Canadian Labour Market and Skills Researcher Network

Working Paper No. 70

Returns to Apprenticeship in Canada

Daniel Boothby
Industry Canada

Torben Drewes
Trent University

December 2010

CLSRN is supported by Human Resources and Skills Development Canada (HRSDC) and the Social Sciences and Humanities Research Council of Canada (SSHRC). All opinions are those of the authors and do not reflect the views of HRSDC or the SSHRC.

Returns to Apprenticeship in Canada

Daniel Boothby
Industry Canada

Torben Drewes
Trent University

Abstract

The paper exploits the newly available Census data on the earnings of individuals in the apprenticeable trades to examine the returns to apprenticeship training. Only a small minority of males work in these trades, concentrated in the construction, production and mechanical trades where their weekly earnings premia over completed high school range from 9 to 14 percent. An even smaller minority of women report working in apprenticeable trades and it appears that many of them mistakenly report having apprenticed. In the largest single trade for women, personal services and culinary arts, the earnings premium is actually negative, although weekly earnings compare more favourably against the earnings of women without completed high school. Given reasonably large returns for men, late entry into apprenticeships is a puzzling phenomenon requiring further investigation.

JEL Classification: J24, J31
Keywords: Human Capital, Wage Differentials, Canada

The authors gratefully acknowledge support from the Canadian Labour Market and Skills Researchers Network and Human Resources and Skills Development Canada and comments by participants at the HRSDC-CLSRN Apprenticeship Workshop in Vancouver. The paper has benefited substantially from suggestions made by an anonymous reviewer. The views expressed herein are not necessarily those of Industry Canada. All errors are the responsibility of the authors.

Executive Summary

- While only a small proportion of the Canadian labour force has trained in the apprenticeship system, the system is critical for the supply of labour to certain sectors, such as construction. Prior to the 2006 Census, data required to estimate the returns to apprenticeship as a form of post-secondary education were simply not available in Canada. The paper intends to begin the process of establishing those returns using the new apprenticeship classifications in the latest Census.

- There is little evidence on the returns to training certification in Canada. The 2000 Census suggests that the earnings premium over completed high school for this certification (apprenticed and non-apprenticed) was in the order of 11.5 percent for men and 3.6 percent for women. In Great Britain, the premium to apprenticeable training have been estimated to be 5 – 7 percent for men and nil for women.

- According to the 2006 Census, approximately 7 percent of males and 2 percent of females reported themselves as having certification in an apprenticeable trade. Using the Classification of Instructional Programs to identify specific trades, we find that about 80 percent of males are in the construction, production and mechanical trades while one third of females are in the personal services and culinary arts trades. Over 40 percent of females report apprenticeship training in business management and support or health services trades. These individuals are most likely confusing apprenticeship training with less formal programs of study, which leads to some concern about using Census data to estimate returns to true apprenticeship programs.

- According to the 2007 National Apprenticeship Survey, the mean age at the start of apprenticeship programs was around 25 years for males for most of the trades but was over 30 years for women in some trades. Median program lengths ranged from 2 to 5 years, suggesting a significant human capital investment by apprentices.

- A human capital earnings function approach is used to estimate the proportional increase over high school earnings associated with different apprenticeship types. Among men, the construction and engineering technology trades produced the largest estimated premia at 13.8 percent and 13.5 percent, respectively. The earnings gap was 12.0 and 8.6 percent, respectively, in the production and mechanical trades. For the small number of males entering the personal services/culinary arts trades, the earnings gap was actually negative with mean earnings in these trades estimated to be over 17 percent below the average high school graduate's earnings.

- For the small number of women in the male-dominated apprenticeable trades, the earnings premia were substantial, at over 27 percent. However, in the single largest trade destination for women, personal services and culinary arts, the earnings premium is estimated to be negative.

- Data on the earnings of apprentices during training are not available in the Census and those data cannot be used to develop estimates of the internal rate of return to apprenticeship training. Attempts to use the 2007 NAS to fill in the missing data resulted in estimates that were overly sensitive to small changes in the assumptions made. The "confidence interval" around any of our estimates was simply too large to allow reporting of a point estimate of the rate of return. Given that apprentices normally receive compensation during training and do not incur tuition costs, we conjecture that the difference in the rates of return between three post-secondary education choices (university, college, and apprenticeable trades) are likely to be smaller than the estimated weekly earnings gaps.

I. INTRODUCTION

Although Canada's apprenticeship system does not play as pervasive a role in skills development as in some countries, it is an important part of the human capital production process nevertheless. First, the apprenticeship system is the primary provider of labour in many of the skilled trades, particularly in the construction, production and mechanical trades. With current concerns about the aging demographic of labour in those trades, there is considerable attention focussed on the ability (or inability) of the apprenticeship system to alleviate potential skills shortages. Second, the apprenticeship system is also regarded as a potentially beneficial school-to-work transition path for those young Canadians not particularly inclined to benefit from the academic focus that appears to be the over-riding characteristic of secondary and post-secondary education in Canada.

It is fair to say that the Canadian apprenticeship system has received little attention from labour economists and our understanding of it is rather poor. In contrast to the enormous volume of literature on the economics of higher education in the university and college systems, there is almost no analysis available of apprenticeships. Indeed, to this point, we have no estimates of one of the most fundamental metrics in the analysis of post-secondary education, the return to apprenticeship training. That return is critical both in understanding choices individuals make with respect to investments in training and in undertaking cost-benefit analyses of public policy investments in promoting apprenticeship training.

