A DISCRETE CHOICE MODEL OF EDUCATIONAL ATTAINMENT: AN APPLICATION OF THE YOUTH IN TRANSITION SURVEY

By

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Abstract

Harnessing the richness of the Youth in Transition Survey this study provides an updated overview of which youth in Canada are graduating from post secondary education and an analysis of which youth are at risk of following the identified pathways relative to graduating from a university program. The findings are consistent with past research and theory. All of which suggest a new approach to policy is necessary to continue increasing the post secondary education attainment numbers to fill the projected skilled labour shortages within Canada.

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Contents

1 Introduction

There is long understanding of the relationship that exists between the highest level of education acquired and a person's economic human capital. By identifying the importance of education and skill attainment, Becker showed in 1964 that an individual with higher education and more skills has a higher measure of human capital. Thus as an individual, your human capital becomes the valuable asset you own, which you then sell to the labour market for the course of your working life. Fast-forwarding time, globalization and technological advancements have led to higher education becoming a requirement for the majority of sustainable careers.

The demand for college and university educated workers has substantially increased and is expected to continue to exceed supply over the medium-term horizon. Employment and Social Development Canada, in their Occupational Projection Summary, showed that the majority of occupations in 2012 to 2014 showing signs of labour shortages required some form of post-secondary education. Conversely, they stated that most of the occupations demonstrating a labour surplus required no education beyond a high school diploma or on-the-job training. Over their 2015 through 2024 projections, they anticipate that 71% of job openings due to economic growth will require education above the high school level, or will be management positions.

Technological advancements, or technological change have been at the heart of the literature surrounding the discussion of the forces driving the rise in labour market demand for highly skilled workers. Economists have coined the term skills biased technical change (SBTC), which refers to the idea that the demand for higher educated workers has been increasing, beginning throughout the late 20th century, because the bundle of skills necessary to do a job changed in favour of say, a university educated worker. Essentially, the idea is that new technologies were introduced that consequently increased the relative productivity of a specific skill set. Thus, to a firm the productivity gain associated with hiring a "skilled" worker exceeded the costs they would face by paying higher wages.

It is the aim of this paper to develop a discrete choice model of educational attainment using recent Canada data. The study reviews recent projections indicating there exists future shortages of a highly skilled workforce, thus motivation exists to review what Canadians are at relative risk of not attaining higher education. It will utilize the richness of the Youth In Transition Survey, as it is comprised of socioeconomic, and demographic variables of Canadian youth across a decade of their lives allowing a multinomial logistic regression model to be applied.

This study is divided into 7 sections. The proceeding section endeavours to capture an understanding of the trajectory for skilled workers within the Canadian economy to provide motivation for the subsequent analysis. The third section reviews briefly preceding theory surrounding educational attainment decisions and further reviews the empirical literature of educational attainment modelling. The fourth section presents the multinomial logistic regression model. Afterwards, a descriptive analysis of the applied Youth In Transition Survey is provided, followed by the analysis in section 6. Lastly, section 7 concludes the results with a discussion of the policy implications of the study.

2 Trajectory of the Demand for Skilled Workers

This section relates directly to the motivation of the study. It reviews a range of reports pertaining to the skill levels that employers are and plan to seek from the future labour market. It aims to develop a thorough discussion of whether investments in higher education should be made. As has been made evident in past research, Canada and it's southern neighbour, the United States, are similar in their job creation and destruction, and economies, as such, both Canadian and American studies are reviewed (Baldwin, Dunne, & Haltiwanger, 1998).

Every two years the Economic Policy Directorate (EPD) of Employment and Social Development Canada (ESDC) releases the Canadian Occupational Projections Summary (COPS) that is comprised of a 10-year, detailed, projection of the national labour market. ESDC defines one of its main objectives: "to identify occupations where the current and projected states of supply and demand suggest that imbalances could develop or persist over time." Unfortunately, the 2017 projection has not yet been

released at the time of writing; as such the review will consider the 2015 projection into 2024.

The COPS uses standard supply and demand to discuss the imbalances that are projected to occur in the labour market. It does not provide year-to-year changes, and instead gives a national overview of the medium-term horizon of Canada's labour market. A shortage is said to occur in a given occupation if the projected number of job openings exceeds the projected number of new job seekers (ESDC, 2016), and conversely for a surplus to be identified, the projected number of job openings must be "well below the number of new job seekers" (ESDC, 2016).

A key feature of the COPS projections is that they are presented by skill levels. Using strictly occupation and industry growth as a mechanism for evaluating whether or not to invest in higher education with the intent of increasing the supply of post-secondary educated workers is inefficient, as jobs cannot be easily binned as "university" and "non-university". Thus causing difficulty for national projections to be made. Taking this into consideration, the classification is a two-stage process. In the first stage, each occupation is put into 1 of 10 skill type categories. An occupation's skill type is derived by considering and evaluating the type of work performed, the responsibility and complexity of work, and the previous experience of workers. In the second stage, skill types are then put into skill levels. A skill level is defined as "the amount and type of education and training required to enter and perform the duties of an occupation" (ESDC, 2012).

In their 2011 harmonization of the National Occupation Classification (NOC) and the National Occupation Classification for Statistics (NOC-S), ESDC and StatCan re-evaluated the skill level classification system in the wake of a changed labour market. Their release noted that: "in the decade since its first structural revision in 2001, the labour market has evolved significantly. Technological innovation, further globalization of the economy and restructuring of the workplace have impacted many occupations" (ESDC, 2017). Which resulted in content changes and a new classification system. The skill levels and their criteria are presented below.

Table 1: ESDC skill level criteria

Skill Level	Label	Criteria
A	University education	University degree (bachelor's, master's or doctorate)
B	College education	Two to three years of post-secondary education at a community college, institute of technology of CEGEP OR Two to five years of apprenticeship training OR Three to four years of secondary school and more than two years of on-the-job training, occupation-specific training courses or specific work experience
C	High school education	Completion of secondary school and some short duration courses or training specific to the occupation OR Some secondary school education, with up to two years of on-the-job training, training courses or specific work experience
D	On-the-job training	Short work demonstration or on-the-job training OR No formal education requirements

Source: (ESDC, 2017)

That said the COPS projections for the 2015 to 2024 horizon were that 5.95 million job openings would occur. This number is slightly different from a net new job count as it includes openings that may become available from retirement or other circumstances. There are three identified categories that ESDC uses to explain this number: (1) expansion demand (job creation); (2) retirement (a form of replacement demand); and (3) other replacement demand, such as death or emigration.[1]

Of the 5.95 million job openings, two-thirds, or 65.9%, are identified to be in occupations requiring some form of PSE (management, Level A or Level B). Removing a level of aggregation, jobs created by economic expansion exceed the openings from replacement demand for occupations said to require some form of PSE, 71% and 64.3%, respectively (ESDC, 2016). Whereas for skill levels C and D, job openings from economic expansion trail those from replacement, 29% and 35.7% respectively (ESDC, 2016). Thus, as job creation from economic expansion is projected to dominate replacement in occupations falling into management, level A, or level B

[1] Given that we live in a time where a large portion of the workforce is set to soon retire (Baby Boomers) the replacement demand stemming from retirement is projected to far outweigh the alternatives at each skill level. By 2024 it is estimated that 40% of the labour force population will be aged 55 and over, compared to 35% in 2014 (ESDC, 2016).

categories, one can infer that the demand for higher educated workers is projected to increase.

