THE IMPACT OF ACADEMIC PERFORMANCE ON POST-GRADUATION EARNINGS

STEPHANIE DALTON

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A thesis submitted to the

School of Graduate Studies

in partial fulfillment of the

requirements for the degree of

Master of Education (Leadership)

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This research examines *performance effects*, or the dispersion in post-graduation earnings relative to the distribution of average course grades, for a variety of post-secondary academic performance measures. The primary research question was intended to identify if there is a significant additional earnings premium associated with higher course grade performance in specific sets of courses over and above the return to a variety of contextual factors that have been known to yield individual differences in post-graduation earnings. Knowledge of dispersion in the economic return to academic performance for specific sets of courses in the presence of individual, credential, and labour market characteristics answers a number of clearly defined questions on the relationship between academic performance and post-graduation earnings and raises a number of interesting questions in relation to the role of academic performance in the rising return to education, shifting return to skills, and evolving wage structure.

The analysis was conducted on a dataset constructed by combining individual-level employment and earnings data obtained from a provincial follow up survey of university graduates from the 1999-2000 academic year with individual-level academic and demographic data acquired from official university records. The dataset was extended by incorporating occupation- and degree-level labour market data from the week referenced by the earnings data, as reported in *Job Futures* compiled by the Department of Human Resources Development Canada.

This research confirms the economic return to post-graduation earnings of targeted efforts to improve post-secondary academic performance, but suggests that the return is sensitive to specific groups, performance measures, and contextual effects. The

research finds that, on average, even after taking into consideration the high premiums associated with individual, credential, and labour market characteristics, the impact of post-secondary academic performance on post-graduation earnings over a broad range of performance outcomes and lifetime of earnings can be substantial. The findings provide valuable policy and career planning information for provincial, national, and international education policymakers as well as education administrators, education practitioners, and individuals interested in pursing a post-secondary education.

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CHAPTER ONE: INTRODUCTION

This chapter presents an overview of the research project. It commences with a brief description of the purpose of the research followed by the problem statement that gave rise to the research questions. To set the context, a synopsis of the theoretical and historical background is presented, followed by the research questions and an outline of the data sources. The chapter concludes with an in depth analysis of the significance of the research for students, post-secondary institutions, education policy, and education researchers.

Purpose of the Research

The purpose of this research is to identify the additive effect and economic return to post-graduation earnings of post-secondary academic performance over and above factors that have been known to yield individual differences in wages, such as individual characteristics, credential characteristics, and labour market characteristics. It should be noted that this research places a focus on academic performance and away from factors over which education policy has little influence or control, by treating contextual characteristics as control variables in the specification of earnings equation. The focus is not intended to diminish the importance of individual, credential, or labour market characteristics in the determination of post-graduation earnings, but emphasizes the need to identify the return and contributory value to factors that are amenable to change through student choice, education policy, or both.

Are post-secondary graduates with the highest course grades the ones that earn the highest incomes? Or is academic performance relatively unimportant in the determination of post-graduation earnings in the presence of individual characteristics such as age and

gender? To what extent does academic performance influence earnings in the presence of credential characteristics and labour market characteristics? Or do employers remunerate graduates, or groups of graduates, differentially based upon various combinations of academic performance, individual characteristics, credential characteristics, and labour market characteristics?

There are a variety of elements that influence a student's ability to acquire a post-secondary credential. According to Carroll (1963), students learn through perseverance, opportunity, aptitude, ability, and quality of instruction. However, just as there is variation across students in the amount of each of these elements that any individual student must expend to obtain a post-secondary degree, there is variation across students in the amount of each of these elements that any individual student must expend to achieve a targeted course grade or average course grade.

The grade a student receives in a course, or set of courses, serves a variety of functions. It informs the student of his or her level of skill in a particular area, is an indicator of the student's comparative advantage in a field of study, enables the student to assess his or her potential for successful completion of a specific credential, and assists the student in estimating the amount of time, money, effort, and foregone opportunity earnings he or she will likely have to expend to obtain a particular credential (Altonji, 1993). For example, a student with a history of high course grades in mathematics will likely have to invest less time, money, effort, and foregone opportunity earnings to achieve a minimum acceptable passing grade in a subsequent mathematics course than a student with a history of low course grades in this subject area. Similarly, a student with a history of high course grades in mathematics is likely to successfully complete a

credential with a large mathematics component with a smaller investment of time, money, effort, and foregone opportunity earnings than a student with a weak performance history in the same area. However, in the absence of an economic return to academic performance, over and above the minimum acceptable grade for successful completion of a course or credential, for some students the investment of time, money, effort, and foregone opportunity earnings might achieve a higher return if directed toward one of many other activities that comprise a post-secondary investment and yield a return to post-graduation earnings.

From an employer's perspective, the grade a student receives in a post-secondary course, or set of courses, provides information on the employee's potential level of productivity in a particular area, productivity relative to other applicants, and amount of time, money, effort, and foregone opportunity revenue the employer will likely have to invest to bring the employee to a desired productivity level. For example, consider the case of students competing for a job in a field of study related to their obtained credential. The student with the higher average grade in courses in the credentials major field of study will likely require a smaller investment of the employer's time, money, effort, and foregone opportunity revenue to achieve a desired productivity level than the student with the lower average grade in courses in this area. Thus, the employer's potential return on investment in the student with the higher academic performance level is likely to be larger than the return on investment in the student with the lower academic performance level. The potential differential should, in turn, yield an economic return to academic performance in the form of higher wages for the student with the higher average course grades.

In fact, if one of the intended outcomes of a post-secondary education is the preparation of students for the labour market, variation in academic performance effects should raise the earnings potential of higher performing students relative to lower performing students and be manifested in a positive correlation between course grade performance and post-graduation earnings that is retained even in the presence of contextual effects. Indeed, the absence of a correlation might suggest that employers are skeptical of the relationship between course grades and graduates' knowledge, skills, and abilities, or that the knowledge, skills, and abilities acquired during the acquisition of a post-secondary credential are mutually exclusive of those required by the employer. Both explanations support the view that emerged in the early 1990s that public funding intended for investment in human capital for the express purpose of enhancing social and economic returns might achieve a better return on investment if reallocated away from universities toward trades and vocational institutes. Allen (1998), Laidler (2002), and Davenport (2002) provide a comprehensive review of the literature in the area, but find no evidence that since the 1970s there has been a decline in the premium for a university credential relative to the premium for a trades or vocational credential.

This research was focused on three lines of inquiry. The first was intended to detect distinct patterns in how the economic return to academic performance varies by individual characteristics, credential characteristics, and labour market characteristics. The second was focused on identifying the relative contribution of academic performance in courses in areas such as English, mathematics, and student's academic major in determining post-graduation earnings to identify if a significant additional earnings premium is associated with academic performance that cannot be explained by individual,

credential, or labour market characteristics. The third line of inquiry was grounded in the Mincer (1974) human capital earnings function, where, in this case, academic performance was employed as a proxy for unobserved ability to determine its additive effect on post-graduation earnings over and above the two key variables in the Mincer framework, years of education and years of work experience. Policy and practice implications were considered.

Problem Statement

It is widely held that a post-secondary education conveys an earnings and employment advantage in the labour market. According to a December 3 through 16 Ekos Research poll (2003) of a random sample of 1,550 Canadians over the age of 16, 75% of Canadians feel that a university education improves an individual's chance of securing employment, 78% believe it has a large impact on a person's personal growth and quality of life, and 82% believe it positively influences lifetime earnings and career advancement opportunities.

In the province of Newfoundland and Labrador, there is evidence to support these convictions. According to *Beyond High School: A Follow-Up Study of June 2001 High School Graduates*, 29.0% of students in the province of Newfoundland and Labrador did not continue on to a post-secondary institution within approximately one year of graduation. Of this group, 37% were working full-time, 21% were working part-time or self-employed, 19% were actively looking for work, 8% were unemployed but not looking for work, 9% had returned to school to improve their grades, and 6% were engaged in personal or family activities. A similar follow-up survey of university graduates in the same province who entered the labour market one year earlier reported

employment rates that were considerable higher. *CareerSearch 2002* notes that 64.7% of those who graduated in the academic year 1999-2000 with an undergraduate degree reported they were working full-time during the week of June 24 through 30, 2001, 7.6% had obtained part-time employment, 10.9% were unemployed, 14.0% were in school, and 2.8% were engaged in other activities. At the graduate level the differential was even more pronounced with 79.3% engaged in full-time employment, 1.5% working part-time, 7.7% unemployed, 5.7% in school, and 5.7% engaged in other activities.

The aggregate data, however, masks important credential effects. *CareerSearch 2002* also notes that during the same week, 100% of graduates with an undergraduate degree in mechanical engineering reported they were engaged in full-time employment, while only 47.7% of graduates from the same university with an undergraduate degree in special education indicated they had achieved the same objective. Of the latter group, more than one in ten (11.4%) noted they were engaged in part-time employment and in excess of one in four (27.3%) reported they were unemployed.

In addition to credential selection, students face a variety of one-time choices in relation to the pursuit of their post-secondary education and career goals. Until recently their economic decisions could be based, at best, on anecdotal evidence or speculation. Today, a variety of resources exist to assist students with their decision-making. Most universities provide comprehensive estimates of anticipated education expenses including tuition fees, local housing costs, and living expenses. In addition, with minimal effort students can obtain emerging research on variation in the economic returns to education by field of study and level of educational attainment.

Post-secondary institutions, and federal and provincial governments, also face a variety of one-time choices relating to the optimal investment of public funds in human capital development. For example, decisions about the appropriate allocation of a limited quantity of financial and human resources among the variety of activities that have the potential to enhance social and economic returns. Social and economic returns, or externalities, are the basis for justification of continued investment of public funds in post-secondary. Externalities accrue to federal and provincial governments and increase their capacity to fund a variety of activities when individual returns on education investment spill over into the economy, increase the size of the tax base from which funds for social programs are drawn, and decrease the magnitude of unemployed and underemployed graduates that draw upon welfare programs.

There are a number of converging factors that suggest an emerging need for focused research on the impact of post-secondary academic performance on labour market outcomes. For example, in recent years, pressures to increase externalities to justify investment in post-secondary has resulted in the emergence of a variety of provincial, national, and international comparisons of the social and economic returns to investment in human capital through investment in post-secondary education. Input variables typically include measures such as highest level of educational attainment, years of completed education, and years of work experience. Output variables are normally measured in terms of employment and earnings.

In addition to the need for evidence on externalities, as the government is the primary supplier of education in Canada, efficiency and equity of supply are important public policy issues. According to a recent Ekos Research Associates poll (2003), 67% of

Canadians believe that Canadian universities do not have the capacity to meet the emerging demand for spaces from all qualified student who will want to attend. The primary concern is that increased capacity will require increased funding to expand faculty, staff, and infrastructure. There is public support for continued and increased funding for post-secondary. According to the same poll, an overwhelming 88% of respondents believe that public funding for universities to educate Canadians is a good long-term investment decision. In fact, 85% indicated their belief that it is time for the federal government to invest more in support of post-secondary. However, not all Canadians feel that the expansion of capacity should be the singular financial responsibility of governments. While 79% support additional government grants to universities almost one in six (17%) indicated their belief that the expansion should be funded through tuition fee increases (Ekos, 2003).

It is likely that as the demand for university spaces exceeds the supply against the backdrop of pressures for externalities, the quality of a post-secondary education will be a key factor that informs the decision-making. According to Ekos (2003), approximately one in four (72%) Canadians feel that a space should be guaranteed for every Canadian student who wants to attend. In fact, 37% indicated their belief that a space should be provided even at the expense of crowding or lowered educational quality. However, not all Canadians share this view. Approximately 77% of those responding to the survey indicated their belief that governments should enhance the quality of Canadian students' educational experiences through additional spending.

Today, however, most existing estimates of the economic return to investment in post-secondary education focus on years of education and do not taken into account

differences in the quality of an individual's experience or outcome. Hunushek (2004) observes the same phenomenon at the secondary level and notes that while analysis of the relationship between test scores and labour market performance has been precluded by a lack of comprehensive data sets, the need for such analysis is consistent with today's policy issues that revolve more around quality than quantity. In emerging research at the secondary level, student performance on standardized tests has been used as a proxy for school quality. It follows that course grade performance is an appropriate proxy for the quality of educational outcomes at the post-secondary level. In fact, if the magnitude of the individual return to academic performance differs substantially between levels of education, and in the presence of contextual effects, the magnitude and distribution of the externalities that accrue from investments in improving academic performance may be sufficiently diverse to modify the ranking of investment priorities for students, institutions, and governments.