Until the 2006 Census, any attempt at estimating the return to apprenticeship training would be stymied by a lack of data. Previous censuses did not identify individuals with certification in the apprenticeable trades, combining them with all tradespeople. The National Graduates Surveys did identify those obtaining certification in these trades but did not provide the counterfactual information on the earnings of high school graduates required to produce estimates of returns. The same problem occurs in the National Apprentice Surveys. The Youth in Transition Survey reports earnings for both of these groups but the sample sizes for apprentices are too small to yield meaningful estimates. Although there are some

difficulties with the 2006 Census (as will be explained below) it represents the first opportunity to produce estimates of the returns to apprenticeship training in Canada. The singular purpose of this paper is to exploit that opportunity.[1]

The following section provides a very brief review of the small literature on the returns to apprenticeship, followed by a discussion of the data used. Section IV begins with a statistical overview of apprenticeship using both Census and National Apprenticeship Survey data. This section then goes on to estimate earnings premia to apprentice certification using a standard human capital earnings function approach. Conclusions are offered in Section V.

Individuals in the apprenticed trades form only a minority of the Canadian labour force and are concentrated in only a few trades. This is particularly true for women whose apprenticeship experience considerably different than it is for men. Compared to those with only completed high school education, men in some, but not all, apprenticeable trades do receive a premium for their educational investments that are only slightly smaller than the college premium. Female apprenticed labour, on the other hand, is concentrated in the personal services trades where earnings are actually lower than the earnings of female high school graduates. This phenomenon, coupled with the late age of entry among both male and female apprentices, suggests that we have much to learn about the processes at work in this post-secondary education sector.

II. EXISTING LITERATURE

While there are no Canadian estimates of the returns to apprenticeship training, there is some limited evidence on the returns to trades training in general. Drewes and Boothby (2006) find that high school graduates continuing on to complete a trades certificate do benefit from higher subsequent incomes, although the gains tend to be rather small. In the 2000 Census data, weekly earnings for these individuals were 11.5 percent higher compared

1. Krashinksy and Gunderson (2010) are also developing estimates of the returns to apprenticeship using a slightly different approach to ours.

to high school graduates among men, but only 3.6 percent higher for women. This compares to college and university earnings premia of 18.8 and 51.2 percent, respectively, for men and 19.6 and 62.1 percent for women.

On the face of it, it would appear that training in the trades provides relative poor returns compared to other post-secondary options. Like the vast majority of estimates of "returns" to education in the literature, however, these estimates actually only measure earnings premia. In other words, controlling for as many observables as the data permit, human capital earnings functions are used to estimate the proportional differences in earnings subsequent to schooling and training. True internal rates of return estimates must take into account differences in costs. Drewes (2006) demonstrates that, while the earnings premium associated with a university degree is substantially higher than that associated with a college diploma, the different lengths of the programs and different tuition levels result in an equalization of the internal rates of return to the two PSE options.[2] Since costs are incurred up front, their relative sizes have a very significant influence on the rate of return calculation compared to income differences occurring in the future and which are, therefore, discounted. The situation may be similar for apprenticeable trades. If the earnings premium of 11.5 percent for males in the trades were to apply to the subset of apprenticeable trades, it would compare unfavourably to the 18.8 percent premium for college education. Since apprentices typically earn incomes while learning and do not generally pay tuition costs, differences in the rates of return to trades and college education may be much smaller and, in principle, could even be reversed.

A similar conjecture is made by McIntosh (2005) who uses the UK Labour Force Survey to estimate the returns to apprenticeship in Great Britain. Using a standard OLS human capital earnings function regression, he estimates an hourly earnings premium of 5 – 7 percent for male in the apprenticeable trades (relative to those who have not completed trades training). There appear to be absolutely no gains for women. To provide a comparison, he estimates an earnings premium of 14 – 17 percent for males acquiring two or more A levels.

2. Boothby and Rowe (2002) estimate higher median rates of return to college than to university certificates.

McIntosh does not estimate internal rates of return, citing difficulties in measuring the foregone opportunity costs of apprentices engaged in training. He nevertheless suggests that the gap between rates of return is likely to be appreciably smaller than the gap between earnings premia.

Estimating the returns to apprenticeship training will involve the same econometric difficulties that plague attempts to estimate the returns to education in general. There may be selection on unobservables that biases least squares estimates and there are issues of whether one needs to distinguish between average and marginal returns. To address the selection bias issue, Fersterer et al. (2007) use data on the eventual labour market outcomes of Austrian apprentices, some of whom were apprenticing in firms that failed for various reasons. As long as not all of these apprentices go on to complete their apprenticeships elsewhere, firm failure produces, they argue, exogenous variation in the length of the apprenticeship period that can be used to produce unbiased estimates of the earnings premium to this training. Least squares estimates of the returns to apprenticeship for males are 2.6 percent per year of training, which translates into a return of about 8 percent for a typical three year program. IV estimates turn out to be essentially the same suggesting little or no bias in least squares estimates.