Turning to the supply side, the COPS (2016) uses a job seekers categorization. It projects that 5.83 million job seekers will enter the labour market throughout the projection period. This immediately points to an imbalance somewhere as it suggests the demand for labour is expected exceed supply over the medium-term. Of the 5.83 million entrants, 64.8% are expected to seek employment in positions requiring some form of PSE (ESDC, 2016). Leaving 35.2% seeking jobs requiring a high school diploma or on-the-job training. The following table presents a summary of the shortage and surplus categorization of the occupations within each skill level.

Table 2: Projected number of occupations by labour market condition and skill level

	Number of Occupations by Labour Market Condition		
Skill Level	Shortage	Balance	Surplus
Management	0	28	1
A	15	41	3
B	41	85	20
C	1	49	14
D	0	12	8

Source: (ESDC, 2016)

As can be seen, the majority of the shortages appear within occupations classified as requiring some form of PSE. In 2014, these 56 occupations showing signs of future shortages represented 1.36 million jobs (ESDC, 2016). However, it is worth noting that there are signs of college educated workers not finding employment within their field of study as 20 occupations falling into skill level B are projected to have a surplus. The surplus occupations of skill levels C and D represented just shy of 1 million workers.

These trends in labour projections are not unique to Canada. The United States Bureau of Labor Statistics (BLS) releases a similar projection to that of Canada's COPS. The BLS's most recent projections, released in early 2015 were for the 2014 to 2024 horizon. The BLS uses a system similar to Canada in order to assign categories of education level, work experience, and training required for a specific occupation. This system allows them to group together different occupations by typical education level or

training required for an entry-level opening. The following table presents the projections of job growth by typical entry-level education and includes the median annual wage, updated in April of 2017 to reflect earnings realized in 2016, USD.

Table 3: Employment, wages, and projected change in employment by typical entry-level education (Employment in thousands)

Typical entry-level education	2014 Employment		Employment change, 2014-24 (percent)	Median annual wage, 2016
	Number	Percent distribution		
Total, all occupations	150,539.9	100.0	6.5	$37,040
Doctoral or professional degree	4,111.5	2.7	12.2	$103,280
Master's degree	2,518.8	1.7	13.8	$67,970
Bachelor's degree	31848.6	21.2	8.2	$71,530
Associate's degree	3,458.2	2.3	8.7	$51,050
Postsecondary non-degree award	9,090.7	6.0	11.5	$36,650
Some college, no degree	3,785.8	2.5	0.5	$34,540
High school diploma or equivalent	54,927.4	36.5	3.9	$37,110
No formal educational credential	40,799.0	27.1	6.9	$22,490

Source: (United States Department of Labor, 2017)

The story emerging from the BLS projections is not unlike that of Canada's COPS. The trends show the fastest job growth occurring in industries that require some form of higher education. The highest being in jobs demanding a master's degree, whereas the slowest is experienced in occupations demanding some college, but no degree required.

With Canada and the U.S. giving the same story, it provides motivation to analyze who is completing PSE and who is not in order to provide evidence for sound policy decisions. However, it is necessary to consider some possible complications with the projections. Both the COPS and the BLS Employment Projections use a classification system for the "usual" or "typical" education level required (United States Department of Labor, 2016). Meaning they consider the most common pathway to the job, whereas in reality there are many different trajectories individuals can take to land a job. In this scenario, the projections could be underestimating or overestimating the skill, or educational requirements for occupations. An example of this for both the United States and Canada would be that of nurses. The standard pathway in both

countries is to obtain a bachelor's degree, however, in the US the BLS notes that you could complete an associate's degree or complete a diploma program. In Canada, the requirements can change depending on the province; in Ontario you have the decision between two years of university in conjunction with two years of college, a diploma program from a community college or a bachelor's degree. In this case, college attendees are identified as university graduates, overestimating the skill level.

Further, in order to truly accept the evidence presented by ESDC, it would be necessary evaluate bias and accuracy within the projections. Unlike forecasts, projections do not predict specific outcomes; instead, they give an indication of the medium- and long-run trends. Thus, they rely on stated assumptions, which leads to an increased potential for bias. Unfortunately, there are no publicly available evaluations of the COPS at this time and it is beyond the scope of this study to perform one. As such, the projections will be taken as is but sound judgement is used in any conclusions they shed. On the other hand, the BLS provides access to evaluations of their employment projections. Due to the lengthy process involved in the evaluation, the most recent has yet to be published. However, as the current methodology was used in the 2010 release, the evaluation pertaining to 2006, 2008, and 2010 projections can provide insight into the accuracy of the 2014 through 2024 publication.

Where possible the evaluation involves comparing the BLS mean absolute error with other projection publications. However, since the BLS is the primary and sole provider of many indicators, the evaluators run a separate model, titled the naïve model and compare its projections with their BLS projections.[2] The findings of the projections were somewhat mixed across the years. The authors attribute a great portion of the varied performance to the 2007-09 recessionary years, which with out a doubt would complicate evaluating projections and forecasts. Rejecting the null hypothesis, the evaluation concludes that the BLS projections outperform the naïve model for at minimum half the variables evaluated (nonfarm payroll employment, manufacturing employment, the GDP, the unemployment rate, the labour force participation rate, non-institutional population, and others[3]). The projections appeared to be directionally

[2] For more on the naïve model, see (Stekler & Thomas, 2000).
[3] For the complete list of variables, see (Byun, Henderson, & Toossi, 2015).

accurate in aggregate, and industry levels varied. For instance, the projections did not catch the boom in the mining industry resulting from increased oil prices, and thus, projected a decline when in fact it was the opposite. Further, while capturing the shift towards an increased employment share of service sector jobs, they largely underestimated the decline in manufacturing (Byun, Henderson, & Toossi, 2015).