Today, however, very little is known about variation in post-graduation earnings relative to academic performance. The void in the literature that incorporates controls for individual characteristics, credential characteristics, and labour market characteristics is even more pronounced. Furthermore, the limited information that is available is disjointed in the international literature and non-existent in the Canadian context. Moreover, the unique social, cultural, economic and political environment in Canada precludes the valid and reliable application of international findings.

Theoretical Background

This research is delineated within the framework of *human capital* theory. Human capital theory is based on the premise that investment in education is an investment in

human capital. The conventional argument is that increasing the average education level of the population increases the future creativity and productivity of individuals in the workforce and that a more creative and productive workforce generates greater externalities, or social and economic returns. A complete review of the historical development and methodological approaches of human capital theory from its origins in 1776 to 1960 when its theoretical and empirical foundations were well established is available in Sweetland (1996).

Within the human capital framework there are a variety of diverse and competing theoretical explanations that inform the interpretation of research findings in the area of labour market outcomes. Three of the most extensively used are labour market segmentation theory, credentialing theory, and achievement theory. Each focuses in a different way on how post-secondary education increases an individual's creativity and productivity in the workplace and yields social and economic returns. The underlying premise of this research is that each of these theories operates concomitantly within the framework of human capital theory to determine post-graduation earnings.

Historical Background

Subscription to the economic value of investment in human capital transcends longitudinal, economic, and geographical borders. Since the late 1950s, and on an international scale, governments have invested significant human efforts and financial resources in the provision of public education. The investment decision is evidence-based. In a comprehensive global review of the profitability of investment in education, Psacharopoulos (1994) concludes that from both an individual and a social perspective, education is a highly attractive investment opportunity. Kreuger & Lindahl (2000),

examining the connection between microeconometric and macro growth literatures and the effect of education on income and gross domestic product, conclude that education is a major source of economic growth.

Over the last half century, the Government of Canada, as well as its provinces and territories, has invested substantial human efforts and financial resources in the development of human capital. The investment has significantly raised the average education attainment level of the Canadian population. According to the 2001 census analysis series, *Education in Canada: Raising the Standard*, at the start of the 21st century, Canada had a population that was better educated than at any point in history. Over the ten-year period ending 2001, the percentage of the population with a university credential grew 15%, from 5% to 20%, the percentage of the population between the ages of 25 and 34 holding a university credential grew 10% from 18% to 28%, and the percentage of the working-age population aged 25 to 64 holding a doctorate, master, or other qualification above the bachelor level grew 50% to 1.1 million people. Growth and dispersion, however, have not been homogeneous. Over the same period, the percentage of the male population over the age of 25 with a university credential grew 17% from 4% to 21% while the comparable growth for their female counterparts was 14% from 6% to 20%.

The trend appears to be one that will continue. In a 1999 Joint Ministerial Declaration, the Council of Ministers of Education of Canada reaffirmed its unanimous belief that the future social and economic progress of Canada is dependent upon an informed and educated population. The belief is reflected in provincial and national policy making. According to Green & Riddell (2001), the modern view of long-term economic

growth places an emphasis on the development of the skills and knowledge of the workforce. In fact, they note that the development is seen more and more as a central ingredient in national economic policy that is having an important influence on the distribution of economic rewards.

The importance of post-secondary education in the future social and economic progress of Canada is a view that is widely and publicly held. In a December 2003 joint letter from students, faculty, scholarly associations, and post-secondary institutions to the Prime Minister of Canada, the Association of Canadian Community Colleges, Association of Universities and Colleges of Canada, Canadian Alliance of Student Associations, Canadian Association of University Teachers, Canadian Federation for the Humanities and Social Sciences, and Canadian Federation of Students appealed to the federal government to commit to working with provincial and territorial governments to design and implement a system of fiscal transfer to the provinces and territories for the express purpose of funding a high quality post-secondary education that is accessible by all and vital to Canada's economic, social, and cultural development.

In Canada, there is an argument for continued and increased investment of public funding in post-secondary education. According to Green & Riddell (2001), recent advances in our understanding of the relationship between education and labour market success indicate that conventional estimates of the economic return to education are biased downward, the marginal return to incremental investments in education may exceed the average return from previous investments, there is no evidence that investments in education are running into diminishing returns, and investment in human

capital continues to remain an important potential source of economic growth and equality of opportunity.

Research Questions

This research examined the economic return to academic performance for university graduates from the academic year 1999-2000. The key empirical questions were focused on identifying and quantifying the additive effect and economic return to post-graduation earnings of academic performance in a variety of skills over and above a variety of contextual factors that have been known to influence post-graduation earnings. Control factors included individual characteristics, credential characteristics, and labour market characteristics. Data analysis methods were designed to empirically test the following:

1. What is the differential return to post-graduation earnings of changes in average grade performance in courses in English, mathematics, and student's academic major?
2. What is the additional return to post-graduation earnings of changes in average grade performance in courses in English, mathematics, and student's academic major in the presence of individual characteristics, credential characteristics, and labour market characteristics?
3. Does the additional return to post-graduation earnings of changes in average grade performance in courses in English, mathematics, and student's academic major vary between low return credentials and high return credentials?
4. Does the additional return to post-graduation earnings of changes in average grade performance in courses in English, mathematics, and student's academic

major vary between low and high occupation- and degree-level unemployment rates?

5. What is the additional return to post-graduation earnings of changes in average grade performance in courses in English, mathematics, and student's academic major in the presence of the Mincer (1974) human capital earnings function?
6. What is the additional return to post-graduation earnings of changes in average grade performance in courses in English, mathematics, and student's academic major in the presence of the Mincer (1974) human capital earnings function while controlling for differences in individual characteristics, credential characteristics, and labour market characteristics?

Overview of Data Sources

The analysis was conducted on a dataset constructed by combining individual-level employment and earnings data from a follow-up survey of the 1999-2000 academic year graduates of Memorial University of Newfoundland undertaken by the Provincial Department of Youth Services and Post-Secondary Education with individual-level academic and demographic data obtained from the Office of the Registrar of Memorial University of Newfoundland. The dataset was extended by incorporating occupation- and degree-level labour market data pertaining to the week in which the employment and earnings data were reported, as profiled in *Job Futures* published by the Department of Human Resources Development Canada. The combined dataset provided a rich, comprehensive, and unique source from which to conduct a focused and detailed analysis of the post-secondary labour market transition experiences of this group.

The 1999-2000 academic year graduates consisted of a total of 2,812 students. However, this research was focused on the 1,883 (67.0%) who responded to the survey and for whom academic and demographic data could be matched. Eliminated from this subgroup were 228 (12.1%) graduates who indicated they were still in school during the reference week, 198 (10.5%) who reported they were unemployed, 63 (3.3%) who reported 'other' or 'unknown' activities during the reference week, and 2 (.1%) who reported employment of unknown full- or part-time status, as consideration of these groups requires an alternative framework to deal with selectivity bias.

Thus, the research focused on the 1,274 (45.3%) students who were employed full-time and 118 (4.2%) who were employed part-time during the week of June 24 through 30, 2001. From this sub-group further attrition included respondents who reported a weekly wage of 'other' that was not specific enough to calculate a weekly wage, those who declined to provide information on earnings, and students who graduated with more than one degree. For the latter group data were included based on the student's program of highest standing and data on the program of lower standing were excluded. Table 2 provides detailed final sample sizes for each of the key credentials.

Significance of the Research

This research builds on a worldwide body of literature at the intersection of post-secondary and the labour market with a focus on the rising return to education, shifting return to skills, and evolving wage structure. The context for this, and other research in the area, is the need for empirical information on the determinants of successful labour market outcomes for the purposes of evidence-based decision-making focused on improving individual, social, and economic returns to investments in human capital. A

need for research in the area of rates of return for different groups, and for diverse types of education and training, was called for in a number of recent Canadian studies including, *A Study on Preparing Canada's Youth for the Job Market of the Future* by Human Resources Development Canada (2000a).

Every year, students, institutions, and governments invest substantial human efforts and financial resources in the development of human capital. The investment decision is made with the anticipation it will yield social and economic returns. As with any investment, accurate estimates of the economic return to the specific activities that comprise that investment are imperative for informed decision-making. Thus, since a portion of the investment in education at the post-secondary level by students and governments is directed toward increasing academic performance, identification of the economic return to improving post-secondary course grades, and knowledge of how the return varies in the presence of individual characteristics, credential characteristics, and labour market characteristics has important implications for an array of stakeholders.

Through a precise specification of the impact of a variety of academic performance measures on post-graduation earnings, this research is designed to identify and clarify the role of academic performance as a source of variation in the economic return to post-graduation earnings. The research is intended to provide value added information to findings emerging from current large-scale surveys at the international level through a focused analysis of the relationship between literacy, numeracy, and labour market earning at the provincial level. It is not expected the findings will provide ready-made solutions to all the decisions faced by the wide variety of stakeholders, but that they will provide a range of information, answer a number of clearly defined

questions, and raise a number of interesting questions for future potential research. It is also intended that the research will yield information on the return to efforts to increase course grade performance to inform complex decision-making and facilitate short- and long-term planning for a variety of stakeholders including, but not limited to, provincial, national, and international education policymakers, education administrators, education practitioners, and individuals interested in pursing a post-secondary education.

This research takes a substantially different perspective on the economic return to academic performance from that prevailing in the literature, in four ways. First, it focuses on the return at the intersection of post-secondary and the labour market, whereas the majority of previous studies have focused on the return at the intersection of high school and the labour market, or at a later career point. Second, it is the first to systematically examine the impact of academic performance on post-graduation earnings in the presence of individual characteristics, credential characteristics, and labour market characteristics. Most previous studies have examined the return to these effects independently. Third, the research has significant data advantages over previous studies at the post-secondary level in that it utilizes individual-level course grades in subsets of courses, a finer measure of skill than most studies that have relied on broader measures such as grade point average or degree class. It also utilizes the self-reported earnings of graduates in multiple discrete intervals, whereas most previous studies have had to rely upon earnings aggregated at the occupation level.

Finally, the research places a focus on the role of academic performance in the determination of post-graduation earnings while controlling for the traditional human capital earnings function that emphasizes years of education and years of work

experience. In the specification of post-graduation earnings equations, the return to earnings depends on the coefficients of performance, whereas most human capital studies base the rate of return on the estimated coefficient for years of education. As a result, these studies fail to consider variation in earnings associated with academic performance and overlook an important source of heterogeneity in the returns to education. The advantages are particularly important in light of current research that suggests the evolving wage structure in is occurring in conjunction with a rising return to education and shifting return to skill.

Significance for Students

For students, knowledge of whether academic performance bears an economic return to earnings that varies by, and in the presence of, credential characteristics, labour market characteristics, and individual characteristics, is fundamental to make informed decisions on the effective investment of time, money, and effort in the variety of activities that comprise a post-secondary education so that they can efficiently achieve their education and career goals. The concept that student outcomes are the result of educational choices has its underpinnings in Carroll's (1963) model of learning, Becker's (1976) economic approach to human behavior, and Altonji's (1993) utilitarian view of education.

Carroll (1963) proposes that school learning is a function of the ratio of time spent on learning to the time needed for learning. Thus, for students interested in formatively planning the investment of human efforts and financial resources among the variety of available post-secondary activities, knowledge of the return to academic performance can assist in allocating an appropriate amount of time for learning to reach their targeted

performance outcomes and achieve education and career goals. In a similar vein, Altonji (1993) notes that students make educational choices under considerable uncertainty, particularly in relation to their ability to complete a course or a credential. Altonji concludes that new information about academic performance, preferences, and payoffs influence students' choice of academic major and the decision to stay in school. Thus, for students interested assessing potential payoffs to inform decision-making, knowledge of the relationship between academic performance and earnings can assist in deciding whether to continue with a program of study, change credentials, or abandon the pursuit of a post-secondary degree.

Finally, Becker (1996) claims that available time, financial resources, erroneous decision-making, and incomplete information all impede students' ability to pursue their self-interests. Thus, for students with low control or low predictability over academic performance outcomes, knowledge of the relationship between academic performance and earnings can inform decision making at a point early in the post-secondary experience to avert, alter, or mitigate predicted outcomes. For students in this group, investing in a credential for which the economic return to a specific course, or set of courses, is widely dispersed, and an important determinant of post-graduation earnings, is particularly risky.