III. DATA

This report makes use of two data sources: the 2006 Census and the 2007 National Apprenticeship Survey.[3] Census data have been the preferred source of information in the Canadian literature on the returns to education and will be used in this report to estimate the earnings premia to apprenticeship. Quite aside from the obvious advantage of large sample sizes, the Canadian censuses have asked detailed questions about educational attainment and provide a complete list of possible educational and training credentials. Unfortunately, the 2006 Census dropped questions about the number of years of schooling undertaken so that

3. Both datasets were accessed through Statistics Canada's Research Data Centre programme.

we now only have information on completed credentials. As mentioned, the 2006 version of the Census has been improved in that apprenticeship is now identified as a distinct level of educational certification.[4] Moreover, among those reporting certification following apprenticeship, Classification of Instructional Program codes are provided which can be used to identify the trade for which the individual was undertaking the training.

Census data are not completely free of limitations, however. First, information on schooling and training credentials are self-reported and it would appear from the tabulations to follow that a significant number of individuals report themselves as having undertaken apprenticeable training in occupations which, in fact, are not apprenticeable. This is particularly true of women, who report themselves as having apprenticed in areas like health and business professions where such training does not take place. Our results may therefore differ from analyses based on administrative records such as the Registered Apprentice Information System which records formal registrations in provincial apprenticeship programs. A second limitation that will be particularly problematic in estimating internal rates of return is that the Census does not identify individuals who have followed the apprenticeship route until they complete their training. Therefore, the earnings of those who were engaged in apprenticeship training at the time of the Census are not known. Finally, Census data are not rich in the kind of information needed to implement econometric techniques, such as IV estimators or propensity score approaches, normally in the returns to schooling literature to overcome selectivity bias problems.

To observe the earnings of those currently engaged in apprenticeship training and to provide additional context, we also make use of the 2007 National Apprenticeship Survey (NAS). The NAS is a survey of approximately 30,000 apprentices in 2002, 2003, and 2004 who: had registered in 1999 or earlier and who were still registered in 2004 (long-term continuers); had completed their apprenticeships during the period 2002 to 2004 (completers), or; had discontinued their apprenticeships during that period (discontinuers). The NAS thus

4. Unfortunately, the educational attainment question in the Census remains hierarchical so that we only know the individual's "highest" educational certification. If an individual with a completed apprenticeship continues on to a college technologist's diploma, for example, that individual's acquisition of the apprenticeship certificate is lost in the data.

excludes individuals who were apprentices between 2002 and 2004 and who had entered their apprenticeship program after 1999.

IV. EMPIRICAL RESULTS

IV.1 Descriptive Statistics

We begin with an overview of apprenticeships in Canada. Table 1 reports population estimates of the educational attainment distribution among men and women between the ages of 16 and 65, inclusive, as reported in the 2006 Census. Clearly, the apprenticeable trades do not attract a great number of Canadians, particularly women. Although information on the demand side of the labour market would be required to identify skills shortages in these trades, the small numbers of apprenticeship completers is consistent with the concern by some that not enough individuals are entering the trades to meet demand. Almost three times as many Canadian men have college certification and four times as many have some form of university credential. The contrasts are even more dramatic for women and there is, then, a real economic question of whether the apprenticeable trades are unappealing to young Canadians from a financial point of view.

As a first pass at examining the financial attractiveness of apprenticeships, Table 2 reports mean annual gross wage and salary earnings in the Census sample of individuals reporting positive earnings.[5] For men, the usual positive association between earnings and schooling is inverted in the 16 – 24 year old age group, undoubtedly reflecting the shorter labour market experience of those in the higher education categories. In all other age categories, earnings rise with education and it is interesting to note that mean earnings in the apprenticeable trades are consistently higher than earnings in the other trades. Earnings of apprenticed labour are substantially lower than those of university graduates beginning with the 25 – 34 year old group. They remain higher than college earnings until the 35 – 44 year old group

5. All estimates are population weighted and annual incomes have been top-coded at $500,000. Values in brackets are standard deviations.

but then become lower, although not substantially so. The story is quite different for women. Certification in apprenticeable trades leads to higher earnings compared to women without completed high school but, in all age groups, lower earnings compared to women with completed high school.

The bottom row of Table 2 reports the mean ages by educational attainment and gender. The means in the cross-sectional Census data will reflect the changing participation rates in higher education. As educational attainment in the population increases, the average age among those without post-secondary education will also increase. This has clearly had a substantial impact on mean ages by education for women where those without completed high school are significantly older. Among males, the average age of apprenticed labour is the highest among all age categories, providing some basis for the concern that the skilled trades labour force is older and about to experience a looming retirement bulge that will be problematic for labour supply in these trades

As will be shown below, the labour market returns to apprenticeship depend very much on which trade the individual pursues. The 2000 Classification of Instructional Programs was used to identify the trades in which apprenticeship took place and Table 3 reports aggregated numbers to illustrate the distribution by gender. Almost 80 percent of males took apprenticeships in the construction, mechanical and production trades.[6] Construction trades include the expected trades, such as masonry, carpentry, glazier, plumbing and electrical some of which are compulsory in some provinces and some which are not. Mechanical trades include automotive mechanics, HVAC technicians, and heavy equipment and aviation repair mechanics. Tool and die, sheet metal workers, ironworkers and machinists predominate in the production trades category.