As mentioned, in order to perform projections, strong assumptions need to be made. A limiting assumption that both the BLS and COPS make is one pertaining to educational requirements. The typical level of education is a contributing factor to ESDC's skill level derivations and the BLS releases projected increases in occupations by their entry-level educational requirements. Thus by doing so, they assume away any change in educational requirements over the projected horizon.

Weighing the benefits that these projections against their shortcomings, it is concluded they can provide adequate information for decision making when used with sound judgement and caution. They correctly identify aggregate trends, which can inform students on what education to pursue, workers on where the jobs are and what skills are needed, businesses on what skills are available and where the gaps are, and the government about which training or education programs are needed. Consequently, the information aids these agents in efficiently allocating their resources. With the motivation established, the study proceeds by reviewing the literature on models of educational attainment.

3 Overview of Literature on Educational Attainment Modelling

Dating back to 1964, human capital theory has been at the centre of the majority of educational attainment research. The theory, introduced by Schultz (1960), and Becker (1964) and (1974), considers an individual's choice to attain or not attain any more education. It requires the individual to maximize their net return on investment and continue to invest in education up to the point at which the marginal cost of additional investment equals the marginal return. The costs considered are direct education costs, such as textbooks and tuition, and opportunity costs. The opportunity costs would then be defined as the forgone earnings throughout the time spent in education full time.

This theory implies that education levels differ from one individual to the next as a result of differences in return or costs conditions (Lauer, 2002).

This approach was widely criticized for its sole focus on education as a monetary investment; Blaug's A View on Human Capital Theory (1976) provides a thorough critique of the theory. Released in 1965, Becker's A Theory of the Allocation of Time provided a new direction for the human capital model, considering the non-labour allocation of time. The article developed a theoretical framework with the primary assumption being that households are both producers and consumers. Acting as a cost-minimizing firm they produce commodities by use of goods and time as inputs. They then consume the optimal amount of these commodities as a utility maximizing consumer subject to prices and a resource constraint (Becker, 1965). Human capital can then be considered to appear in the household's problem as a commodity, and investment in human capital appears through the price of consuming such a commodity; where the price of consumption would be the sum of the direct (prices of goods) and indirect (time spent on production) prices.

This theory contributed widely to the literature and has an array of applications. In an application to education, this theory would then imply that a child's educational attainment is a household decision in which educational attainment is the commodity. Consequently implying that the household decision makers, generally the parents (Haveman & Wolfe, 1993), are directly and indirectly deciding upon their child's education. Direct decisions appear through the monetary contributions to tuition, which can reflect, at times, the quality of an education especially within the U.S. or indirectly through marital decisions, number of children or location of the household. Card and Krueger (1992) provide empirical evidence that higher quality schools increase the return to education. Further, their definition of higher quality is built upon higher teacher salaries and lower pupil-to-teacher ratios, which in turn implies the cost of the education would be higher relative to a lower quality alternative. Hanushek (1992) hypothesized that there would be a trade off between the quantity and the quality of children. Empirically tested, the study found that "child achievement falls systemically with family size" (Hanushek, 1992).

Michael (1973) built on Becker's (1965) allocation of time model to explore whether the human capital investment approach yielded a return through nonmarket channels (Michael defines these nonmarket activities as productive activities outside the labour market). The framework was empirically tested and concluded the existence of positive nonmarket returns to investment in education (i.e. an individual is more efficient in allocating their non-labour consumption, the higher their educational attainment). Providing further support of the nonmarket benefits of education, Heckman (1976), in his life cycle model incorporated non-monetary returns to education. He did this by incorporating them in the agent's instantaneous utility function. Kodde and Ritzen (1984) integrated the two theories of consumption and investment in education showing that when consumption motives are considered, the demand for education increases.

Another branch of the literature surrounding an individual's educational attainment choice is that of screening. At times referred to as labeling, screening in the context of labour economics, is the process in which qualities of an individual are identified and then sorted in order to label them as "more productive," "productive" or "not productive" (Stiglitz, 1975). In this context, education acts as the sorting device that filters out the less productive individuals. Combining signaling theory with human capital theory, an individual self-selects into additional education attainment given the offered wage schedule of employers while maximizing their return net of the costs of signaling (i.e. education) (Spence, 1973). Selecting into more education, the individual signals their higher ability, which to the firm is perceived as "more productive" leading to increased earnings for the individual. This stream of literature brings forth the role in which ability plays in determining educational attainment levels.

The *typical* model of educational attainment considers a continuous dependent variable. That is, the number of years spent in schooling identifies the level of educational attainment. The attempt is to identify the correlations existing between a set of identifying characteristics and the outcome variable: years of schooling. This type of analysis can be carried out using the Ordinary Least Squares (OLS) estimation method. A limiting feature of this methodology is the assumption of a linear relationship existing

between the background variables and years of schooling. For examples of studies of this sort, see Cane & Katz, 1991; Datcher, 1982; Blau & Duncan, 1967.

In contrast to models using the years of schooling approach, researchers have since introduced a complementary method. This method has been titled school transition modeling. In this framework, educational attainment is disaggregated into a finite number of stages where the individual faces a sequence of decisions pertaining to their educational trajectory. It is then the product of the transition probabilities, where the transition refers to one stage of education to the next that generates the probability of final educational attainment (Mare, 1980). Using this rationale of educational attainment, it is the probability of making a transition or continuing education to the next level (i.e. from high school to college) that is of interest as opposed to years spent in the education system, as is in OLS models. Mare (1980) applied a logistic regression model to estimate the transition probabilities controlling for social background factors (see also Bouden 1974; Manski & Wise 1983; Shavit & Blossfeld 1993). A limiting feature of the school transition model is it views educational transitions as ordered, when in fact they are not always.

Over the past decades of educational attainment research, many criticisms have been brought forth. In order to focus the critiques, two will be discussed, both of which are addressed in the methodology of this study. The first to be considered is the econometric flaw as depicted by Cameron and Heckman (1998). They argued that models such as the school transition model suffered from unobserved heterogeneity, which in turn resulted in dynamic selection bias or alternatively educational selectivity. Their objection stemmed from the fact that educational models typically omitted controls for ability and motivation (which the authors argue to be statistically independent regressors). They note that "The non-linearity of conditional probabilities and the progressively selective sample composition with respect to ability at higher levels of educational attainment give rise to bias from omitting statistically independent regressors" (Cameron & Heckman, 1998).