It has not been clearly established that the relationship between education and earnings is causal. It is also unlikely that before students' commence a post-secondary degree they complete a detailed analysis of the expected economic return to their education investment that is based upon a particular framework or theoretical position. However, a full understanding of the economic return to improved academic performance can assist students in the planning stage of their post-secondary experience to formatively

make informed decisions on the optimum investment of their human efforts and financial resources in the variety of available post-secondary activities so that they can achieve their short- and long-term education and career goals. For example, whether to work full- or part-time, which courses and credential to select, whether to invest in tutoring supports, the appropriate course load, and whether to target efforts toward increasing academic performance. In fact, knowledge of the economic return to academic performance can enable students to continually assess their predicted labour market outcomes as they acquire new information on their individual academic performance outcomes so they can make informed decisions and take calculated risks that can assist them in achieving their short- and long-term education and career goals.

Take the case of the student for whom debt is a significant deterrent to the pursuit of a post-secondary degree. For this individual, the findings can inform decision-making on whether education and career goals might be best achieved by working full-time while completing a degree part-time, even if diverting time to employment is at the expense of academic performance and length of time to degree completion. On the other hand, the student who is primarily interested in maximizing the economic return to investment in education can use the findings to inform decision-making on whether individual earning outcomes might be further improved by directing human efforts and financial resources toward maximizing academic performance outcomes in specific courses, or sets of courses, even if that investment is at the expense of part-time employment.

Significance for Post-Secondary Institutions

It is generally accepted that an academic institution's outcomes are defined by its policies and that the close alignment of institutional policies with intended outcomes can

substantially improve student progress toward institutional goals and enhance the predictability of interventions and outcomes. For post-secondary institutions, knowledge of the economic return to academic performance provides information that can assist decision- and policy-making in a variety of areas including, but not limited to, program marketing, entrance requirements, tuition fees, program offerings, enrolment limits, monitoring and intervention tools, and graduation standards.

In recent years, as a mechanism for funding post-secondary education, there has been pressure to replace flat-rate tuition fees with differential fees (Philippe, 2002). Information on the economic return to academic performance can inform this debate. For example, evidence that there is a significant earnings premium associated with a credential that is not dependent upon academic performance provides an argument that the credential is a better candidate for a differential fee than a credential with high mean post-graduation earning, significant intra-credential earnings variation by performance, and a substantial negative premium for graduates with below average academic performance outcomes. In the latter case, differential fees might deter participation from high performing students from lower socio-economic groups and result in a dipping into the lower ends of the performance distribution for higher socio-economic groups. Under these conditions, an argument can be made for increased selectivity into the credential based on performance, income-related exemptions and allowances linked to academic outcomes, tuition fees negatively scaled to grades, and loan repayment or interest rates proportional to overall course grade average.

To intervene effectively in post-secondary education outcomes it is necessary to identify which outcomes are inflexible and which outcomes are malleable through

interventions. This requires knowledge of the full range of factors that affect post-graduation earnings including the extrinsic incentives and disincentives for improved academic performance. Information on how the economic return to academic performance varies in the presence of individual, credential, and labour market characteristics can assist with the identification of segments of the student population whose combination of factors increase the risk they will experience a negative return on their education investment. The findings can inform the development of intervention programs, policies, and procedures that can be implemented early in the course of a student's program to ensure that once a student enters a post-secondary program, they productively and efficiently complete that program and achieve a positive return on investment.

For example, if the academic performance level of a student increases the individual's risk of experiencing a negative return on education investment, and the student's academic performance level is more amenable to change than credential choice or occupation- and degree-level unemployment rate, the graduate's expected outcome might be more effectively mitigated or averted through interventions designed to modify academic performance. Alternatively, if the academic performance level of the student is resistant to interventions, expected outcomes may be more effectively mitigated or averted through interventions at an earlier stage in the student's program, perhaps through stringent institutional and credential screening and admission polices and protocols. In either case, interventions that positively alter a student's predicted outcome and enable the student to complete a credential and compete successfully in the labour market have the potential to enhance the social and economic externalities that accrue to the institution.

Finally, the findings have the potential to provide information that can assist education administrators shift the size of post-secondary programs toward areas where the labour market demands graduates while minimizing the risk of increasing the proportion of students who experience a negative return on their educational investment as a result of increased admissions into high demand credentials that yield negative returns to students with low academic performance levels. Bureaucratic leadership and long-term commitments in publicly funded academic institutions typically make it difficult to shift resources from units with declining demand to units where demand is increasing. The problem is compounded by the absence of a properly defined mechanism to identify demand shifts. If the economic return to academic performance is a function of individual, credential, and labour market characteristics, increases in the premium for graduates with high academic performance might be an indicator that there is a surplus of graduates relative to the demand and suggest that enrolment limits should be adjusted downwards. Thus, if the coefficient of return to academic performance can be shown to be a reliable and valid indicator of shifts in the over- or under-supply of graduates, the measure can be used to enhance the accuracy of optimum enrolment limits for credentials and academic units and inform the decision-making on long-range resource allocation.

Significance for Policy Makers

To ensure efficiency and effectiveness in projecting outcomes, allocating resources, achieving targeted outcomes, and improving targets, policy analysts need to be able identify which student groups have the potential to have their labour market outcomes altered or mitigated by specific policies and which have the potential to yield the highest outcomes. This requires knowledge on the full range of educational inputs and

outcomes, how inputs and outcomes can be altered, and how inputs, processes, and outcomes should be measured. For example, according to Riddell (2001), Canada does not obtain "good value for money" relative to investment at the elementary and secondary school level in terms of measured average student performance in mathematics and science. Riddell notes that, of the G7 counties, Canada ranks near the top in terms of per student expenditures and near the bottom in terms of student performance. In this context, identification of the economic return to academic performance at the post-secondary level can provide information to inform decision-making on the optimal investment of public funds for the purpose of improving academic performance at the elementary, secondary, and post-secondary levels.

More specifically, if the magnitude of the effect of academic performance on post-graduation earnings resides primarily at the intersection of high school and post-secondary then targeted efforts to increase academic performance at the post-secondary level are largely ineffective and resources intended for this purpose might achieve a higher return if redeployed at an earlier point in the student's educational experience. The knowledge is particularly important in light of recent findings by Sianesi & Van Reenen (2002) that the magnitude of the economic return to education at the different levels of education appears to depend on the level of a country's development, with the post-secondary level being the most important for growth in the Organisation for Economic Co-operation and Development (OECD) countries. Sianesi & Van Reenen also conclude that type, quality, and efficiency of education also influence growth.

For provincial, national, and international governments, an evidence-based understanding of differential earnings effects for students with diverse academic

performance outcomes is essential to inform decision-making with respect to the identification, implementation, and evaluation of human capital development polices. For example, rising tuition fees can place pressures on students to direct time to employment. This has the potential to deter participation, increase length of time to completion, and reduce academic performance outcomes. The pressures are particularly acute for students from lower socio-economic groups. Knowledge of the economic return to academic performance can assist policy makers in determining if the social and economic externalities that accrue from investment in high performing students from low socioeconomic groups have a higher marginal return than investment in low performing students from high socio-economic groups. Policies that encourage participation among students with higher marginal returns by reducing pressures to direct time to employment have the potential to yield higher social and economic externalities.

Finally, identification of the relative contribution and quantitative return to post-graduation earnings of academic performance in the presence of individual, credential, and labour market effects informs the development of a valid set of common factors that influence post-graduation earning. Knowledge of the full range of factors and their variations is essential to foresee outcomes and assist in the identification of public policy interventions and adjustments that improve social and economic externalities. For example, if a student gains relatively few productivity skills by increasing average course grade performance in English, mathematics, and academic major, but merely improves his or her chance of selection for employment, efforts to increase performance in these skills will increase competition for grades with little net effect on labour market creativity and productivity. On the other hand, if a student with higher average course grade

performance in English, mathematics, and academic major is more creative and productive in the workforce, policies that foster the acquisition, development and maintenance of these skills throughout the individual's lifetime has the potential to raise average labour productivity and enhance social and economic externalities.

Significance for Researchers

For education and economic researchers, this study informs the current understanding of the relationship between academic performance and post-graduation earnings and further advances the definition, validation, and measurement of factors that contribute to successful labour market outcomes. This research contributes to the knowledge base in the area of human capital theory (Mincer, 1954), achievement theory (Carroll, 1963), credentialing theory (Berg, 1971), and labour market segmentation theory (Doeringer & Piore, 1971). It also contributes to the understanding of statistical modeling of the returns to education with a focus on including unobserved ability in the Mincer (1974) human capital earnings function.

This research complements existing literature on the measurement of the economic return to education, rising wage inequality, changing return to skill, evolving wage structure, and stratification of workers through the impact of differential remuneration practices on social structures. Finally, this research has a variety of implications for the interpretation of research in relation to the Carroll (1963) model of learning, Becker (1976) economic approach to human behavior, and Altonji (1993) utilitarian view of education.

CHAPTER TWO: LITERATURE REVIEW

This chapter presents and overview of the education and economic literature in the area of the economic return to education with a focus on the key issues surrounding the linkage between academic performance and post-graduation earnings. It commences with a review of the literature in the area of human capital theory, followed by post-secondary expenditures, the rising wage inequality, the rising return to education, and the endogeneity bias. It continues with a synopsis of current research on the return to academic performance, return to skill, and the return to contextual effects including individual characteristics, credential characteristics, and labour market characteristics. The chapter concludes with an analysis of what is known and what is not known about the relationship between academic performance and post-graduation earnings.

Human Capital Theory

The Organisation for Economic Cooperation and Development (n.d.) defines human capital as "the familiar notion that knowledge, skills and attributes derived from education, training and experience, represent some of our most valuable resources" (para. 1). Jacob Mincer introduced the theory of human capital in his 1957 doctoral dissertation on wage differentials. Mincer extended the theory in 1974 to incorporate the impact of work experience. Today, the Mincer *human capital earnings function* is based on the concept that the logarithm of individual earnings is a linear function of years of education, a quadratic function of years of work experience, and a function of a variety of other influences. The human capital earnings function is typically fitted with the natural logarithm of wages as the dependent variable, years of schooling, years of work experience, and years of work experience squared as independent variables, and

demographic variables, such as gender and race, as explanatory variables. The use of the natural logarithm of wages serves two key purposes in the function. First, it transforms the wage variable, which is typically positively skewed, to reduce the degree of non-normality. Second, it enables the coefficients on each of the independent variables to be interpreted as a proportionate effect of a unit change on wages. The latter functionality has the added advantage of facilitating extrapolation of findings across longitudinal, geographical, and economic borders.

Today, a large body of research utilizes the human capital earnings function to investigate the causal link between education and labour market earnings. According to Card (1999), the human capital earnings function has been extremely successful. While the literature on this topic is voluminous and cannot be done justice in this review, a comprehensive international review up to 2002 can be found in Psacharopoulos (1973, 1985, 1994) and Psacharopoulos & Patrino (2002). In recent years, the human capital earnings function has been extended to undertake research on a variety of human behaviors while recognizing heterogeneity in the returns to individuals, including those in 1976 and 1996 by Becker, and 1999 by Card. In the Canadian context, recent studies utilizing the human capital earnings function include Boothby (2002), Green & Riddell (2001), Lemieux & Card (2001), Lewis (2002), and Sweetman (2000).

Within the broad human capital theory there are several diverse and competing theoretical perspectives that inform the interpretation of research findings in the area of labour market outcomes. These include credentialing theory, labour market segmentation theory, and achievement theory. According to credentialing theory, credential characteristics are the key determinants of labour market outcomes. Credentialing

theorists contend that education does not increase graduates' creativity and productivity in the workplace, but that the acquisition of a credential confers a positive status on the graduate that brings about increased wages through authorization to entry into employment in a field of study. In its extreme form, credentialing theorists might argue that there is no economic return to academic performance and that the wage of a graduate with a degree in engineering with extremely high course grades and the wage of a graduate with the same credential with course grades sufficient only to authorize award of the credential can be predicted without any information on the individual's academic performance. The vast majority of research on credentialing theory (Attewell, 1987; Collins, 1979; Levin & Rumberger, 1987) builds on the seminal work of Berg (1971), who claimed that employees are acquiring more education than necessary, not based upon the requirements for the job or the individual's ability to do the job, but because employers are constraining access to employment through excessive hiring requirements that fulfill an organization's need for sorting criteria.