Women chose entirely different apprenticeable trades with almost one third of them in the personal services and culinary arts trades (CIP code 12). The personal services category

6. Two digit CIP codes are used to classify apprenticeships in construction (46), mechanical (47) and production (48) trades.

includes personal grooming services such as hairstyling. The large proportion of women coded as having completed apprenticeships in the health services field is somewhat worrisome since there are very few designated apprenticeship trades in this CIP area. It may be that the link between the reported CIP codes and trades in which the apprenticeship was undertaken is not direct, or that a significant number of individuals report themselves as having undertaken an apprenticeship when, in fact, they did not. This needs further exploration.

A matter of some policy concern and something of an academic curiosity has been the late entry of young Canadians into apprenticeship programs. Using the NAS data, Table 4 confirms that the average age of entry is a significant number of years higher than the typical age associated with entry into the other post-secondary options of college or university.[7] The substantial length of programs also reported in Table 4 suggests that apprenticeship training involves human capital investments that are comparable to college and university programs in terms of the time commitments individuals must make. The mean entry age, on the other hand, is puzzling if apprenticeship training is to be regarded (and analyzed) as a third post-secondary education choice considered by high school graduates. In the NAS, the mean length of time elapsing between high school graduation and the beginning of an apprenticeship is 6.5 years for men and 7.5 years for women so it is clear that apprenticeship remains more a form of adult learning than a post-secondary education choice for high school graduates, especially for women. Why this is so is an interesting question worthy of further research. There is a fundamental difference between post-secondary education in the college and university sectors and apprenticeship training. A well-defined market for higher education exists for college and university education, with efficient information and low transactions costs. Students with the requisite academic requirements can quickly exercise their choice to demand this kind of education. The same is not true of apprenticeship training where such training takes place through a process more akin to idiosyncratic exchange rather than competitive supply of training places. In other words, late entry into

7. Note that apprenticeable trades in the table are categorized using the Registered Apprenticeship Information System scheme, not the CIP categories.

apprenticeship training programs may reflect supply decisions as much as choices to pursue this training only after some delay.

Unlike individuals who pursue post-secondary education in colleges or universities, apprentices earn incomes during the training period. Rates of pay are normally established by provincial apprenticeship boards and expressed as proportions of journeypersons time rates of pay. The NAS provides earnings ranges for respondents and the mid-points of these ranges have been used to estimate annual earnings for two groups: those still apprenticing and those who have completed their apprenticeships.[8] Given the survey design, the latter group will be recently certified journeypersons. Results are reported in Table 5.

Recall that the NAS sample design excludes individuals who were apprentices between 2002 and 2004 and who had entered their apprenticeship program after 1999. Therefore, the apprentices represented in Table 5 were either part of the exit cohort in the sample period or were long term continuers. In other words, the earnings for apprentices in Table 5 are based on a sample of apprentices in which individuals who have been in the program for longer periods of time are over-represented relative to a representative cohort of entrants. This may explain why the average ratio of apprentice to journeyperson earnings across the trades categories is approximately .80 for both men and women when regulated ratios tend to be smaller. The finding that apprentice earnings for women in the "other" trade category is actually greater than journeypersons' earnings is puzzling.

IV.2 Earnings Premia to Apprenticeship

In this section, human capital earnings functions are estimated using Census data to establish earnings differentials between those with completed apprenticeship training and those with

8. The earnings ranges in the NAS are 0, 0 – 19,999, 20,000 – 39,999, 40,000 – 59,999, 60,000 – 79,999, and 80,000 plus.

only a completed high school certificate.[9] To provide context, the earnings premia for college certificates and university degrees at the Bachelor's level are also estimated. Our estimating equations have an orthodox form:

$$\ln W = \beta_0 + \beta_1 D_A + \beta_2 D_C + \beta_3 D_U + \beta_4 E + \beta_5 E^2 + X\beta + \varepsilon$$

where lnW is the natural logarithm of weekly wages,

D_i , i = A, C, D, are binary indicator variables for completion of apprenticeship training, college or university, respectively,

EXP is a measure of years of labour market experience, and

X is a vector of controls.

The coefficients on the education indicators are approximately equal to the proportional differences in weekly earnings between individuals in the census with completed high school and individuals with the respective educational qualifications. Note that these earnings premia estimates are not internal rates of return since coefficients on schooling in Mincer human capital earnings functions coincide with the rate of return only under restrictive assumptions that are unlikely to hold[10]. Nor are the coefficients claimed to be estimates of the true causal effects of education and training. Census data are not rich enough in personal information such as family background that might permit the use of possible remedies for selectivity bias. Matching methods are stymied by the lack of background variables sufficiently correlated with the probability of pursuing an apprenticeship instead of stopping at the end of high school. Similarly, there are no obvious candidates for instruments, no discontinuities, and no longitudinal dimensions that have been used elsewhere to address selection on unobservables.

9. High school graduates are the usual reference group in estimates of returns to education. The implicit context is one in which we are interested in understanding post-secondary education decisions made at the time of graduation from high school where the choices are to enter the labour market or choose more education/training.