The second criticism is more conceptual than econometric. Breen and Jonsson (2000) argued that the school transition model assumes that an individual advances through the educational system exclusively in a sequential manner, which they suggest

is an often overlooked limitation of the model. As is the case in Canada and in many countries it is possible to change trajectories mid-degree or -diploma and furthermore, attainment is not limited to being progressive. The following section discusses how the preceding criticisms are dealt with and it introduces the resulting discrete-choice model used for analysis.

4 The Multinomial Logit Model

To address the limitation of progressive education, a multinomial logit model will be utilized as opposed to an ordered logit model. This will treat educational attainment as unordered while allowing the study to maintain a discrete-choice model. As Canada has no national governing body of education, it is argued that the educational systems are systematically and qualitatively heterogeneous across provinces. For instance, the tertiary level in Ontario consists of a university, college or a form of vocational training, while in Quebec it is CEGEP or college.[4] Thus, it is empirically difficult to assume an ordered sequence.

In order to deal with the unobserved heterogeneity, a proxy for motivation is identified. The study will utilize whether or not an individual worked for pay while in high school. This is chosen over using GPA as a proxy for ability as GPA would undoubtedly cause endogeneity bias. A more robust measure would be a measure of cognitive ability or achievement and would be done by estimating it using socio-economic controls, but is beyond the scope of this study (see Todd & Wolpin, 2003 and Jaeger & Holm, 2003 for examples on how to do this). The study now proceeds to discuss the multinomial logit model.

The dependent variable, Y, has M categories. The dependent variable with the highest frequency is designated as the reference category (Menard, 2002)[5]. It is then the probability of being in any other category that is compared to the probability of being in the reference category. Thus, with M categories there are $M - 1$ equations, each of which explains the relationship between the dependent and independent variables for each category relative to the reference category (Greene, 2012).

[4] The heterogeneity of provincial education systems is discussed further in the section 6.
[5] One could also choose the reference category as the first or last category (i.e. 0 or M).

Where category 0 is the reference, and there are $m = 1, \dots, M$ other categories, the resulting multinomial logit model takes the form:

$$ln\frac{P(Y=m)}{P(Y=0)} = \propto_m + \sum_{k=1}^{K} \beta_{mk} X_{ik} = Z_{mi}$$

Where α_m is a category specific constant, Xs are a set of predictors for $k = 1, \dots, K$ independent variables, and βs are regression coefficients. This equation is termed the $logit(Y = m)$ and is denoted Z_{mi}. Alternatively, it is referred to as the predicted log odds, and with M categories there are $M - 1$ predicted log odds.

The resulting β coefficients are what determines the direction of the relationship between the dependent, Y, and independent, X, variables. For instance when $\beta > 0$, smaller (or larger) X values are associated with smaller (or larger) logits of Y, relative to the reference category. Inversely, when $\beta < 0$, smaller (or larger) values of X are associated with larger (or smaller) logits of Y, again relative to the reference category (Peng, Lee, & Ingersoll, 2002).

A more common way of presenting the results is in terms of relative risk ratios (RRRs). Relative risk ratios are obtained by exponentiating the estimated coefficient. Stata 14, which is used for this analysis, computes the RRRs by simply specifying it as an option on the –mlogit- command. The interpretation of the RRRs is straightforward. For categorical variables, an RRR greater (less) than one implies an increase (decrease) in the odds of belonging to a particular category of the dependent variable relative to the reference group compared to the reference of the categorical variable.

5 Data

The analysis is carried out using the Youth in Transitions Survey (YITS), which is a data-rich longitudinal study of Canada's youth. It is rich in the sense that it contains data on not only the youth but also their schools and their parents (or guardians) and then follows them through their transition into adulthood. Further, it is not limited to students who go onto PSE as it composed of individuals who have graduated and not graduated high school, and graduated and not graduated PSE.

The YITS is unique in many ways; however, the primary identifying feature is that it is actually two distinct surveys. The first is the YITS-A Cohort (15-year-old

cohort and/or reading cohort) and the second, the YITS-B Cohort. This study utilizes the YITS-A, which has a target population of anyone born in 1984 and attending any form of schooling in Canada in the 1999/2000 school year, this criteria results in the initial sample consisting of youth aged 15 or 16 dependent on their birth month.[6] Using the YITS-A allows the study to consider high school effects on PSE attainment. And furthermore, family background and socio-economic characteristics are considered to be more accurate as they are backed by the parental survey responses.

The YITS-A follows a stratified two-stage cluster sample design. First, it built a sample of 1,242 high schools across Canada, from all ten provinces, identified as the primary sampling unit (PSU). Second, from those schools, students born in 1984 were selected to participate, identified as the secondary sampling unit (SSU).[7] Once in the sample, respondents were surveyed every second year for the course of 6 cycles: 2000 (cycle 1, as of December 1999), 2002 (cycle 2, with January 2000 to December 2001 as a reference period), 2004 (cycle 3, with January 2002 to December 2003 as a reference period), 2006 (cycle 4, with January 2004 to December 2005 as a reference period), 2008 (cycle 5, with January 2006 to December 2007 as a reference period), and 2010 (cycle 6, with January 2008 to December 2009 as a reference period).

Cycle 1 is the most unique of the cycles; it is composed of 4 separate surveys. First was the student questionnaire, followed by each student then participating in the Organization for Economic Co-operation and Development's (OECD's) Program for International Student Assessment (PISA). Thirdly, the principal of each of the selected high schools responded to the PISA/YITS school survey, and lastly, the parents of the student respondents participated in the parent survey. This composition occurred solely in cycle 1, the remaining cycles strictly surveyed the students who had responded to the student questionnaire in cycle 1.

As with any longitudinal survey analysis, one must proceed with caution as sample attrition can lead to analytical problems, which should not be left unturned. The main issue with attrition is that the sample may become unrepresentative of the population as observations are lost after each cycle and are likely non-random. To

[6] The YITS-B targeted youth who were 18 to 20 years old on December 31st, 1999.
[7] For a complete explanation of all super strata, stratum, and clusters refer to Statistics Canada, (2005).

rectify this issue, weights are constructed, by Statistics Canada, for each observation. These weights are a complex and take into consideration the stratified two-stage cluster design of the survey. A weight is attached to each respondent that indicates the number of non-respondents in the population that are represented by that sampled individual (Statistics Canada, 2011). The weighted sample results will hereafter be referred to as the population and will be the only reported number of observations. The following table presents the longitudinal response rates.