There are a number of distinct branches of labour market segmentation theory in both the economics and sociology literature. However, the majority of current research builds on the seminal work of Doeringer & Piore (1971) and holds that not all graduates compete equally in a single labour market on the basis of their level of creativity and productivity, but that there are multiple labour markets differentiated on the basis of individual characteristics. In its extreme form, labour market segmentation theorists might argue that post-graduation earnings are independent of academic performance and that an employee's wage can be accurately predicted from individual characteristics such as the graduate's age, gender, race, and ethnicity. Market segmentation theory is frequently used

to explain why individuals from specific groups earn comparatively lower or higher wages than individuals from other groups.

Finally, achievement theory contends that through the education process graduates become more creative and productive. In its extreme form, achievement theorists might claim that the wage of a graduate with a degree in arts and the wage of a graduate with a degree in engineering can be predicted without any information on the individual's obtained credential, and that a graduate who achieves a specific overall performance level in an arts degree will earn the same wage as a graduate who achieves the same performance level in an engineering degree, as both graduates have the potential to be equally creative and productive in the workplace. In other words, each additional increase in average course grade performance signals to the employer the graduate's potential for higher creativity and productivity in the workforce that is remunerated differentially upon selection for entry into employment.

Current research on achievement theory builds on the seminal work of Carroll (1963) who proposed that time is a key determinant in learning. According to Carroll, there are five elements under two domains that contribute to the effectiveness of student performance. The first domain, the amount of time spent on learning, is the product of opportunity and perseverance. Opportunity is the amount of time made available by the teacher for learning and perseverance is the percentage of that time the student is actually engaged in the task. Time engaged on task is the multiplicative product of opportunity and engagement. The second domain, the amount of time needed for learning, is a function of the three elements, ability to learn academic material, ability to understand instruction, and quality of instruction.

The Carroll (1963) model of learning has a natural interpretation within the human capital earnings function. Individuals differ in the amount of time they have available to engage in learning and the amount of time they need to spend on learning. This heterogeneity has the potential to increase the human capital of some students relative to others and lead to differential economic returns to education. Current research on heterogeneity in the economic return to education builds on the work of Mincer (1974), Becker (1964) and Heckman (1994) and has its underpinning with research in the area of personnel psychology that has demonstrated that the strongest independent predictor of work productivity is cognitive ability (Hunter & Hunter, 1984).

These diverse theoretical perspectives have a variety of implications for the interpretation of research on the relationship between academic performance and post-graduation earnings. Findings that graduate's with higher course grades are those with higher post-graduation earnings are consistent within the framework of achievement theory. Findings that graduate's with specific credentials have higher post-graduation earnings than graduate's with other credentials is explicable from the perspective of credentialing theory. Finally, results suggesting that post-graduation earnings are determined primarily through individual characteristics such as gender and age are interpretable within the perspective of labour market segmentation theory.

Post-Secondary Expenditures

In its most recent report on education (*Education at a Glance 2003*), the Organisation for Economic Cooperation and Development notes that over the five year period ending 2000, the latest year for which comparable international data are available, Canadian public and private per capita expenditures on post-secondary education

institutions increased .3% from 2.3% to 2.6% of gross domestic product. The report also notes wide variation in spending across countries among the various levels of education, with more pronounced differential effects at the post-secondary level than at the elementary and secondary levels. In Canada, spending at the primary and secondary education levels was less than the OECD average but .9% higher than the average at the post-secondary level. The differential is not insignificant. The ratio of spending to gross domestic product at the post-secondary level is matched by Korea and exceeded only by the United States (2.7%). In fact, for Canada and the United States, the proportion of gross domestic product devoted to post-secondary education in 2000 was more than twice that of all other G7 counties.

The report also notes that over the same five year period Canada significantly curtailed education spending relative to the 30 member countries such that per student expenditures fell from a second place standing to a rank of fifth. However, intra-level spending in Canada retained its relative distribution with expenditures at all levels totaling $7,764 per student, expenditures at the post-secondary level approximately double this amount at $14,983 per student, and expenditures in post-secondary type A institutions with advanced research programs reaching $16,690 per student. A similar pattern is evident at the provincial level, although it is interesting to note that in some cases average expenditures at all education levels were higher than the national average. Combined public and private per student education spending at all levels in Newfoundland and Labrador was $377 higher than then national average at $8,141 per student, post-secondary education spending was close to $472 higher at $15,455 per student, and university level spending was 22.9% ($3,817) higher than the national average at $20,507

per student (Statistics Canada, 2003). In terms of total dollar investment, the Canadian government invested $27,599 million dollars in post-secondary education in 2001-2002. In Newfoundland and Labrador, the investment was $532 million, of which $301 million went to the province's single university (Statistics Canada, 2003).

While the magnitude of the financial investment may appear large, evidence supporting the economic return to this investment continues to accumulate. In recent years current deliberations are no longer focused on the existence of a return but are centered on the appropriate methodology for measuring the magnitude of the returns. Researchers quantifying the *long-run level of output per capita growth rate* assume that the stock of human capital may influence subsequent growth in a variety of ways and typically regress growth on control variables and the initial level of education measure, such as average years of education. Researchers measuring the *long-run growth rate of the economy* typically use the change in educational attainment to explain output growth. Recent evidence suggests that the long-run level of output per capita growth rate is between 3% and 6% while the long-run growth rate of the economy is a full percentage point higher (Sianesi & Van Reenen, 2002). Regardless of the methodology, the magnitude of the returns provides a sound rationale for continued investment.

In addition to the enhancement of social and economic returns, the investment is changing the educational composition of the Canadian population. Relative to the Organisation for Economic Co-operation and Development countries, in the year 2000, Canada had the highest percentage of students attending an education institution at the post-secondary level (OECD, 2003). The high statistic is partly the result of definition as Canada, unlike the United States and other countries, considers trade programs and

Quebec's CEGEPs at the post-secondary level. However, increasing participation rates is a trend that is expected to continue. According to the national organization representing 93 public and private not-for-profit university and university-degree level colleges, the Association of Universities and Colleges of Canada, the demand for post-secondary education in Canada is expected to push enrolment up by at least 30%, or 200,000 additional full-time students by the decade ending 2011 (Ekos Research Associates, 2003).

Rising Wage Inequality

Rising post-secondary participation rates is a phenomenon that is occurring on an international scale and in conjunction with a rising wage inequality. This combination of factors is transforming the global wage structure. In Canada, the transformation is evident at both the national and provincial levels. According the 2001 census, more than 60% of workers in the lowest earnings category had not attained more than a high school education while more than 60% of those in the top earnings category had obtained a university degree. In terms of income effects, in 2001, average earnings of the Canadian population over the age of 15 with a high school graduation certificate or some post-secondary, or both, were $25,477. This compares to an average earnings that was 90.9% higher ($48,648) for a worker with a university certificate, diploma, or degree. Not unexpected, the aggregate data obscures provincial effects. In the province of Newfoundland and Labrador, a worker with a high school graduation certificate or some post-secondary, or both, had average earnings in 2001 of $16,860 as compared to an average earnings that was 148.8% higher ($41,942) for a worker with a university certificate, diploma, or degree (Statistics Canada, 2003).

In early research on the rising wage inequality in the United States, Juhn, Murphy & Pierce (1993), using data from the *Current Population Survey*, find increased wage inequality within narrowly defined education and work experience groups. Among the study's findings is an increase in wage inequality for males over the period 1963 to1989, a decline of 5% in the wages of low-skilled workers, and an increase of 40% in the wages of high-skilled workers. The researchers conclude that the rising wage inequality for males is due to rising returns to components of skill other than years of education and years of work experience. The study's findings are supported by Murnane, Willett & Levy (1995), who using longitudinal data from surveys of high school seniors, find that in 1973 college graduates earned 46% more than their high school counterparts, and that by 1989 the differential had risen to 53% and was projected to continue on an upward trend.

In Canada, primarily due a lack of comprehensive datasets, research on the return to education is less well developed. As a result it is not clear if the rising wage inequality parallels findings in the United States. In a 1996 strategic international review of labour market research, Browning, Jones, & Kuhn conclude that since the 1970s there has been an increase in wage inequality in Canada that has been coupled with a slowdown in real wage growth. According to the review, the inequality has widened along both the age and skill dimensions such that wages of younger workers have fallen in comparison to older workers, and wages of low-skilled workers have declined relative to high-skilled workers. In 2001, Green & Riddell (2001) conclude that, although the skill polarization is less pronounced in Canada than it is in the United States and United Kingdom, the trend is disturbing enough to have focused attention on national education and training systems.

Rising Returns to Years of Education

In the United States and United Kingdom, increasing post-secondary participation rates and the rising wage inequality have occurred in conjunction with an increase in the economic return to education. Since the 1980s, residual wage dispersion in the United States has increased while the conventional measure of the economic return to education, the coefficient on the years of education variable in the Mincer (1974) human capital earnings function, has almost doubled (Deschenes, 2001). Due to a lack of comprehensive datasets, the phenomenon has not been as well documented in Canada.

The growth has stimulated a worldwide resurgence of research to determine if change in the measure has been brought about by an increase in the causal effect of education on earnings or through the influence of a variety of other mechanisms. For example, a second potential explanation is that through labour market supply and demand effects there has been an increase in the demand for higher educated individuals with higher marginal productivity of education (Blackburn & Neumark, 1993). This phenomenon can occur due to either a deceleration in the growth rate of the supply of skilled workers and a holding constant of demand (Katz & Murphy, 1992, Card & Lemieux, 2001) or acceleration in the demand for skilled workers and a holding constant of supply (Juhn, 1999). A third potential source of the increase is that changes in compositional effects, such as entry into the labour market of graduates with higher marginal productivity of education, is leading to time-varying "performance biases" in the observed earnings-education relationship (Card & Lemieux, 2001). Finally, changes in the conventional measure can also occur through performance effects or an increase in the

return to performance-sorting variables over time (Blackburn & Neumark, 1993; Grogger & Eide, 1995; Murnane, Willett & Levy, 1995; Taber, 2001).

Rising returns to education through compositional effect changes can occur through improved education-labour market articulation. Research in this area emerged in the early 1990s and focused on the match between the knowledge and skills acquired during a post-secondary education and workplace literacy requirements. In 1992, in an attempt to improve articulation between education and the labour market, and in response to a "growing concern that many young people do not see the direct relevance of what they are learning in school to their needs in later life" (McLaughlin, 1992, p. 2), the Conference Board of Canada developed and disseminated the *Employability Skills Profile*. The framework identifies three broad categories of skills considered essential by Canadian employers for success in the Canadian workplace. The profile has subsequently been updated, and although the framework has been retained, the Conference Board notes the new skills considered essential for success as including communication, problem solving, positive attitudes and behaviours, adaptability, working with others, and science, technology and mathematical skills. The skills parallel those identified by Human Resources Development Canada (2000a) in *A Study on Preparing Canada's Youth for the Job Market of the Future*. The study lists adaptability, flexibility, broad-based training, communication, people skills, team skills, and ability to deal with globalization, diversity, change, and uncertainty as essential for Canadian youth. Interestingly, with the exception of mathematics, student performance in the above skills is not explicitly measured and reported in conventional post-secondary transcripts. Nevertheless, widespread identification and dissemination of key desired employability skills can lead to younger,

compositionally different cohorts of graduates entering the labour market, improving articulation between post-secondary and the labour market, and resulting in a rise in the coefficient of the return to education.

Research on the rising return to education through a rising return to performance sorting variables emerged in the mid 1990s and focused on the returns to performance in specific skills. In the Canadian context, Krahn & Lowe (1998), investigating the match between existing adult literacy skills and their utilization in the workplace, conclude that approximately 25% of Canadian workers are employed in jobs that are inappropriately matched to their current literacy level. The study concludes that those who are under employed outnumber those who are over employed "by a ratio of about two-to-one for quantitative literacy, three-to-one for prose literacy, and four-to-one for document literacy" (p. 61). Despite the oversupply, skills in these areas continue to yield an economic return in the labour market. Using Canadian data from the *International Adult Literacy Survey* to investigate the return to the same three measures of literacy, Osberg (2000) and Green & Riddell (2001) find that prose, document, and quantitative literacy have a large impact on earnings.