10. See Heckman et al. (2008).

Earnings premia estimates are generated from three different regression specifications. In the first, the natural logarithm of weekly wage and salary earnings for full-time, full-year workers is regressed against a set of indicators for educational attainment, aggregated across all apprenticed trades. In this parsimonious form, the estimates simply pick up mean differences in weekly earnings between the educational groups. The second specification accounts for the different demographics of the educational groups by including a measure of experience. In the usual fashion, experience is proxied by age minus years of education minus 6. The 2006 Census no longer reports years spent in education so mean years of schooling by educational category from the 2001 Census were used, with apprenticed individuals assigned the 2001 mean for trades. The third specification separates the trades, using the classification from Table 3, and interacts experience with the level of educational attainment. Results for all three specifications are reported for males and females, respectively, in the appendix. Table 6 provides the earnings premia estimates generated by the first two specifications.[11]

The results for the specification with no controls conform to the mean earnings comparisons reported in Table 2, although the sample is now restricted to full-time, full-year workers. Women with training in the trades, whether apprenticeable or not, have earnings that are lower than those of their high school graduate counterparts. One possible explanation is that the personal service trades that attract females tend not to require high school graduation as a prerequisite for entry. If so, it may be more appropriate to compare the earnings of females in these trades to those of females with less than a completed high school education.[12] In regressions not reported here, we used the latter group as the reference category and found that, indeed, the earnings premium to female apprentices over incomplete high school became positive (0.10) and significant when experience was not controlled for but rather small and barely significant when experience measures were included.

11. The models were also estimated using annual earnings instead of weekly earnings. Since higher levels of education lower unemployment probabilities, doing so increased the estimated premium somewhat. The differences were, however, fairly small.

12. We thank Craig Riddell for this point.

Men, on the other hand, do appear to benefit from apprenticeship training with a premium of 17 to 22 percent, depending on whether one controls for experience. The gap between apprenticeship and college earnings for men has widened somewhat from the results of Table 2 but a Bachelor's degree continues to be associated with a very large earnings premium. Accounting for experience has little impact on the premium estimates for individuals with less than a university degree but does increase quite significantly the estimate for women with a Bachelor's degree. The recent and rapid growth in female participation in universities has resulted in women with a Bachelor's degree being younger. Without controls for experience, we would be comparing the earnings of female university graduates with non-graduates who have more experience and bias estimates of the impact of a university education downwards.

In the third specification, reported in the appendix, we introduce the usual range of possible explanatory variables such as marital status and province of residence, interact the educational attainment dummies with experience to allow different patterns of earnings growth, and produce separate estimates for the different types of apprenticeable trades. There are statistically significant but numerically small differences between the educational attainment categories in the rate at which weekly earnings grow with experience. Table 7 calculates the earnings premia using 20 years of experience but using other values for experience has little effect on the estimated premia.

The introduction of the additional demographic controls variables reduces the average apprenticeship premium from the 17 - 22 percent range in Table 6 since none of the individual trades have estimates that high. Nevertheless, for men, average earnings in the top three trades categories are significantly higher than they are for high school graduates. Trades in the personal services and culinary arts category are associated with substantially lower earnings for men and women. Recall that only slightly more than 4 percent of men with completed apprenticeships trained in this category but that it accounts for the largest share of apprenticeships among women. Although women do appear to benefit from

apprenticeships in business and health services, there is some question as to whether these women actually participated in regulated apprenticeship programs. An interesting, but not surprising, finding is that those women who do train in the male-dominated construction, production, and mechanical trades have higher earnings gains than men who train in those sectors. Presumably, the gender gap between male and female high school graduates is larger than the gap in these trades.

Especially for women but also for men, the earnings premia for college and university education are higher than they are for any of the apprenticeship categories. Could this be producing a rate of participation in the apprenticeships that is too low? As Boothby and Rowe (2002) and Drewes (2006) have pointed out, it is important to distinguish between earnings premia and rates of return and both papers show that the shorter, lower cost college programs generate rates of return that are similar for college and university options. This is an important finding since it suggests that the allocation of students between these two PSE streams has responded to rates of return signals and equilibrated the returns, as theory suggests it should. Could it be that, although earnings premia for apprenticeships are lower than those associated with college or university, the rates of return are similar?

We experimented with a number of approaches to estimating the internal rate of return to selected apprenticeable trades.[13] The calculation of rates of return requires estimates of the entire age-earnings profiles of apprentices and non-apprentices and Census data can be used to produce those estimates for the post-schooling and post-training earnings of all workers. There is, however, a fundamental data problem when it comes to the earnings of individuals engaged in apprenticeship training since Census data identify individuals in the apprenticeable trades only upon attainment of the journeyperson's ticket. Provincial regulations produce a structural break in the earnings profile as we move from apprentices to journeypersons so the profile of the latter group cannot be extrapolated backwards to estimate the earnings of the former. The NAS is the only source of earnings information for apprentices of which we are aware and would have to be spliced on to the Census data for

13. It made little sense to estimate rates of return to those trades in which earnings are actually lower than high school earnings.

apprentices. Rates of return calculations are extremely sensitive to up-front values and slight changes in our assumptions about apprentice earnings produced very large changes in the estimates. With no way to produce useful upper and lower bounds, we have elected not to quote estimates. As McIntosh (2005) concluded, reliable estimates of rates of return to apprenticeship training require better data. We can only speculate, as did he, that the fact that apprentices earn income while undergoing training may mean that the rate of return gap between apprenticed tradespeople and college graduates (or university graduates) will be smaller than the earnings premium gap.

