönberg. 2009. "Revisiting the German Wage Structure." *Quarterly Journal of Economics* 124 (2): 843-81.

Emery, J.C.H., A. Ferrer, and D.A. Green. 2012. "Long-Term Consequences of Natural Resource Booms for Human Capital Accumulation." *ILR Review* 65 (3): 708-34.

Essaji, A., and C. Neil. 2012. "Policy Forum: Delivering Government Grants to Students through the RESP System — Distributional Implications." *Canadian Tax Journal* 60 (3): 635-49.

Ferrer, A., and W.C. Riddell. 2008. "Education, Credentials, and Immigrant Earnings." *Canadian Journal of Economics* 41 (1): 186-216.

Finnie, R. 2012. "Access to Post-Secondary Education: The Importance of Culture." EPRI Working Paper 2012-02. Ottawa: Education Policy Research Initiative.

Finnie, R., and T. Qiu. 2008. *The Patterns of Persistence in Post-secondary Education in Canada: Evidence from the YITS-B Dataset*. MESA Project Research Paper 2008-6. Ottawa: Canadian Education Project.

Foley, K., G. Gallipoli, and D.A. Green. 2014. "Ability, Parental Valuation of Education, and the High School Dropout Decision." *Journal of Human Resources* 49 (4): 906-44.

Fortin, N.M., and T. Lemieux. Forthcoming. "Changes in Wage Inequality in Canada: An Interprovincial Perspective." *Canadian Journal of Economics*.

Frenette, M. 2004. "Access to College and University: Does Distance to School Matter?" *Canadian Public Policy* 30 (4): 427-43.

Frenette, M., D.A. Green, and K. Milligan. 2007. "The Tale of the Tails: Canadian Income Inequality in the 1980s and 1990s." *Canadian Journal of Economics* 40 (3): 734-64.

Garces, E., D. Thomas, and J. Currie. 2002. "Longer-Term Effects of Head Start." *American Economic Review* 92 (4): 999-1012.

García-Peñalosa, C., and E. Orgiazzi. 2013. "Factor Components of Inequality: A Cross-Country Study." *Review of Income and Wealth* 59 (4): 689-727.

Goos, M., A. Manning, and A. Salomons. 2009. "Job Polarization in Europe." *American Economic Review* 99 (2): 58-63.

Green, D.A., and B.M. Sand. Forthcoming. "Has the Canadian Labour Market Polarized?" *Canadian Journal of Economics*.

Havnes, T., and M. Mogstad. 2010. "Is Universal Child Care Leveling the Playing Field? Evidence from Non-Linear Difference-in-Differences." IZA Discussion Paper 5978. Bonn, Germany: Institute for the Study of Labor.

Heckman, J., R. Pinto, and P. Savelyev. 2010. "Understanding the Mechanisms through Which an Influential Early Childhood Program Boosted Adult Outcomes." *American Economic Review* 103 (6): 2052-86.

Kampelmann, S., and F. Rycx. 2011. "Task-Biased Changes of Employment and Remuneration: The Case of Occupations." IZA Discussion Paper 5470. Bonn, Germany: Institute for the Study of Labor.

Laporte, C., and R.E. Mueller. 2012. *Certification, Completion, and the Wages of Canadian Registered Apprentices*. Analytical Studies Branch Research Paper 345. Ottawa: Statistics Canada.

Lefter, A., and B.M. Sand. 2011. "Job Polarization in the U.S.: A Reassessment of the Evidence from the 1980s and 1990s." Discussion Paper 2011-03. St. Gallen, Switzerland: School of Economics and Political Science, University of St. Gallen.

Lemieux, T. 2002. "Decomposing Changes in Wage Distributions: A Unified Approach." *Canadian Journal of Economics* 35 (4): 646-88.

_____. 2003. "Residual Wage Inequality: A Re-examination." TARGET Working Paper 2. Vancouver: Department of Economics, University of British Columbia.

Lu, Y., W. Chan, and R. Morissette. 2014. *Wages, Youth Employment, and School Enrollment: Recent Evidence from Increases in World Oil Prices*. Analytical Studies Branch Research Paper 353. Ottawa: Statistics Canada.

Ménard, M., C.K.Y. Chan, and M. Walker. 2008. *National Apprenticeship Survey: Canada Overview Report, 2007*. Ottawa: Culture, Tourism and the Centre for Education Statistics, Statistics Canada.

Milligan, K. 2005. "Who Uses RESPs and Why." In *Higher Education in Canada*, edited by C.M. Beach, R.W. Boadway, and R.M. McInnis. Montreal and Kingston, ON: McGill-Queen's University Press.

Milligan, K., and M. Stabile. 2011. "Do Child Tax Benefits Affect the Well-Being of Children? Evidence from Canadian Child Benefit Expansions." *American Economic Journal: Economic Policy* 3 (3): 175-205.

Oreopoulos, P., and K.G. Salvanes. 2011. "Priceless: The Nonpecuniary Benefits of Schooling." *Journal of Economic Perspectives* 25 (1): 159-84.

Organisation for Economic Co-operation and Development. 2014. *Skills Beyond School: Synthesis Report*. OECD Reviews of Vocational Education and Training. Paris: OECD Publishing.

Rees, D.I., and H.N. Mocan. 1997. "Labor Market Conditions and the High School Dropout Rate: Evidence from New York State." *Economics of Education Review* 16 (2): 103-9.

Riddell, W.C., and X. Song. 2011. "The Role of Education in Technology Use and Adoption: Evidence from the Canadian Workplace and Employee Survey." CLSRN Working Paper 83. Vancouver: Canadian Labour Market and Skills Researcher Network.

Sharpe, A., and J. Gibson. 2005. *The Apprenticeship System in Canada: Trends and Issues*. CSLS Research Report 2005-04. Ottawa: Centre for the Study of Living Standards.

Usher, A., J. Lambert, and C. Mirzazadeh. 2014. *The Many Prices of Knowledge: How Tuition and Subsidies Interact in Canadian Higher Education*. Toronto: Higher Education Strategy Associates.