Endogeneity Bias

In recent years, a research focus on the rising returns to education has led many economists to speculate that traditional ordinary least squares estimation methods overstate the economic return to education because of their failure to control for measures of *unobserved ability*. The phenomenon, known as *endogeneity bias*, is based on the concept that higher ability workers are able to acquire more education than lower ability workers, and as a result ordinary least square methods overstate the return to education

because they attribute to years of education some of the effect that should be attributed to higher ability. The endogeneity bias is interpretable within the Carroll (1963) model of learning. If academic performance is a function of time spent on learning and time needed for learning, higher ability students will require less time for learning than lower ability students to achieve the same performance outcome. The Carroll model of learning implicitly controls for productive ability by incorporating controls for 'ability to learn academic material' and 'ability to understand instruction' under the domain of time needed for learning.

Following a 1999 comprehensive survey by Card that emphasizes the importance of endogeneity bias in traditional estimation methods, a variety of statistical approaches have modified the Mincer (1974) framework to control for unobserved ability. One estimation method attempts to correct for the omitted ability through a control variable approach. The underlying assumption of this approach is that incorporating a proxy for unobserved ability in the earnings equation eliminates the effect of unobserved ability on the relationship between earnings and education and reduces the upward bias in the years of education coefficient.

A second estimation method holds that identification of the causal relationship between education and earnings requires an exogenous source of variation. This method attempts to correct for omitted ability with a quasi-experimental instrumental variables or two-stage least squares approach that takes advantage of natural variation in the data through the exogenous assignment of individuals to different treatment groups (Card, 1999). The underlying assumption of this method is that the instrumental variable is not correlated with the individual's ability but will have an impact on their ability to acquire

additional education. Researchers employing the instrumental variables approach typically utilize family background variables, such as parental education (Ashenfelter & Zimmerman, 1997) to instrument schooling. Other instrumental variables include an individual's season of birth as a measure of school leaving age (Angrist & Krueger, 1991), the presence of any sister within a family (Butcher & Case, 1994), geographic proximity to a four-year college (Card, 1995), the Veterans Rehabilitation Act (Lemieux & Card, 2001), and a policy change that increased the number of years of required schooling (Sweetman, 2000).

According to Card (1999) "IV estimation based on an intervention that affects a narrow sub-group may lead to an estimated return to schooling above or below an OLS estimator for the same sample". However, the vast majority of studies utilizing the instrumental variables approach have yielded returns to education that are substantially higher than conventional estimates. The phenomenon has led many researchers to speculate that ordinary least squares estimation methods introduce a downwards bias into the coefficient of years of education that understates the economic return to education (Green & Riddell, 2001). For example, Sweetman (2000), examining the impact of an educational policy intervention that increased the number of years of required schooling from 11 to 12 and effectively raised educational attainment by approximately 0.8 years, finds that using an instrumental variables approach the returns were 11.8% for males and 17% for females. However, utilizing an ordinary least squares estimation method, the returns were substantially lower at 10.8% for males and 14.6% for females.

There has been considerable debate over which estimation method yields more accurate results. According to Griliches (1977), the underestimation bias caused by

measurement error and the overestimation caused by ability bias effectively cancel each other out and ordinary least squares estimates are correct. The argument has been supported by a number of researchers including Angrist & Krueger (1991), Ashenfelter & Kruger (1994), and Hogan & Rigobon (2002). However, in a meta-analytic review of approximately 100 estimates of the rate of return to education, Ashenfelter, Harmon & Oosterbeek (1999), using a method due to Hedges (1992) that was generalized to accommodate systematic heterogeneity in the return to education across countries, over time, and by econometric method, find that differences between instrumental variables and ordinary least squares estimation methods, while sometimes significant, were much smaller than sometimes reported. The researchers conclude that 1.8% of the average 3% premium for instrumental variables methods over ordinary least squares methods is explained by publication bias, or the tendency on the parts of investigators, reviewers, and editors to produce, submit, or accept results for publication that are based on the direction or strength of the study's findings. In other words, the estimated premium for an instrumental variables approach over an ordinary least squares approach may be correlated with sampling errors that may, in turn, be correlated with other variables, and lead to conclusions about the premium that are seriously biased.

In recent years, emerging large-scale national and international surveys such as the *International Adult Literacy Survey*, *National Graduates Survey*, *Survey of Literacy Skills Used in Daily Activities,* and *Survey of Labour and Income Dynamics* provide measures that facilitate comparable analysis using both estimation methods. In addition, a recent emphasis on the importance of measuring heterogeneity in the return to education across otherwise comparable individuals has led to emerging, and often controversial,

methodological approaches in heterogeneous treatment effect models such as those utilized by Manski & Pepper (2000). While the above developments show promise in resolving the methodological problems relating to unobserved ability and endogenous education, at the present time, the lack of existing comprehensive frameworks that simultaneously address all of the issue limits the scope of current understandings of recent changes in the returns to education and the underlying reasons for the heterogeneity.

Return to Performance

Within the literature on the economic return to education is an area of research focused specifically on the relationship between academic performance and labour market earnings. The linkage between these two measures gained attention in 1971 when Richard Hernstein argued that labour market success was predictable from test scores. In subsequent years Hernstein's contention was widely supported by a variety of researchers, and contested by others.

The relationship between performance and earnings has been observed on an international basis. In 1979, Jencks et al., using path analysis on data from seven different countries, estimates that a one standard deviation above the mean increase in test performance is associated with an increase in earning between 3% and 27%. The study concludes that even when controlling for socioeconomic status and family background, adolescent cognitive ability predicts educational attainment.

Current research in the area of academic performance and labour market outcomes suggests that performance on standardized testing is positively related to individual earnings, productivity, and social and economic growth. Existing analyses typically emphasize different aspects of individual earnings and find that performance has a clear

impact on wages even after allowing for heterogeneity in the quantity of education, the experiences of workers, and a number of other factors that might also influence earnings (Hanushek, 2004). For example, Altonji & Blank (1999) conclude that even in the presence of controls for years of education, work experience, industry, and region, test scores predict wage differences across gender and racial groups.

It is generally accepted that the linkage between performance and earnings occurs through the relationship between academic performance and job performance. After almost a century of research in the area of personnel psychology, Schmidt & Hunter (1998) conclude that general cognitive ability measures are the best predictors of individual job performance. In addition, there is evidence to suggest that the return might not be fully realized in early career earnings. Rosenbaum & Roy (1996), using the 1982 cohort of the *High School and Beyond Study*, conclude that grades do not improve wages of recent high school graduates, but have a strong return 10 years later. According to Altonji & Pierret (2001), the reason the relationship between performance and earnings is not observed immediately upon entry into the labour market is because the rewards to cognitive skills increase with work experience as employers have an opportunity to observe differences in performance.

The relationship between academic performance and earnings has been the subject of a limited number of investigations at the post-secondary level. A review of the education and economic literature reveals that early research originated in the United Kingdom. Dolton & Makepeace (1990), using a 1980 survey of one in six graduates, report higher early post-graduation earnings for graduates with a first class or upper second class degree. Three years later, Blackburn & Neumark (1993), investigating the

relationship between ability and education to see if it had changed in way that would increase the economic return to education, find an increase concentrated among workers with comparatively high levels of academic ability.

The variation is not insignificant. Naylor, Smith & McKnight (2000), using 1993 data on the population of 44,000 United Kingdom graduates, identify a large and significant variance in earnings that is dependent upon degree class. For the average male graduate, the span around earnings is approximately 12%, with a 5.6% premium for a first class honours degree, 2.3% for an upper second class degree, –2.6% for a lower second class degree, and -6.3% for a third class degree. For the average female the range is 4% smaller at approximately 8%, with a 2.4% premium for a first class degree, -4.3% for a lower second class degree, and -5.8% for a third class degree. In addition, similar to the rising wage inequality between those with higher and lower levels of educational attainment, there is a widening inequality along the performance dimension. In a later study (2002), the same researchers find that the earnings premium for a first class degree over an upper second class degree, and an upper second class degree over a lower second class degree, increased between 1985 and 1993 from 2.1% to 9.2% for males and 4.1% to 7.9% for females. The researchers also note that analysis of the 1998 *Higher Education Statistics Agency* data suggest that the pattern continued to hold over the period 1993 to 1998, and that the returns for this period rose to 9.4% for males and 11.2% for females.

The positive relationship between post-secondary academic performance and post-graduation earnings is not universal. In a comparative review of recent empirical analyses of higher education labour market transitions in the United Kingdom and Italy, Boero, McKnight, Naylor & Smith (2002) find that, unlike the United Kingdom, in which there is

a strong relationship between earnings and the level of educational attainment, Italian university post-graduation earnings are largely insensitive to measured academic performance. The study concludes that, with the exception of a 2% premium associated with graduating *con lode*, there is virtually no relationship between academic performance and labour market earnings in Italy.

The positive relationship has been documented in the United States. Building on the work of Blackburn & Neumark (1993), Hernstein & Murray (1994) conclude that the rising return to education is attributable to a rising return to ability and that efforts to increase formal education are essentially ineffective attempts to increase ability. Grogger & Eide (1995) and Murnane, Willett & Levy (1995) also find a positive relationship between performance and earnings. Using data from two longitudinal surveys of high school seniors, Murnane, Willett & Levy find a positive correlation between standardized test performance and labour market earnings that has increased in recent years. The researchers conclude that between 1978 and 1986 a significant portion of the rising return to education for 24-year-old males and females is attributable to a rise in the return to cognitive skills, and that for females the increase in the return to cognitive skills accounted for all of the increase in the wage premium associated with the pursuit of a post-secondary education.

In Canada, the relationship between post-secondary academic performance and post-graduation earnings has not been as widely researched and the results are inconclusive. A review of the literature reveals only one early study. Using 1995 data from the Institute for Social Research of York University and a sample size of 2,200, Grayson (1997) finds a positive relationship between post-graduation earnings and the

receipt of an honours degree versus an ordinary degree using aggregate data in a bivariate correlation. However, in further analysis at the field of study level he finds positive non-significant relationships for all but one field of study. Grayson observes a significant negative correlation between post-graduation earnings and a degree in dance, film and theatre.

Two additional Canadian studies, at a career point further than the intersection of post-secondary and the labour market, report a positive relationship between skill performance and earnings. Osberg (2000), using Canadian data from the *International Adult Literacy Survey* to explore the relationship between earnings, schooling and literacy, finds that literacy accounts for as much as 40% to 45% of the economic return to education. Osberg also notes that the rate of return is higher for females and less influenced by literacy proficiency than males. In a second study using the same data to investigate the return to three measures of literacy, Green & Riddell (2001) conclude that literacy has a large impact on earnings and accounts for approximately 33% of the 8.3% return to each additional year of education. The study also notes that prose, document and quantitative literacy is a better predictor of post-graduation earnings than credential, and that educational attainment has a larger impact on earnings than work experience.

The literature on the relationship between post-secondary academic performance and post-graduation earnings has also demonstrated a positive relationship between high school academic performance and wages. Using data from the United Kingdom, Naylor, Smith, & McKnight (2000) find that even after controlling for degree subject and classification, upon graduation from post-secondary, a six point increase in high school A-level score is associated with a 1.1% post-graduation earnings premium for males and a

0.6% premium for females. The study also concludes that there is a strong effect for having previously studied A-level mathematics, with a 3% premium for males and 4% premium for females.

It is possible that the influence of high school academic performance on post-graduation earnings is both direct and indirect, and that some of the economic return to high school performance is actually the effect of performance on screening or self-selection into credentials with high mean post-graduation earnings. Smith & Naylor (2001), using United Kingdom data, conclude that only a small proportion of the variance in post-secondary academic performance can be explained by high school performance, but that degree performance is positively associated with having A-level mathematics. However, Boero, McKnight, Naylor & Smith (2002), using data from the United Kingdom and Italy, conclude that "pre-university qualifications are strong influences on degree performance" (p. 1162) and that in the United Kingdom there is a significant relationship between pre-entry characteristics, university performance, and labour market outcomes.

Return to Skill

In recent years, in an attempt to identify whether heterogeneity in worker skills might explain the rising wage inequality for those with a given level of education, and to determine if there is evidence for a general increase in the return to skill, some labor economists have investigated the return to additional measures of skill (Riddell, 2001). The vast majority of this research has focused on the return to literacy and numeracy.

In early research, Boissiere, Knight & Sabot (1985), using evidence from developing countries, conclude that literacy and numeracy performance has a larger

impact on wages than performance in reasoning ability and years of education. McIntosh & Vignoles (2000), using data from the *National Child Development Study* and the *International Adult Literacy Survey*, also find evidence of a wage and employment return for those with higher levels of literacy and numeracy. In the Canadian context, Charette & Meng (1998), using Canadian data from the 1989 *Survey of Literacy Skills Used in Daily Activities*, conclude that incorporating measures of literacy and numeracy in the income equation increases the return to education for females but has the opposite effect for males. Studies by Osberg (2000) and Green and Riddell (2001) also support an economic return to measures of prose, document, and quantitative literacy.