Table 4: Survey response rates

Cycle (year)	Response Rate for Each Cycle (%)	Longitudinal Response Rate (%)
1 (2000)	86.6	86.6
2 (2002)	90.5	78.4
3 (2004)	84.4	66.2
4 (2006)	83.1	55.0
5 (2008)	78.3	43.0
6 (2010)	75.4	32.5

Source: Author's calculations

The longitudinal response rate is of significance with panel data as it is representative of the attempt to minimize the loss of statistical power or population representation resulting from attrition. As can be noted from table 4, 32.5% of the initial sample participated in all 6 cycles of the YITS-A. It should further be noted that the response rate of the parent and school surveys in cycle 1 was 90.6% and 96.4%, respectively (Statistics Canada, 2005).

5.1 The dependent variable

The dependent variable of interest is deemed to be nominal and consists of 4 educational attainment categories:

(0) High school droppers,

(1) High school graduates or GED,

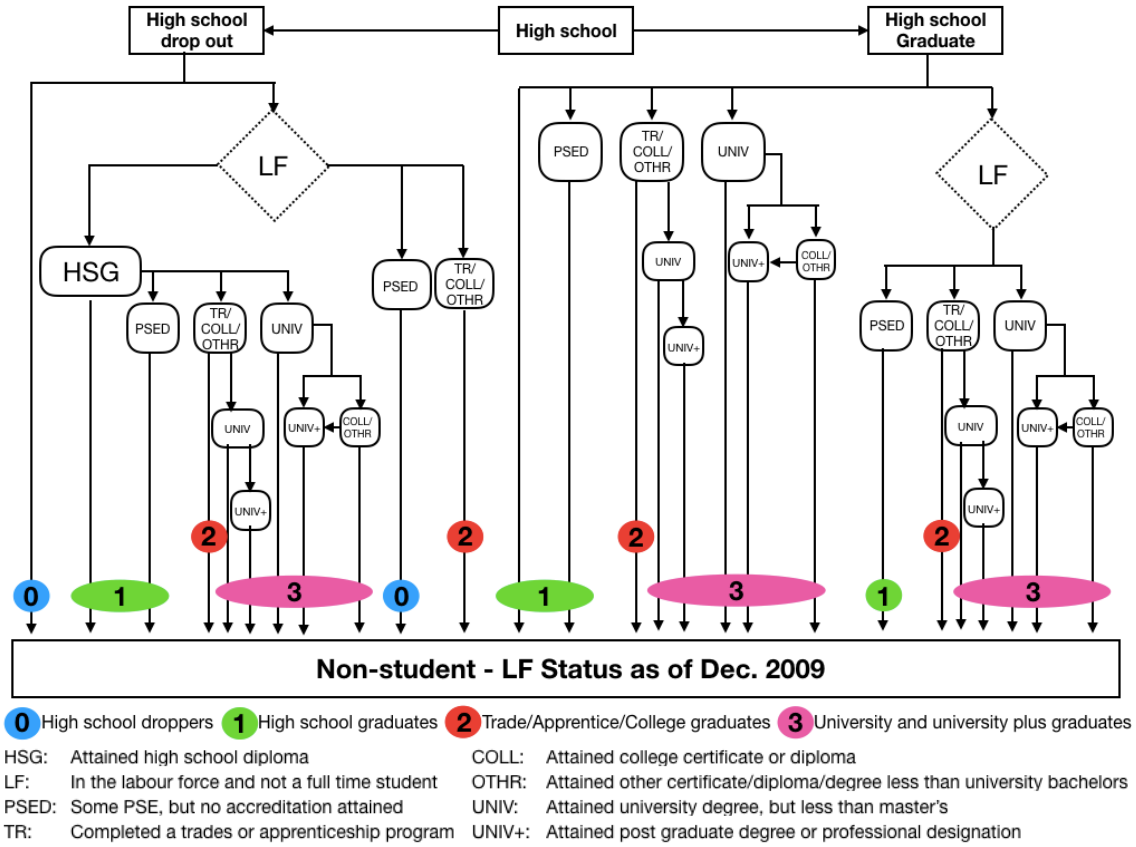
(2) Trade/Apprenticeship/College graduates, and

(3) University 4-year bachelor's degree, University post-graduate degree, or professional designation.

The following figure has been adapted from the late CPRN's mapping of education-to-labour market pathways to be representative of those present in the YITS-A sample. What it shows are the possible pathways a youth could face from the time they were

initially sampled to when they enter the labour market. The identified trajectories were then grouped into final educational attainment level and are used as the aforementioned dependent variable subpopulations of interest in the analysis.

Figure 1: Education-to-labour market trajectory map



Path 0 – High school droppers, contains any respondent who did not graduate high school, they may have gone straight to the labour force or spent some time at a PSE institution but did not graduate. Path 1 – High school graduates represents any individuals who graduated high school or ever dropped out and returned to receive their high school diploma or GED. Further, it contains individuals who graduated high school and attended a PSE institution but received no accreditation. Paths 2-4 all require the surveyed individual to have attained their high school diploma. These paths overlap in the sense that someone could have received a college diploma, but then graduated university, or completed university and then completed a college program. In both of these cases, a university degree is the highest level attained and is consequently the path they fall member too. Path 3 is comprised of individuals who attained any university 4-

year bachelor's degree, or any post-graduate university degree or professional designation such as a CFA. Ideally, the trajectories would have included a category for those who attained some PSE but did graduate the program and would further divide path 3 into 2 separate paths, 1 for any university 4-year bachelor's degree holders and another for post-graduate or professional designation holders. Unfortunately, due to the sample composition, it was not possible to have accurate results with the "ideal" categories; as such they were collapsed into the resulting 4 categories.

Chart 1: Percentage of respondents who are member of the identified educational attainment category

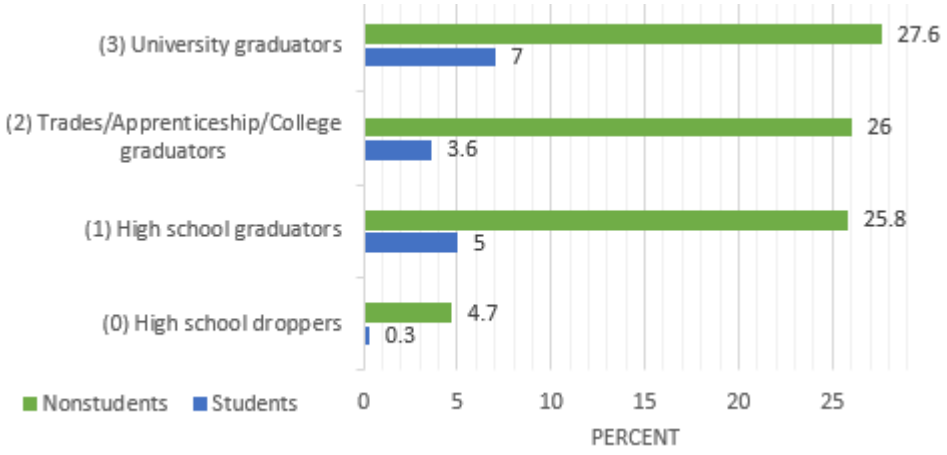


Chart 1 displays the proportions of the sample, weighted to be representative of the population, for the aforementioned levels of educational attainment. The chart displays the attainment levels for both non-students as of December 2009 and those reporting full-time student status.