V. CONCLUSIONS AND PUBLIC POLICY IMPLICATIONS

Although only a minority of Canada's labour force is trained in its apprenticeship system, this form of training is of considerable importance in selected trades and therefore warrants analysis. The 2006 Census provides us with the first opportunity to investigate perhaps the most basic economic parameter in understanding the workings of a training system, the return to training. The primary purpose of this paper has been to generate estimates of the earnings premia associated with the completion of training in the apprenticeable trades.

Our estimates should be regarded as initial steps in understanding the private benefits to trainees, since they are subject to the same difficult econometric challenges faced in estimating the returns to formal schooling. In particular, we have not addressed the issue of causality and our estimates should be understood to be comparisons of individuals who have apprenticed in the trades with other individuals who have not. The potential for bias exists if these groups differ in other earnings-related ways that have not been taken into account in the estimating equation. One disadvantage of the Census data is that they are not rich in personal background variables that might be used in a strategy to identify causality and so we cannot claim that the estimated earnings premia represent the true causal impacts of apprenticeships. There would appear to be less a priori reason to expect ability bias in this situation and the Fersterer et al. (2007) results corroborate that supposition for Austrian data. Nevertheless, it remains a supposition.

Bearing this caveat in mind, our results raise as many questions as they answer. The construction, production and mechanical trades account for almost 80 of male apprentices and the earnings premia in these trades are significant. Although not as large as the earnings gaps for male college graduates, it would not be surprising to see the gap in rates of return close or even reverse once account is taken of earnings made by apprentices during training. If so, apprenticeship training, if it can be completed, should be as financially attractive a post-secondary education destination as colleges are. This raises the question of why the age of entry into apprenticeships for males is so delayed compared to college and university entry. We cannot address that issue with either Census or NAS data but would suggest that we need better information on the process by which entry occurs. In particular, and bearing in mind the basic economic principle that employers have no incentive to provide general skills training, we need a better understanding of the supply of apprenticeship training.

Females in male-dominated trades exhibit even higher earnings premia than males, which begs the question of why they overwhelmingly choose other trades in which earnings are actually lower than is the case for high school graduates. It may be the case that a more appropriate comparison would be between their earnings and the earnings of women without completed high school. As well, it should be noted that the results above refer to paid workers and women entering the personal services (i.e., hairdressing) trades may benefit more from their training if they are self-employed entrepreneurs. It is also worth bearing in mind that if this choice of trades appears to be economically irrational behaviour on the part of women, it is not widespread. Very few women apprentice.

Although we have not been able to produce meaningful estimates of the internal rates of return that theory suggests guides economic decisions about human capital investment, our conjecture is that these rates are attractive for the male-dominated trades. Further research is required, however, to address the usual econometric questions about the returns to training as well as to determine whether the paradigms used to consider the supply of and demand for college or university education are useful in understanding apprenticeship training.

REFERENCES

Boothby, D. and G. Rowe (2002), "Rate of Return to Education: A Distributional Analysis Using the LifePaths Model", Applied Research Branch Working Paper W-02-8E, Human Resources Development Canada, Ottawa.

Boothby, D. and T. Drewes (2006), "Postsecondary Education in Canada: Returns to University, College and Trades Education", *Canadian Public Policy*, Vol. 32, No. 1, pp. 1 – 22.

Drewes, T. (2006), "Returns to College Education: Evidence from the 1990, 1995, and 2000 National Graduates Surveys", Learning Research Series Report, Human Resources and Social Development Canada, Ottawa.

Fersterer, J., J-S. Pischke and R. Winter-Ebmer (2007), "Returns to Apprenticeship Training in Austria: Evidence from Failed Firms", National Bureau of Economic Research, Working Paper 13344.

Hansen, J. (2006), "Returns to University Education: Variations Within Disciplines, Occupations and Employment Sectors", Learning Policy Directorate, Learning Research Series, Human Resources and Social Development Canada.

Heckman, J., L. Lochner and P. Todd (2006), "Earnings Functions, Rates of Return and Treatment Effects: The Mincer Equation and Beyond" in E. Hanushek and F. Welch (eds.), *Handbook of the Economics of Education*, Vol. 1, Chapter 7, Amsterdam: Elsevier Science.

Heckman, J., L. Lochner and P. Todd (2008), "Earnings Functions and Rates of Return", NBER Working Paper 13780.

Krashinsky H. and M. Gunderson (2010), "Returns to Apprenticeship: Analysis Based on the 2006 Census", mimeo.

McIntosh, S. (2005), "The Returns to Apprenticeship Training", *Journal of Education and Work*, Vol. 18, No. 3, pp. 251 – 282.