A number of studies in the United States focused on the relationship between high school performance and earnings find a positive return to wages for increased performance in mathematics (Kenny et al., 1979; Willis & Rosen, 1979). Rivera-Batiz (1992), using 1985 data from the *Young Adult Literacy Assessment Survey*, conclude that higher quantitative skills raise the chance of full-time employment for young adults while weaker skills explain the lower probability of employment for young Black Americans relative to Whites. Grogger & Eide (1995), using data from the *National Longitudinal Study of the High School Class of 1972* and the *High School and Beyond Study of 1980*, to examine the return to high school grades, pre-college standardized test scores, and specific skills associated with college majors for workers with different educational attainment levels, find pre-college performance on standardized mathematics tests is a statistically significant predictor of earnings.

The returns are not insignificant. Mulligan (1999), using normalized *Armed Services Qualifying Test* scores in the *National Longitudinal Study of Youth 1979* data,

finds that a one standard deviation increase in standardized mathematics scores is associated with an 11% return to earnings. Murnane et al. (2000), using data from the *High School and Beyond Study* and the *National Longitudinal Study of the High School Class of 1972*, find the same increment in performance is associated with a 15% return to earnings for males and a 10% return for females. Finally, Lazear (2003), using a sample from the *National Educational Longitudinal Study of 1988*, estimates an aggregate return for males and females of 12%.

The findings are consistent with evidence from the United Kingdom. Dolton & Vignoles, in a number of studies exploring the relationship between mathematics performance and earnings, find an earnings premium for individuals with A-level mathematics (1999), a positive relationship between adult earnings and advanced mathematics competence over and above formal qualifications and a variety of other variables (2000), an 8% earnings premium for adults who further study mathematics after the age of 16 (2002a), and no return to earnings for studying a wider curriculum at age 18 (2002b). Building on the work of Dolton & Vignoles, Chevalier, Dolton & Levacic (2004) conclude that caution should be exercised when reforming the curriculum to increase the number of subjects studied after the age of 16. They note that there is a clear need to improve mathematics skills, possibly to the exclusion of other subjects.

Naylor, Smith & McKnight (2000), using *Universities Statistical Records* for the entire cohort of 1993 graduates from 'old' universities in the United Kingdom to analyze first destination occupational outcomes, conclude that there is approximately a 3% earnings premium for males and a 4% premium for females for having previously studied A-level mathematics. In a subsequent study, using full graduating cohorts from 1985 to

1993, the same researchers (2002) find that even after controlling for degree subject and classification, there is a substantial earnings premium for graduates who previously studied A-level Mathematics. The study concludes that a ten-point increment in mathematics scores conveys an additional earnings premium of between 1.0% and 1.6% for males and 1.0% and 3.4% for females, and that the effect of having previously studied A-level mathematics is largely consistent over time.

As a natural outgrowth of research on the rising return to education, several investigations have examined the relationship between mathematics performance and the rising wage premium. Murnane, Willett & Levy (1995), using longitudinal data from the *National Longitudinal Study of the High School Class of 1972* and the *High School and Beyond Study of 1980* to examine the effect of standardized mathematics scores on earnings six years after high school graduation, conclude that the relationship between mathematics performance and earnings increased between 1978 and 1986 and that the association was stronger six years after graduation than two years after graduation. The study also notes differentiation by gender. For males, over the eight year period ending 1980, the study concludes there were increasing returns to both years of education and mathematics skills. For females, however, the wage return to mathematics skills accounted for all the increase in the post-secondary wage premium. Using data from the same source, Grogger & Eide (1995) find that pre-college mathematics accounts for all of the return to further education for females, but not for males. The researchers conclude that failing to account for mathematics performance substantially overstates the growth in the college wage premium for females.

In Canada, there is a void in the literature in this area. The dearth is due, in part, to a lack of appropriate datasets at the skill level of specificity. The issue has important policy implications. According to Hanushek (2004), a one standard deviation increase in mathematics and science scores implemented over a 30 year period in the United States would yield a gain to the economy of 5%, or $1.4 trillion dollars, by the year 2035. In early research in this area, Hanushek & Kim (1995), using standardized test data from 39 countries to analyze growth rates, finds that cognitive skills are an important determinant of economic growth. However, in a later study of advanced industrial economies, Robinson (1997) concludes that above average mathematics or science scores are not correlated with the level of, or growth rate in, per capita gross national product. In 2000, building on their earlier study, Hanushek & Kimko (2000), using a composite measure of international standardized test scores from six tests of mathematics and science cognitive abilities from students between the ages of 9 and 17 across 38 countries over the period 1960-1990 as a proxy for labor-force quality, find that a one standard deviation increase in test performance is related to a 1% increase in annual gross domestic product per capita growth rates. The researchers conclude that while total enrollment in school and educational attainment levels are positively correlated with gross domestic product, the quality of the labour force, as measured by test scores, is more important to economic growth than mean years of education. However, in a subsequent test of the model, using data from a later period, Neri (2003) concludes that the composite measure is related to economic growth, but that the direction of the relationship is negative.

Credential Characteristics

A variety of Canadian research has examined various aspects of the economic return to credential characteristics. Most studies have compared the earnings of graduates with varying levels of educational attainment and find that labour market earnings vary significantly by the level of educational attainment (Lemelin & Prudhomme, 1994; Parent, 1999; Riddell & Sweetman, 2000; Vaillancourt, 1998; Vaillancourt & Bourdeau-Primeau, 2002) and by field of study and gender. Stager (1996), examining the private rate of return for nine major fields of study by gender for Ontario university graduates in 1990, finds that with the exception of medicine, female rates of returns are much higher than male rates of returns. For males, the rate was highest for medicine (20.8%), followed by commerce (16.2%), engineering (16%), mathematics and physical sciences (15.1%), law (15%), other health professions (14.9%), biology (6.8%), arts and humanities (7.3%), and the social sciences (12.8%). For females, the rate was highest for commerce (21.8%), followed by mathematics and physical sciences (21.2%), other health professions (21%), engineering (19.8%), medicine (19.7%), arts and humanities (14.8%), biology (15%), law (16%) and the social sciences (17%).

A second line of research has focused on the *sheepskin effect* of credentials, or the additive effect of credential acquisition on earnings over and above years of education. The sheepskin effect is based on the concept that degree completers possess characteristics that make them more productive than degree non-completers, and that the acquisition of a credential provides a signal that employers use to sort potential employees based on expected level of productivity. In the United States, the sheepskin effect has been extensively investigated with early research findings that were based exclusively on

years of education and were generally inconclusive. Layard & Psacharopoulos (1974) find no evidence that degree or diploma completers earn higher wages than program dropouts. However, Hungerford & Solon (1987) and Belman & Heywood (1991), using information on highest level of educational attainment and inferring sheepskin effects from nonlinearities in the relationship between highest grade completed and the log of wages, conclude that sheepskin effects are larger for post-secondary graduates but smaller for high school graduates. Card & Krueger (1992) and Heckman, Layne-Farrar & Todd (1996) also find evidence that sheepskin effects are more pronounced at 16 years of education. Focusing on course credits instead of educational attainment, Kane & Rouse (1995) note that sheepskin effects are generally small and that course credits at two-year colleges and four-year colleges yield similar returns in the labour market.

In recent years changes to the United States census has facilitated investigation of the sheepskin effect using data on both years of education and degree receipt. Commencing with the 1990 survey, the Bureau of the Census changed the emphasis of its educational attainment question from years of education to degree receipt. The change resulted in cohorts providing answers to both questions. Using data from a matched sample of the *1991 and 1992 March Current Population Survey*, Jaeger & Page (1996) conclude that years of education is an imperfect measure of degree completion and that sheepskin effects are much larger when information on degree receipt is available. The researchers report sheepskin effects of 11% for high school graduation and 31% for college graduation. The comparable increments based on years of education are 3% and 12% respectively. The researchers also find large sheepskin effects for associate's degrees and post-graduate degrees over and above those associated with a bachelor's degree. In

related research, Arkes (1999), Frazis (1993) and Park (1999) also find evidence that sheepskin effects are much larger when both years of education and degree receipt are observed.

In Canada, research on the sheepskin effect is just beginning to emerge. Ferrer & Riddell (2002), using 1996 census data containing information on both years of education and degree receipt, find strong evidence that both years of education and graduation from high school, community college or trade school, and university have a significant effect on earnings. The study notes that the effect of credential increases with educational attainment and accounts for almost 33% of the return to 16 years of education, and more than 50% of the return to each year of education above 16 years.

A third line of research conceptualizes credential as a recognition that skills vary across disciplinary area. For example, according to Start, Shaw & Lowther (1989), physical scientists focus on fact, principles and problem solving, while social scientist and humanitarians emphasize communication skills and a critical perspective. It is widely accepted that initial and long-term labour market earnings vary significantly across credentials. As a result students often enrol in a field of study with the anticipation that their choice will improve their individual rate of return on investment in education. According to Statistics Canada (2003), over the ten year period ending 2001, more than one in five university students graduated with a degree in business or technology. Twelve percent obtained a degree in business and commerce and 11% obtained a degree in engineering. The pattern can have a significant impact on the future skill set of the Canadian workforce.

Recent research suggests that, within credential effects, there are unobserved factors that influence post-graduation earnings about which very little is known to date. Boothby & Rowe (2002) conclude that the variance of individual rates of return within credentials is much wider than the variance of median rates of return among credentials within a level of study, although credentials vary greatly in their median rates of return. The study notes that the median individual rate of return for a bachelor's degree is 12% for males and 13% for females. However, the study also notes that 20% of graduates with a bachelor's degree have a negative rate of return to their investment in education and that at the undergraduate level, the median rates of return by credentials and gender range from 5% to 23%. It is difficult to determine how much of this variation is due to credential effects and how much is due to performance, Breen & Lindsay (2002) find that that there is more variation across than within disciplines in the extent to which motivation indexes explain performance. They conclude that different types of motivations lead to higher performance in some disciplines but not in others.

Individual and Labour Market Characteristics

There is a large amount of literature on the relationship between individual characteristics and labour market outcomes. In fact, gender and age are standard variables in the vast majority of human capital studies. As a result, it is well known that within the various levels of educational attainment males earn higher wages than females in the labour market. Less well known is that the wage gap is narrower at the lower levels of educational attainment than it is at the higher levels. According to Statistics Canada (2003b), in the year 2000, the average employment income for a male university graduate was $60,480 compared to an average income of $36,721 for a female university graduate.

The 64.7% differential falls to 54.7% for those with less a high school graduation or some post-secondary, or both. For workers in this group, average employment income was $30,870 for males and $19,952 for females.

A variety of research also exists on the relationship between age and earnings. Current findings note a general trend that younger graduating cohorts are earning less than older graduating cohorts and there is a narrowing of the gender wage gap for younger cohorts. Statistics Canada (2003b) reports that in the year 2000, males between the ages of 25 and 34 with a university certificate, diploma or degree earned an average employment income of $43,691 as compared to $31,866 for females, while males between the ages of 55 and 64 earned an average income of $70,623 as compared to $36,772 for their female counterparts. The report notes reasons for the variance include factors such as younger cohorts being on a lower earnings trajectory than older cohorts, younger cohorts not having experienced increases in average earnings over the last two decades, and younger cohorts having experienced a decrease in earnings in many cases.

The generational earnings divide is further dispersed by gender. According to Statistics Canada (2003b), males under the age of 40 experienced a $1,740 decline in average earning between 1980 and 2000, while those over 40, and predominantly over 50, experienced an increase in average earnings. For females, the dividing line was 30 with workers over this age experiencing a $1,395 increase in average earnings over the same 20 year period. The report notes that, overall, all younger groups of workers earned less in the year 2000 than in the year 1980 while all older groups experienced uninterrupted earnings gains in each decade.

The gender- and age-based earnings differential is partly the result of variation in occupational choices. Statistics Canada (2003b) reports that younger cohorts of females have higher relative earnings than females overall, partly because they are less likely to have experienced career interruptions due to family responsibilities, and partly because they have a wider breadth of occupational choices. Statistics Canada finds that in seven of the ten occupations that females were most likely to hold in the year 2000, females earned more than 90% of their male counterparts, and in some cases close to 98%. Overall, however, the report notes that the most common occupations held by young females had lower earnings than the most common occupations held by males. In terms of income effects, the ten most common occupations held by university-educated females between the ages of 25 and 29, had an average earning of $37,185 in 2000 while the most common occupation held males had an average income of $41,509. However, the wage gap is not fully elucidated by occupational choice. The report also notes that university educated females between the ages of 25 and 29 who were employed in the ten most common occupations chosen by males, had earning that were 11% less than their counterparts.