5.2 The controls

The following table presents the percentage of each subpopulation that has the listed identifying characteristic. It is read as: of the total population of 332,949 youth, 5% are said to have not graduated high school as of December 2009. Of that 5%, 3% are male, 1.6% are female, and 0.04% of respondents did not report their gender.

Table 5: Percentage of weighted population with identified characteristics by educational attainment category

Background Factor	(0) High school drop-out	(1) High school diploma	(2) Trades or Apprentice or College certificate	(3) University or post-graduate degree or professional designation	Total
	Percent				N
Total	5.0	30.8	29.6	34.6	332,949
Sex					
Male	3.0	18.3	14.5	14.2	166,730
Female	1.6	12.3	14.8	20.3	162,836
Unknown	.04	0.2	0.3	0.2	3,382
Visible minority					
No	4.0	24.9	23.3	24.9	256,9178
Yes	0.2	2.2	2.8	5.3	34,921
Unknown	0.7	3.7	3.5	4.4	41,110
Birthplace					
Canada	4.0	25.3	24.5	27.3	269,951
Elsewhere or unknown	1.0	5.5	5.0	7.3	62,998
Urban residence in cycle 1					
Yes	2.9	18.8	17.5	24.2	211,299
No	1.2	7.7	8.2	5.6	75,441
Unknown	0.8	4.3	3.9	4.8	46,208
Mother tongue					
English	2.4	17.6	17.7	20.1	192,712
French	1.5	7.2	5.8	5.8	67,405
Other	1.0	6.0	6.0	8.8	72,831
Last province of high school					
NL/PEI/NS/NB	0.3	2.5	2.5	3.1	27,925
QC	1.8	8.1	6.6	6.3	75,995
ON/MB/SK	1.9	12.3	13.4	17.5	149,993
AB/BC	1.0	8.0	7.0	7.8	79,036
Number of siblings					
None	0.2	2.0	1.6	2.6	21,428
One	1.5	11.5	12.1	14.7	132,311
Two	1.5	9.3	8.6	10.6	100,006
Three	0.6	4.8	3.9	4.2	44,648
Four or more	1.2	3.2	3.4	2.5	34,557
Family structure in cycle 1					
Intact	2.1	18.4	19.3	24.7	214,820
Step parent present	1.0	3.1	2.5	1.6	27,002
Lone parent	1.1	5.2	3.7	3.6	45,302
Other	0.8	4.2	4.1	4.6	45,825
Birthplace of parent(s)/guardian(s)					
All known to be born in Canada	2.6	17.1	17.1	17.2	179,591
At least one known to be born in Canada	1.3	6.4	5.1	6.1	62,639
None are known to be born in Canada or unk.	1.1	7.3	7.5	11.4	90,719
Primary parent/guardian's highest level of education	1.2	3.6	2.6	1.1	28,225
Less than high school	1.1	8.4	7.7	6.5	78,983
High school diploma	0.2	2.4	2.5	2.1	23,749
Some PSE – did not graduate	1.3	11.7	12.5	20.3	152,511
Post-secondary graduate					
Unknown	1.3	4.6	4.3	4.6	49,481
Total annual parental income					
Less than 50,000	2.3	11.3	8.5	7.0	96,783
Greater than 50,000 but less than 100,000	1.8	13.0	14.0	16.4	150,699
Greater than 100,000	0.1	2.9	3.5	7.0	44,982
Unknown	0.7	3.7	3.5	4.2	40,485

Student respondent had marriage before age 19					
No	4.8	30.3	28.9	34.2	326,795
Yes	0.1	0.2	0.3	0.0	1,893
Unknown	0.1	0.4	0.4	0.4	4,261
Student respondent had first dependent child before age 19					
No	4.4	29.7	28.7	34.1	322,625
Yes	0.5	0.8	0.5	0.1	6,107
Unknown	0.1	0.4	0.4	0.4	4,217
Student respondent worked for pay while in high school					
Yes	3.8	26.6	26.5	31.0	292,744
No	0.6	3.1	2.1	3.1	29,834
Unknown	0.6	1.1	1.0	0.4	10,371
Student respondent volunteered for more than 40 hours in cycle 1					
No	2.9	13.3	12.0	9.3	124,590
Yes	2.0	17.2	17.2	24.9	204,271
Unknown	0.1	0.4	0.3	0.4	4,088
Student respondent's GPA(%) in last year of high school[8]					
80-100	0.3	7.2	8.0	24.9	134,663
70-79	1.5	14.2	14.8	8.8	130,843
69 or less	2.7	8.8	6.4	0.9	62,597
Unknown	0.4	0.6	0.4	0.1	4,846

Source: Author's calculations
Note: Total subpoplation may not add to full population due to rounding.

5.3 Data limitations

As previously discussed, in Canada there is no national governing body of education, leaving each province responsible for having a ministry of education. This along with other contributing factors has led to a divide in the systems of education and a qualitative divergence of curricula across provinces. Generalizing, all provinces are fairly similar in the structure of their education systems with the exception of Quebec (refer to Council of Ministers of Education Canada, n.d. for a thorough mapping of all provincial education systems). Singling it out, Quebec has more complex pathways of education. Once completed high school, youth can go onto to the CEGEP (College d'enseignement general et professional) system. CEGEP allows 2 to 3 years of university preparation courses to be taken. Alternatively, the youth could choose to go straight into college, which during the sample period tended to be 3 years of schooling. The CEGEP system results in these individuals graduating high school 1 year before those in other provinces, and consequently, they begin university 1 or 2 years later.

This proposes two issues for analysis. First, youth who follow the CEGEP system into university would graduate 2 years after those from another province had

[8] While GPA is not used explicitly as a control it is presented here to give the reader a full picture of the population.

they not taken any breaks between education levels. Thus, causing the attainment results in Quebec to not be entirely comparable to the rest of Canada at the end of the survey. In an attempt to mediate this limitation, both students and nonstudents as of December 2009 are used in the analysis. If students were omitted Quebec attainment levels would be under-represented.