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

Table 1: Educational Attainment in the Canadian Labour Force

	Males	Females
Less than High School	16.4%	12.1%
Completed High School	25.1	26.4
Trades Certificate	9.3	7.1
Apprenticeship	6.6	2.1
College, CEGEP, other non-university certificate	17.8	24.1
University Certificate below Bachelor's	3.8	5.2
University Bachelor's Degree	13.1	15.5
University Above Bachelor's Degree	8.0	7.6
Total	100.0%	100.0%

Source: 2006 Census

Table 2: Mean Annual Gross Earnings by Age and Educational Attainment
2005$

	Males		Females	
Ages 16-24 Mean *(Standard Deviation)*				
Less than High School	$19,475	*(13,719)*	$13,914	*(9,416)*
Completed High School	22,492	*(14,953)*	17,160	*(9,975)*
Trades Certificate	26,044	*(15,447)*	18,860	*(9,971)*
Apprenticeship	29,905	*(17,968)*	19,231	*11,554)*
College, CEGEP, other non-university certificate	27,528	*(16,092)*	22,291	*(11,540)*
University Bachelor's Degree	27,301	*(19,604)*	24,951	*(15,111)*
Ages 25-34				
Less than High School	32,361	*(21,387)*	20,161	*(13,241)*
Completed High School	37,646	*(23,820)*	25,874	*(15,401)*
Trades Certificate	38,333	*(20,244)*	23,714	*(13,076)*
Apprenticeship	46,252	*(24,929)*	25,276	*(14,838)*
College, CEGEP, other non-university certificate	44,567	*(24,643)*	30,840	*(16,795)*
University Bachelor's Degree	53,927	*(36,986)*	41,250	*(23,125)*
Ages 35-44				
Less than High School	39,609	*(26,428)*	24,408	*(15,205)*
Completed High School	48,399	*(32,195)*	33,375	*(21,959)*
Trades Certificate	46,112	*(26,130)*	29,551	*(16,506)*
Apprenticeship	55,187	*(30,702)*	30,689	*(20,447)*
College, CEGEP, other non-university certificate	58,174	*(34,962)*	39,120	*(22,912)*
University Bachelor's Degree	76,931	*(61,680)*	54,843	*(36,696)*
Ages 45-54				
Less than High School	43,585	*(28,949)*	26,617	*(17,283)*
Completed High School	54,351	*(39,720)*	36,528	*(23,738)*
Trades Certificate	51,011	*(29,111)*	31,729	*(17,433)*
Apprenticeship	60,264	*(43,153)*	31,601	*(19,045)*
College, CEGEP, other non-university certificate	63,946	*(43,153)*	43,224	*(24,908)*
University Bachelor's Degree	88,984	*(76,354)*	60,200	*(38,723)*
Ages 55 +				
Less than High School	40,483	*(29,621)*	25,352	*(16,309)*
Completed High School	51,220	*(41,997)*	34,698	*(22,322)*
Trades Certificate	48,080	*(30,848)*	31,156	*(16,591)*
Apprenticeship	55,569	*(35,864)*	31,796	*(21,095)*
College, CEGEP, other non-university certificate	60,841	*(44,903)*	41,497	*(24,376)*
University Bachelor's Degree	84,642	*(76,737)*	56,974	*(34,679)*
Mean Ages				
Less than High School	42.3		44.0	
Completed High School	39.8		42.2	
Trades Certificate	42.5		42.1	
Apprenticeship	44.0		42.2	
College, CEGEP, other non-university certificate	41.0		40.8	
University Bachelor's Degree	41.0		39.0	

Source: 2006 Census
Note: Includes all workers, part-time and full-time.

Table 3: Distribution of Apprentices

CIP codes	Males
Mechanical Trades	32.3%
Construction Trades	29.8
Production Trades	16.9
Engineering Technology	5.4
Personal Services/Culinary	3.9
Aviation Technology	3.1
Other	8.6
Total	100.0%
	Females
Personal Services/Culinary	32.3%
Business Mgt. and Support	22.7
Health Services	21.9
Information Technology	2.3
Construction Trades	1.9
Mechanical Trades	1.8
Other	17.1
Total	100.0%

Source: 2006 Census

Table 4: Characteristics of Apprentices

	Males	Females
Entry Ages and Completion Times		
Mean Age at Start of Apprenticeship Program		
Bldg. Construction	25.8	32.1
Electrical/Electronics	24.9	27.9
Food and Services	25.1	24.3
Industrial	28.3	31.1
Metal Fabrication	25.0	27.4
Motor Vehicle, Heavy Equipment	25.6	26.9
Other	28.8	37.1
Median Length of Time to Completion (among completers)		
Bldg. Construction	5	4
Electrical/Electronics	5	4
Food and Services	3	2
Industrial	4	3
Metal Fabrication	4	4
Motor Vehicle, Heavy Equipment	4	4
Other	3	3

Source: 2007 National Apprenticeship Survey

Table 5: Annual Earnings of Apprentices and Journeypersons
(Means and *Standard Deviations*)

	Males		Females	
	Apprentices	Journey-persons	Apprentices	Journey-persons
Bldg. Construction	$37,807	$53,763	$26,613	$47,661
	(20,502)	*(22,988)*	*(13,643)*	*(22,016)*
Electrical/Electronics	48,230	64,900	32,300	55,843
	(23,877)	*(24,278)*	*(16,553)*	*(20,408)*
Food and Services	31,785	38,922	20,130	27,264
	(18,541)	*(19,531)*	*(13,449)*	*(14,586)*
Industrial	57,675	68,400	47,706	58,283
	(25,278)	*(24,945)*	*(17,759)*	*(20,022)*
Metal Fabrication	48,305	64,867	31,939	63,636
	(23,741)	28,260)	*(15,257*)	*(28,230)*
Motor Vehicle, Heavy Equip.	43,225	57,625	30,958	41,430
	(22,355)	*25,222)*	*(17,189)*	*(15,798)*
Other	41,295	47,858	31,980	29,719
	(25,392)	*(23,035)*	*(18,074)*	*(11,496)*