In addition to the above, it is difficult to determine how much occupational choice is conditioned by age, how much is conditioned by gender, and to what extent previous performance, especially in areas such as English and mathematics, interact with age and gender to condition student choice. In particular, a variety of research has documented differential performance levels between males and females in generic skills such as English and mathematics. For example, using data from the *International Adult Literacy Survey*, Willms (1997) finds that females outperform males in prose literacy, males outperform females in quantitative literacy, and there are no gender differences in

performance for document literacy. Willms also finds large age effects and notes that younger adults have substantially higher literacy skills than older adults.

What is Known and What is Not Known

In Canada, a large body of research exists on the relationship between educational attainment and labour market earnings. Research conducted on large-scale surveys at the intersection of post-secondary and the labour market such as the *National Graduate Survey*, as well as surveys conducted at later career points such as the *Labour Force Survey* and *International Adult Literacy Survey* have consistently found that post-secondary graduates have an employment and earnings advantage over high school graduates. According to Riddell (2001), "The strong positive correlation between education and earnings is one of the most well established relationships in social science" (p. 506). Two related and emerging lines of research have also demonstrated a positive relationship between literacy and numeracy and labour market earnings, and field of study and earnings. Analysis of the variance in each of these relationships by individual characteristics, such as gender and age, has been a consistent feature in the vast majority of studies.

Variation in the economic return to post-secondary academic performance has been the subject of a limited number of international studies. As noted by Green & Riddell (2001), "Most research on the contribution of human capital to economic growth and its role in the distribution of income uses only relatively crude indicators such as educational attainment and years of labour market experience" (p. 7). In addition, a further limitation of the majority of these studies is that they have relied upon indirect proxies for performance such as obtained credential, grade point average, and degree

class. These units of measure fail to pay attention to the different dimensions of performance by recognizing discreet variation in performance, the wide range of potential performance outcomes, and heterogeneity in performance in different skills.

In view of the exponential increase in post-secondary participation rates across all age groups, rising post secondary education costs, debate over the optimal investment of public funds in education, an expressed need by Canadian employers for employees with specific skills, an emerging wage differential between low and high skilled workers, changing returns to skill, and a shift in the source of funding for post-secondary from national and subnational governments to the student (Wildasin, 2003), evidence on the economic returns to the full range of worker skills is important for a variety of stakeholders. A need for research at the skill level of specificity has been called for in a number of recent studies. Green & Riddell (2001) note, "Although the relationships between inputs such as education and experience and outcomes such as employment and earnings have been extensively investigated, relatively little is known about the relationship between direct measures of skills and labour market outcomes" (p. 7).

Despite the intuitive connection between post-secondary course grade performance, literacy and numeracy, and labour market earnings, only a limited number of international studies have explored beneath the surface of observed differences by individual characteristics and credential characteristics to examine how post-graduation earnings varies in relation to measured course grade performance. Incorporating controls for labour market characteristics has not been a feature of any of these studies. The void in the Canadian literature is even more pronounced. With the exception of one early inconclusive study by Grayson (1997), investigations of the relationship between

university course grade performance and earnings are virtually non-existent. Thus, there are no studies at the skill level of specificity.

The reasons are primarily methodological. Although the concept of post-secondary academic performance as a proxy for labour market productivity appears straightforward, the relationship is actually very complex. Difficulties arise in aggregating course grades awarded across years, across instructors, and across fields of study. There is also disagreement over the appropriate statistical methods to employ when including measures of productive ability in a production function of education. Finally, research has been constrained by a lack of comprehensive datasets that facilitate cross-sectional and longitudinal analysis, not only because datasets are expensive to compile, but because the typical autonomous functioning of North American post-secondary institutions makes it difficult to conduct research in the area. The lack of datasets is not exclusive to Canada. In the United States, Levy & Murnane (1992) note that skill measures normally available in large data sets like the *Current Population Survey* are too broad to adequately test hypotheses about the rising demand for skilled workers. Consequently, there are a limited number of statistical models that explicitly attempt to predict how the returns to post-graduation earnings vary in relation to measured academic performance.

In summary, existing literature on the economic return to post-secondary academic performance suffers from two critical limitations. First, existing findings are conflicting, inconclusive and the economic, social and cultural diversity between the United Kingdom, United States, and Canada precludes the valid and reliable application of international finding to the Canadian context. For example, countries differ in the extent to which they aim to raise the average performance among students. Furthermore, the lack of Canadian

studies and diversity of inter-provincial labour markets makes it problematic to extrapolate findings from one province and apply to another. Second, despite the vast array of proposed and tested hypotheses available in the literature, there are no studies that examine the effect of academic performance on post-graduation earnings in the presence of individual characteristics, credential characteristics, and labour market characteristics.

CHAPTER THREE: METHODOLOGY

This chapter presents an overview of the research methods. It commences with a description of the setting for the study and continues with the research design, sample description, data sources, operational definitions, and tests, modelling, and assumption. The chapter concludes with a discussion of the key methodological concerns.

Setting for the Study

This research was conducted using data collected in the province of Newfoundland and Labrador that was focused on the labour market transition experiences of students who graduated from Memorial University of Newfoundland in the 1999-2000 academic year. Memorial University is a comprehensive university that awards credentials at a variety of levels including the certificate level, diploma level, undergraduate level, master's level, and doctorate level. Most credentials have a prescribed number of credits, but length of time to completion can vary widely across students, credentials, and degree levels.

Admission to Memorial University is normally determined by grade performance in a specific set of high school courses. However, students over the age of 21 who have not met the normal admission requirements are also eligible for admission. Normally, all students can gain admission to all credentials as long as they meet the minimum prerequisites, but admission into many credentials is both selective and competitive. Due to its unique geographic location and comprehensive credential offerings, students do not normally transfer between Memorial University and other post-secondary institutions. This provides cohorts of graduates with a naturally high proportion of students that fully complete a degree at one post-secondary institution.

Research Design

This research employed an ex-post facto design using secondary analysis of three main data sources. Graduate follow-up survey data from students who graduated in the 1999-2000 academic year from Memorial University of Newfoundland were obtained from the Provincial Department of Youth Services and Post-Secondary Education. The dataset was combined with individual-level academic and demographic data obtained from the records of the Office of the Registrar of Memorial University of Newfoundland. The dataset was further extended by incorporating occupation- and degree-level labour market data pertaining to the period over which the earnings data were reported, as profiled in the *Job Futures* document published by Human Resources Development Canada. Cross-sectional data analytic techniques included ordinary least squares and two-stage least squares regression.

Data analysis commenced with four preliminary data preparation steps and proceeded with six main analysis steps. Preliminary steps included:

1. Combining the obtained data sets.
2. Recoding, computing, and transforming all necessary variables.
3. Calculating descriptive statistics to provide information on the distributions.
4. Testing the assumptions underlying the use of ordinary least squares and two-stage least squares regression techniques.

The six main analysis steps are presented and described in detail in the tests, assumptions, and modeling section of this chapter.

Sample Description

During the 1999-2000 academic year there were 2,812 graduates from Memorial University of Newfoundland in six levels of study. As shown in Table 1 there is wide variation in the number of students in each level of study and the response rates between each level of study.

Table 1

Graduate Follow-Up Survey Response Rates, by Level of Study

	Graduates	Responses	Response Rate
Certificate	204	89	43.6%
Diploma	128	85	66.4%
Master's	394	261	66.2%
Undergraduate	1,995	1,410	70.7%
Medical Doctor	60	30	50.0%
Ph.D.	31	8	25.8%
Total	2,812	1,883	67.0%

For obvious reasons, the analysis excluded graduates who did not respond to the survey, those for whom data could not be matched, those who were not employed during the reference week, and those who were employed but did not provide a survey response to the income question. Overall, the analysis was conducted on 1,071 (38.1%) of the population of graduates and a total of 76.9% of surveyed graduates who indicated they were employed during the reference week. The data was sufficient to conduct a comprehensive and multi-faceted analysis of the labour market transition experiences of graduates from Memorial University of Newfoundland in the 1999-2000 academic year.

Table 2 presents a detailed distribution of the number of graduates and final sample size for each credential, by gender.

Table 2

Final Sample Sizes, by Credential and Gender

	Graduates	Final	Males	Females
Certificate	204	49	14	35
Diploma	128	53	27	26
Graduate Arts	49	17	5	12
Graduate Business	85	25	15	10
Graduate Education	117	50	28	22
Graduate Engineering	18	4	4	0
Graduate Marine Studies	3	1	1	0
Graduate Nursing	9	7	0	7
Graduate Physical Education	2	0	0	0
Graduate Science	90	30	16	14
Graduate Social Work	19	12	2	10
Graduate Women's Studies	2	0	0	0
Bachelor Arts	511	190	55	135
Bachelor Business	283	143	53	90
Bachelor Education	321	126	36	90
Bachelor Engineering	99	45	36	9
Bachelor Fine Arts	22	9	4	5
Bachelor Maritime Studies	1	1	1	0
Bachelor Music	35	8	2	6
Bachelor Nursing	56	36	0	36
Bachelor Physical Education	46	19	8	11
Bachelor Science	578	218	105	113
Bachelor Social Work	43	28	4	24
Medical Doctor	60	0	0	0
Ph.D.	31	0	0	0
Total	2,812	1,071	416	655

Data Sources

The research dataset was constructed by combining detailed performance, individual, credential, and labour market data from a variety of sources. Individual-level post-graduation earnings data were obtained from the *Graduate Follow-Up Survey* conducted by the Provincial Department of Youth Services and Post-Secondary Education. This telephone survey is conducted every two years, approximately eighteen months after graduation, on the entire population of graduates from Newfoundland and Labrador's largest post-secondary institutions. For graduates from the academic year

1999-2000, the survey was conducted between February and May 2002, allowing the graduates one full year to obtain employment, and at the beginning of the summer when most seasonal employees and one-year contractual teachers would normally still be employed. Overall, the survey had a 67% response rate from graduates of Memorial University of Newfoundland. The survey collects information on a wide range of variables including conventional measures such as full- or part-time employment status and gross weekly earnings, and a host of other variables specifically focused on the circumstances surrounding the post-secondary labour market transition experience including out-migration, prior education, student loans, length of job search, and graduates' opinions on their education investment. The survey instrument appears in Appendix A and a detailed description of the methodology is given in Appendix B.

The obtained dataset was extended by combining individual-level academic and demographic data from the records of the Office of the Registrar of Memorial University of Newfoundland. Data obtained from this source included individual courses taken, grades obtained, degrees awarded, student's academic major, level of degree, date of birth, and gender. The combined dataset was subsequently mapped to occupation- and degree-level labour market data pertaining to the period in which the employment and earnings data were reported. These data were obtained from *Job Futures*, Canada's national career and education planning tool compiled by the Department of Human Resources Development Canada. *Job Futures* provides employment rates for 155 major programs of study representing approximately 90% of all post-secondary graduate occupations and is based on labour market data obtained from Statistics Canada's 2001

census. Programs of study are aggregated based upon the National Occupational Classification system, a coding system of all occupations in Canada.

Operational Definitions

The principal set of variables used in the analysis is presented in Table 3. Since it is well known that wages are positively skewed the wage variable was transformed into its natural logarithm (ln_wage). The transformation has the added advantage of facilitating the interpretation of findings on a percentage basis so that results can be applied in a variety of contexts. The weekly wage variable was computed based on the graduate's self-reported hourly wage multiplied by the number of hours associated with the graduate's self-reported full- or part-time employment status. As the hourly wage information was recorded in 12 equal-interval categories with two wider intervals at each end of the wage distribution, the hourly wage used in the calculation was the midpoint of the recorded interval. The data set also contained several cases in which the graduate reported an hourly wage of 'other'. In these cases, finer calculations of the weekly wage variable were used, if available.