Second, an evaluation of education credentials would be necessary to determine if one could classify degrees, diplomas or certificates to be equivalent across provinces. It is beyond the scope of this analysis to perform an evaluation of the levels of education, as such a high school diploma, trades, apprentice or college certificate, and university degree are assumed to be qualitatively equivalent across all 10 provinces.

Another limitation of the data is embedded in the root of the survey's design. It removes any sort of information on those born 1984 and not in school in 1999/2000. Since at the time the survey was initiated youth could legally self-select out of high school as of age 16 across the nation there exists motivation to capture information on that group of individuals as they would be of peak importance in terms of public policy. This remains a limitation of the study, however, since 1999 Ontario has enacted new legislation that requires youth to remain in secondary school until the age of 18, with existing pressure on other provinces to follow suit (The Law Library of Congress, 2015).

6 Analysis

The background factors presented in section 6 show the final explanatory variables. Initially, these were disaggregated further but due to an insufficient number of sample responses and weak statistical power some of the predictors were collapsed.[9] For example, the last province attended high school variable would ideally have included a control for each province; instead, it is grouped as Atlantic Provinces, Quebec, Ontario and the Prairies, and Alberta and British Columbia. If collapsing was required, a variable was only retained if the manner in which it was collapsed would still provide any sort of useful inference, i.e. if it required grouping likely and somewhat unlikely the

[9] The results are not presented due to restrictions invoked by Statistics Canada on the release of data with an insufficient number of sample responses.

control would be omitted, as the results do not provide logical inference. Or continuing the above provincial example, had the variable been grouped as Atlantic Provinces with Pacific Provinces, Prairies Provinces with Quebec, and Ontario the results would not be conclusive for inference.

Selection Criteria:
As there still remains an exhaustive list of potential predictors, univariable model fitting is conducted with the intent to create a shortlist of independent variables for inclusion in the final model. This procedure follows Hosmer, D et al (2013) Model Building Strategies for Multinomial Logistic Regression. The p-value cut-off is chosen to be any $p > 0.100$.

Table 6: Univariable model fitting results

Variable	Likelihood Ratio Test Statistic (χ^2)[10]	Degrees of Freedom	P-value
Sex	109.9	3	0.0000
Visible Minority	58.44	3	0.0000
Birthplace	6.02	3	0.1108
Urban residence in cycle 1	92.79	3	0.0000
Mother tongue	45.49	6	0.0000
Last province attended high school	84.33	9	0.0000
Number of siblings	54.93	12	0.0000
Family structure in cycle 1	120.11	9	0.0119
Birthplace of parent(s)	37.5	6	0.0000
Primary parent/guardian's highest level of education	294.43	9	0.0000
Total annual parental income	199.25	6	0.0000
Student respondent had marriage before age 19	25.64	3	0.0000
Student respondent had first dependent child before age 19	54.29	3	0.0000
Worked for pay in high school	8.34	3	0.0395

Source: Author's calculations

[10] The log-likelihood test statistic is calculated as $\chi^2 = -2*\ln[(L_0)/(L_1)] = -2 * [ll_0 - ll_1]$, where L_i represents the likelihood of the model and ll_i the log-likelihood of the model and $i = 0$ is the constant only model.

The above table shows that all variables excluding birthplace are retained for the final model. Since the final model contains controls for whether or not the parent(s)/guardian(s) were born in Canada, it less concerning to exclude the birthplace of the child. If it were available within the data set, a variable indicating if the youth were a landed immigrant in their last year of high school would be considered for inclusion. As such, the model proceeds with 81 coefficients in total, which raises concern, however, a significantly large sample size is maintained, thus, the model is assumed to be free of numeric instability. For the purpose of discussion the results of the multinomial regression are split into separate tables, however, it should be noted that all variables were entered simultaneously into the one final model. The tables present the estimated relative risk ratios (RRRs), followed by their standard error in parentheses.

Table 7.a Results from the multinomial logistic regression on level of education attained

	Education Attainment Level (reference: (3) University graduate)		
Predictor	(0) High school dropper	(1) High school graduate	(2) Trade/Apprentice/College graduate
Female (reference: male)	0.217*** (0.213)	0.375*** (0.0827)	0.604*** (0.080)
Visible minority status (reference: no)	0.333* (0.483)	0.362*** (0.226)	0.662* (0.187)
Urban residence in cycle 1 (reference: yes)	0.845 (0.215)	1.267** (0.0915)	1.584*** (0.0882)
Mother tongue (reference: English)			
French	0.799 (0.268)	0.938 (0.141)	0.896 (0.137)
Other	0.908 (0.453)	0.830 (0.222)	0.800 (0.207)
Last province of high school (reference: NL PEI NS NB)			
QC	4.953*** (0.311)	1.960*** (0.143)	1.657*** (0.138)
ON MB SK	1.857* (0.282)	1.343** (0.0991)	1.435*** (0.0918)
AB BC	3.975*** (0.268)	2.085*** (0.102)	1.659*** (0.0956)

Source: Author's calculations
*p<0.05 **p<0.01 ***p<0.001

From table 7.a one can observe, ceteris paribus, that the relative risk of being a high school drop-out compared to a university graduate decreases by a factor of 0.217 for females compared to males. The results further show that the relative risk of

receiving only your high school diploma or a trades/apprentice/college certificate compared to a university degree increases by a factor 27% and 58%, respectively, for rural residents relative to urban residence. This could possibly indicate the barrier that those living in rural communities face in terms of access to universities, as universities are primarily located in urban centres.

Interestingly, all nine relative risk ratios for the last province attended high school are greater than 1 and statistically significant. Indicating that youth from Central and Western Canada are likely to not go beyond a college degree relative to those who attended high school in in the Atlantic Provinces. The most notable are Quebec, where relative to the Atlantic Provinces, a youth is 4.953 times more likely to not receive a high school diploma compared to a university degree. The results of Quebec appear to be quite similar to those of British Columbia and Alberta.