Source: 2007 National Apprenticeship Survey

Table 6: Earnings Premia Over Completed High School: Weekly Earnings
(Increase Over High School Graduates Earnings)

Model with no Controls

Educational Attainment	Males	Females
Trades Certificate	-0.004	-0.042
Apprenticeship	0.222	-0.039
College	0.192	0.184
Bachelor's	0.405	0.471

Model with Controls for Experience

Trades Certificate	0.001*	-0.034
Apprenticeship	0.173	-0.035
College	0.194	0.210
Bachelor's	0.447	0.560

Source: 2006 Census. * indicates insignificance at the 5% level.

Table 7: Earnings Premia by Trade: Weekly Earnings

(Increase Over High School Graduates Earnings)

Model with Controls: Evaluated at 20 years of experience

Educational Attainment	Males
Apprenticeship Type	
Construction Trades	0.138
Mechanical Trades	0.086
Production Trades	0.120
Engineering Technology	0.135
Personal/Culinary	-0.172
Trades	-0.002
College	0.170
University	0.426
	Females
Apprenticeship Type	
Personal/Culinary	-0.115
Health	0.068
Business	0.048
Construction Trades	0.271
Mechanical Trades	0.280
Production Trades	0.142
Trades	-0.022
College	0.205
University	0.538

All estimates significant at the 5% level.
Source: 2006 Census.

Appendix

TableA1: Weekly Earnings Regressions: Males

Variable	Specification 1	Specification 2	Specification 3

Educational Attainment (ref. class = High School)			
Trades Certificate	-.004	0.001	0.038
	(2.79)	*(0.62)*	*(12.24)*
Apprenticeship	0.222	0.173	0.097
	(89.34)	*(73.50)*	*(7.37)*
College	0.192	0.194	0.224
	(114.99)	*(122.47)*	*(67.83)*
Bachelor's	0.405	0.447	0.500
	(208.57)	*(241.75)*	*(133.73)*
Experience		0.069	0.060
		(129.87)	*(111.42)*
Experience squared		-0.018	-0.001
		(67.18)	*(53.04)*
Experience cubed		0.0001	0.0001
		(36.84)	*(25.41)*
Exp * Trade			-0.002
			(9.82)
Exp * Apprenticeship			-0.002
			(15.92)
Exp * College			-0.003
			(19.67)
Exp * Bachelor's			-0.004
			(22.01)
Apprenticeship Type (ref. class = Other)			
Agricultural			-0.058
			(2.26)
Natural Resources			0.035
			(1.25)
Communications Technology			0.033
			(1.43)
Information Technology			0.024
			(0.93)
Personal Services/Culinary			-0.172
			(10.78)
Engineering Technology			0.135
			(8.96)
Construction Trades			0.138
			(10.78)
Mechanical Trades			0.086
			(6.77)
Production Trades			0.120
			(9.07)
Aviation Technology			0.082
			(4.97)
Health Services			-0.070
			(2.72)
Business Mgt. and Support			-0.002
			(0.11)
Constant	6.684	6.000	5.858
	(5900.90)	*(1973.16)*	*(1127.27)*
Other controls (province, marital status, etc.)			

R^2	0.06	0.16	0.23

Table A2: Weekly Earnings Regressions: Females

Variable	Specification 1	Specification 2	Specification 3

Educational Attainment (ref. class = High School)			
Trades Certificate	-0.042	-0.034	0.079
	(8.78)	*(7.45)*	*(8.03)*
Apprenticeship	-0.039	-0.035	0.083
	(8.46)	*(8.08)*	*(5.22)*
College	0.185	0.210	0.264
	(117.26)	*(137.22)*	*(79.25)*
Bachelor's	0.471	0.560	0.637
	(263.38)	*(315.24)*	*(180.49)*
Experience		0.054	0.058
		(100.94)	*(106.88)*
Experience squared		-0.002	-0.002
		(55.07)	*(56.10)*
Experience cubed		0.0001	0.0001
		(34.31)	*(33.27)*
Exp * Trade			-0.005
			(12.55)
Exp * Apprenticeship			-0.004
			(10.86)
Exp * College			-0.003
			(21.58)
Exp * Bachelor's			-0.005
			(30.06)
Apprenticeship Type (ref. class = Other)			
Agricultural			-0.085
			(2.226)
Natural Resources			0.210
			(2.23)
Communications Technology			-0.017
			(0.35)
Information Technology			0.100
			(3.23)
Personal Services/Culinary			-0.115
			(7.73)
Engineering Technology			0.109
			(2.83)
Construction Trades			0.271
			(8.66)
Mechanical Trades			0.281
			(8.58)
Production Trades			0.142
			(3.87)
Aviation Technology			0.095
			(1.81)
Health Services			0.068
			(4.35)
Business Mgt. and Support			0.048
			(3.07)
Constant	6.336	5.815	5.611
	(6052.08)	*(1918.44)*	*(1054.86)*
Other controls (province, marital status, etc.)			

R^2	0.10	0.16	0.22