Table 7.b Results from the multinomial logistic regression on level of education attained

	Education Attainment Level (reference: (3) University graduate)		
Predictor	(0) High school dropper	(1) High school graduate	(2) Trade/Apprentice/College graduate
Number of siblings in cycle 1 (reference: none)			
One	1.385 (0.476)	1.257 (0.173)	1.362 (0.164)
Two	2.382 (0.483)	1.365 (0.178)	1.305 (0.169)
Three	1.896 (0.501)	1.454 (0.198)	1.388 (0.189)
Four or more	2.540 (0.543)	1.443 (0.220)	1.568* (0.210)
Family structure in cycle 1 (reference: intact)			
Step parent present	6.259*** (0.281)	2.246*** (0.159)	1.590** (0.167)
Lone parent	3.040** (0.378)	1.972*** (0.165)	1.346 (0.175)
Other	1.452 (0.712)	1.158 (0.348)	1.820 (0.350)
Total annual parental income (reference: less than $50,000)			
Equal to or greater than $50,000 but less than $100,000	0.444*** (0.238)	0.557*** (0.100)	0.728** (0.0983)
Equal to or greater than $100,000	0.079*** (0.516)	0.332*** (0.139)	0.455*** (0.134)
Primary parent/guardian's highest level of education (reference: less than high school)			
High school diploma	0.212*** (0.271)	0.453*** (0.159)	0.583** (0.168)
Some PSE – did not graduate	0.097*** (0.478)	0.441*** (0.198)	0.621* (0.200)
Post-secondary graduate	0.093*** (0.269)	0.232*** (0.153)	0.361*** (0.160)

Birthplace of parent(s)/guardian(s) (reference: All known to be born in Canada)			
At least one guardian born in CA	0.662 (0.338)	0.710* (0.138)	0.736* (0.139)
Neither guardian born in CA or unk.	0.335 (0.583)	0.756 (0.209)	0.843 (0.189)

Source: Author's calculations
*p<0.05 **p<0.01 ***p<0.001

In table 7.b we observe a lack of statistical power for all but one number of siblings' RRR. This result returns to the discussion on how the parents (household decision makers) decisions as to how many children to have impacts the level of education their child will achieve. While not significant, the results are consistent with the theory; i.e. relative to no siblings, a youth with four or more siblings is 2.54 times more likely to not graduate high school relative to graduating university.

The results further show that the disruption from having an intact family, which consists of the biological parents, significantly increases the odds of not graduating high school relative to graduating from a university program. This conclusion is consistent with past social science research, providing support for the negative relationship that exists between increased stress levels, which associated with lone parent and step families, and educational attainment (see for example Frederick and Boyd 1998).

The RRRs associated with familial income and primary parental education are further consistent with past literature. However, more recent research on PSE has shown a shift in the emphasis on the financial factors towards non-financial. The idea of parental income influencing the educational achievement of a child has been around since the beginning of education modelling, but this new shift shows that when parental education and other non-financial factors are added to the model, total income loses predictive power (Finnie and Mueller 2008; Cunha, et al. 2005). As such, these results are consistent and show that both parental financials and education are statistically significant. Moreover, a youth is 91% less likely to have not graduated high school relative to university if their parent is a PSE graduate compared to a high school drop out. This could stem from the fact that children of higher educated parents partially inherit the academic abilities of their parents reducing the cost of acquiring higher education. And further if this generational mobility of ability occurs, the higher able students can more efficiently convert education into utility and as the reviewed theory would suggest, would, in turn, increase their estimated return to education.

Table 7.c Results from the multinomial logistic regression on level of education attained

	Education Attainment Level (reference: (3) University graduate)		
Predictor	(0) High school dropper	(1) High school graduate	(2) Trade/Apprentice/College graduate
Had marriage before age 19 (reference: no)	27.467*** (0.941)	7.301** (0.719)	11.034*** (0.644)
Had first dependent child before age 19 (reference: no)	29.430*** (0.619)	8.423*** (0.464)	4.716** (0.489)
Worked for pay in high school (reference: yes)	1.228 (0.299)	1.302 (0.161)	0.950 (0.161)

Source: Author's calculations
*p<0.05 **p<0.01 ***p<0.001

Table 7.c provides interesting results. We observe no significant RRRs for the worked for pay in high school variable. One could justify the lack of significance as familial income was also controlled for, which is an indication of financial need of the youth. However, as worked for pay in high school was used as a proxy for motivation it is interesting to note that relative to having worked, youth not working has increased odds of not going beyond high school relative to getting a university degree. Further research would consider controlling for how many hours were worked for pay weekly, which would contribute to a discussion surrounding the legal working age of youth as if working over 25 hours a week was found to increase the odds of dropping out of high school relative to attending PSE policies should be reviewed.

Lastly, the increase in the likelihood of not receiving a high school diploma is statistically significant and drastic for the two familial responsibility controls. These RRRs are however used with caution as referencing table 5, we can see that youth reporting having had their first marriage or dependent child before 19 are drastically underrepresented. The population counts are only 6,108 for having first dependent child before 19 and 1,893 for having been married before 19.

7 Conclusion and Policy Implications

This study has reviewed the projections for higher educated workers and found that future skilled labour supply shortages are expected occur. As such motivation for addressing which background factors played a part in holding youth back from PSE attainment in Canada was found. The study analysed the most recent longitudinal study on Canadian youth, the YITS, and utilized its rich data to determine the relative odds of dropping out of high school, graduating high school or attaining a college degree to completing a university degree, controlling for a number of background factors.

The results were consistent with previous empirical analysis and theory finding that parental education had a strong and significant influence on teens' relative odds of attending university. Finding that the odds of attaining any form of education equal to or less than a college diploma relative to a university degree fall as the parental education level increases. In terms of a policy response, there is straightforward solution stemming from this result. It is unfeasible to discuss a policy to change the current levels of parental education, however, it does provide long-term policy insight to ensure college and university attainment increases for today's youth for when they age into parenthood.

An important conclusion to draw is that while of statistical importance; familial income levels are not the only contributing factor to a child's educational attainment. Over the decade in which the YITS was occurring, policies were strongly targeted at breaking financial barriers to access to PSE. With this respect the study finds two perspectives, first, there was a relatively equal proportion of youth who only attained a high school diploma as there was at the college or university level (refer to figure) with a fairly consistent familial income distribution across the three categories. This is in itself provides motivation to look further as to whether financial barriers should be the primary policy target. Without a doubt, making education affordable for all will by no means harm the odds of an individual attaining higher education, it simply brings us to the second perspective: public resources and funds should be more efficiently allocated and new policy alternatives fostering educational access and attainment need to be considered.

Overall, it appears that in order for a policy to be effective, the desire and motivation to attend PSE needs to be present. This is shown in the results as factors such as family structure in high school, parental birthplace, visible minority status, and urban residency all impact the relative odds of attaining PSE. Furthermore, the population count of high school drop-outs accounts for only 5% of the overall population, whereas those attaining a high school diploma but no more account for just under 30%, which emphasizes a fundamental problem in the system. This would then change the emphasis of policy from being directly on educational attainment to indirectly. It would require resources to be allocated to fundamental issues occurring at earlier stages in the child's life and educational pathway to put them on the trajectory of entering the PSE system.

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