Academic performance was operationalised as a concept comprised of three primary components, average post-secondary course grade performance in each of English (perf_eng), mathematics (perf_mth), and student's academic major (perf_mjr). However, in several explorations average overall post-secondary degree performance (perf-ovr) and average overall high school performance (perf-hgh) are tested in the analyses. The concept of academic performance is considered synonymous with achievement but is used as a proxy for "unobserved ability" in the Mincer (1974) human capital earnings function. The key performance variables were computed by dividing the

aggregate of all course grades in each course area by the number of courses for which a grade was reported and included in the calculation of the student's average. Average overall post-secondary academic performance and average overall high school performance were obtained directly from university records.

Credential was operationalised as a concept comprised of two factors, low or high return credential (low_high) and degree level (less_ bac, equa_bac, grea_bac). Individual characteristics included two variables, age (age) and gender (male), which are standard measures used in most educational research. The Mincer (1974) human capital earnings function consisted of three variables, years of education (yrs_educ) was computed based on the individual's self-reported prior education level, and years of work experience (wk_exp) was computed as the individual's age minus years of education minus six. This calculation is standard across most labour market research and is intended to capture the number of years a person may potentially have been in the workforce. Work experience squared (wk_exp^2), is calculated as the square of work experience and is intended to capture the diminishing returns to work experience.

Full- or part-time employment status (full-emp) was operationally defined as the number of hours per week the graduate was employed. Respondents were considered full-time if they reported working in a job that required more than 30 hours per week and part-time if they reported working in a job that required less than 30 hours per week. This measure is standard across most labour market research with one small departure that may result in a slight bias of the log of weekly wages variable. In the survey, graduates were not asked to report the exact number of hours per week they were working. Those who

reported working full-time were considered to be working 35 hours per week and those who reported part-time were considered to be working 25 hours per week.

Unemployment rate (unemploy) was operationally defined as the occupation- and degree-level unemployment rate reported by *Job Futures* for the period over which the employment and earnings data were reported. The rate was assigned to each graduate, within each occupation and degree level, based on the graduate's field of study, obtained credential, and degree level. *Job Futures* defines unemployment as the percentage of individuals actively seeking employment, able to work, but without a job. The measure is computed by dividing the number of unemployed individuals 15 years of age and older by the aggregate number of individuals in the same age category who have a job or are actively seeking employment. The ratio is multiplied by 100 and expressed as a percentage. The measure includes only the unemployed who were employed in the previous 12-month period and excludes full-time students who were not actively seeking employment. To the extent that the unemployment rate for recent graduates differs from the unemployment rate for individuals 15 years of age or older, the coefficient of the return to unemployment rate may be biased and the economic return to performance under- or over-stated. Province of residency (residnce) was defined as a concept intended to capture provincial variation in labour market earnings. The variable differentiated between students who were residing inside the province during the week and those who were residing outside the province.

Table 3

Key Analytic Variables

Variable	Description
	Outcome variable
$\ln\_wage_i$	Natural log of weekly wage (in Canadian dollars)
$performance_{ij}$	*Performance variables (continuous)*
perf_eng	Course grade average in English courses
perf_mth	Course grade average in mathematics courses
perf_mjr	Course grade average in student's academic major
perf_ovr	Overall degree course grade average
perf_hgh	Overall high school course grade average
$individual_{ik}$	*Individual variables*
male	Gender (1 if male, 0 if female)
age	Age (continuous)
$credential_{il}$	*Credential variables*
low_high	Low or high return credential (1 if high, 0 if low)
grea_bac	Degree greater than baccalaureate level (1 if greater, 0 if lower)
$labour\ market_{im}$	*Labour market variables*
full_emp	Full- or part-time employment status (1 if full-time, 0 if part-time)
residnce	Province of residency (1 if outside province, 0 if inside province)
unemploy	Occupation- and degree-level unemployment rate (continuous)
job_educ	Relationship between job and education (1 if strong, 0 if weak)
$Mincer_{in}$	
yrs_educ	Years of education (continuous)
wk_exp	Years of work experience (continuous)
wk_exp^2	Years of work experience squared (continuous)
ϵ_i	A random error term

Tests, Assumptions, and Modelling

Tests and Assumptions

When choosing a human capital model specification it is important to take into account statistical theory as well as economic theory. To reduce the potential for errors of interpretation, the data were checked throughout the analyses for violations of the five

major assumptions underlying the use of ordinary least squares and two-stage least squares regression techniques:

1 Absence of outliers or influential cases.

2 Normal distribution of the dependent variable.

3 Linear relationship between the dependent and independent variables.

4 Constant variance of the dependent variable.

5 Independence of observations.

When using regression techniques it is possible that even a single large outlier or influential case can have a substantial impact on the regression results. The potential for outliers was tested throughout the analyses by means of a visual examination of scatter plots of studentized and standardized regression residuals against predicted values. Residuals smaller than -3 or larger than 3 were considered potential outliers, and observations outside this range were individually examined by removing them from the dataset, rerunning the regression, and assessing to see if the removal had a substantial influence on the results. Cases that yielded a substantial change were deleted from the analysis. This procedure resulted in the further deletion of a maximum of 4 cases (0.04%) with a residual larger than 3.00.

The potential for influential cases was examined through an analysis of the leverage measure in conjunction with Cook's distance. The leverage of each case was examined to see if the distance between the cases explanatory variable value and the average of the explanatory variable values of the entire dataset suggested that its removal had a high potential to substantially impact the regression results. The analyses revealed a largest case value of .082 which is extremely small. The Cook's distance measure was also

examined to see if the magnitude of the residuals of all cases would change substantially if any particular case were excluded from the estimation process. In addition, there were no small clusters of observations with substantially higher values than all of the remaining observations. A visual inspection of scatter plots for each pair of variables and normal probability plots of the residuals for each regression model did not reveal any further outliers or influential points. Overall, the testing suggested that the assumption of the absence of outliers and influential points was upheld and that excluding any further case from the analyses would not substantially move the regression line and lead to changes in the coefficients.

A second assumption of the employed regression techniques is that the dependent variable is normally distributed. Since it is well known that wages are positively skewed the weekly wage variable was transformed into its natural logarithm. To examine how well the original and transformed variables fit a normal distribution, and to determine if the transformation improved the normality of the distribution, the one-sample Kolmogorov-Smirnov test was computed. This statistic is particularly sensitive to the normality of the distribution at the top of the curve and was calculated as the largest difference in absolute value between the observed distribution and the normal distribution. The results suggested that the original and transformed wage variables were significantly different from a normal distribution, but that the transformation improved the distributions overall normality. For the weekly wage variable, the test statistic was 2.57 ($p < .01$) for the male model, 2.56 ($p < .01$) for the female model, and 3.70 ($p < .01$) for the combined group. For the transformed variable, the statistic was 2.01 ($p < .01$) for the male model, 2.68 ($p < .01$) for the female model, and 3.37 ($p < .01$) for the combined group.

Tests of skewness and kurtosis were also performed to assess the magnitude of departures from normality. The tests indicated the transformed variable was negatively skewed (skewness = -.687, kurtosis = 1.41), but less skewed than the weekly wage variable (skewness = 2.699, kurtosis = 17.398). A visual inspection of histograms, normal quantile plots, and normal probability plots suggested that the transformation substantially improved the normality of the distribution and that the log-transformed variable was nearly normally distributed. A visual inspection of a normal quantile plot of the quantiles of the variable's distribution around the quantiles of a normal distribution showed the points for the log transformed variable clustered around a straight line. A similar inspection of a normal probability plot of the cumulative proportions of the variable's distribution around the cumulative proportions of a normal distribution showed a similar pattern. Overall, the analyses suggested that the transformed variable was nearly normally distributed and closer to a normal distribution than the original weekly wage variable.

A third assumption of ordinary and two-stage least squares techniques is that there is a linear relationship between the dependent variable and the matrix of independent variables. This assumption was tested throughout the analyses by means of visual examinations of scatter plots of studentized residuals against standardized predicted values. Overall, the random scatter of points and the absence of a consistent curvilinear pattern suggested that the linearity assumption was not violated.

A fourth assumption of the regression techniques used in the analyses is that the variance of the residuals must be constant or the data will be heteroskedastic. Heteroskedasticity is a common concern in cross-section data and while the condition does not bias the estimated coefficients it has the potential to affect standard errors and

invalidate hypothesis testing. Heteroskedasticity was tested throughout the analyses by means of visual examinations of scatter plots of standardized residuals against fitted values. The lack of pattern indicated that the relationship among variables was homoscedastic, residuals were dispersed randomly, and error terms were normally distributed. As an added precaution, the residuals were plotted against each of the independent variables. The random scatter of points and variability across all levels of fitted values, with the exception of the smallest fitted values, suggested that the assumption of constant variance was not violated.

A fifth assumption of ordinary and two-stage least squares techniques is control for a high degree of correlation, or multicollinearity, between two or more independent variables. A high degree of multicollinearity has the potential to increase the size of some or all of the standard errors, destabilize the estimated coefficients, and yield wider confidence intervals that diminish the stability of significance testing. To test for pairwise multicollinearity, the matrixes of correlation coefficients between the independent variables were examined. With the exception of the 'work experience' and 'work experience squared' variables ($r = .947$), there were no extremely high correlations among the independent variables. To test for multiple variables collinearity due to the combined effect of two or more predictor variables, tolerance and variance inflation factors were also examined throughout the analyses. In the final models, with the exception of the 'work experience' and 'work experience squared' variables, the largest variance inflation factor was less than 2.817 and the lowest tolerance value was greater than .333.

Diagnostics also included an examination of the condition indices and regression coefficient variance-decomposition matrix. Finally, throughout the analysis, the

magnitudes of the multiple correlations were consistent with the overall regression coefficients and levels of significance, and there were no large changes in the values of the regression coefficients when new variables are added to the regressions. Overall, the analysis suggested that, in the final models, there was no significant degree of collinearity or multicollinearity.

Modelling

This section describes in detail the modeling used to answer each of the six research questions. To facilitate ease of interpretation of the analysis, and to ensure consistency with similar research at the secondary level, the questions were reformulated and are expressed in terms of the impact on the log of wages of a one standard deviation increase in performance.

Question One

What is the return to post-graduation earnings of a one standard deviation increase in average grade performance in courses in English, mathematics, and student's academic major?

Regression analysis is appropriate when analyzing variability of a single dependent variable from information on one or more independent variables (Pedhazur & Schmelkin, 1991) and was used to identify the magnitude of the effect of each of the performance variables on post-graduation earnings. The one-variable model where ln_wage_i and $performance_{ij}$ are as defined in Table 3, was as follows:

$$ln\_wage_i = \alpha + \sum_{j=1}^{J} \beta_j performance_{ij} + \epsilon_i$$

Regressions were performed using listwise deletion and entering each of the performance variables singly and collectively in the absence of contextual effects. An analysis of the estimates of coefficients was undertaken to determine if the magnitude of the effect of each of the performance variables changed singly and in the presence of each other. The obtained R^2s were compared to determine significance and the proportion of variance accounted for by academic performance effects.

Question Two

What is the additional return to post-graduation earnings of a one standard deviation increase in average grade performance in courses in English, mathematics, and student's academic major in the presence of individual characteristics, credential characteristics, and labour market characteristics?

Ordinary least square techniques are appropriate when testing the effects of multiple variables on a continuous dependent variable in the presence of contextual variables that are correlated with the dependent variable but not with each other (Pedhazur & Schmelkin, 1991). The constructed model designed to measure the additional effect attributable to performance while controlling for individual, credential, and labour market characteristics where ln_wage_i, $performance_{ij}$, $individual_{ik}$, $credential_{il}$, $labour\ market_{im}$, and ϵ_i are as defined in Table 3, was as follows:

$$ln\_wage_i = \alpha + \sum_{j=1}^{J} \beta_j\, performance_{ij} + \sum_{k=1}^{K} \beta_k\, individual_{ik} + \sum_{l=1}^{L} \beta_l\, credential_{il} + \sum_{m=1}^{M} \beta_m\, labour\ market_{im} + \epsilon_i$$

The regression was performed using listwise deletion and adding the cluster of performance variables to the clusters of individual, credential, and labour market

variables. An analysis of the estimates of coefficients was undertaken to determine if the magnitude of the effect of each of the performance variables changed in the presence of the control variables. The obtained R^2s were compared to determine significance and the proportion of variance accounted for by academic performance effects.

Question Three

Does the additional return to post-graduation earnings of a one standard deviation increase in average grade performance in courses in English, mathematics, and student's academic major vary between low return credentials and high return credentials?

The constructed model designed to measure the additive effect attributable to performance while controlling for individual, credential, and labour market effects, by low and high return credentials where ln_wage_i, $performance_{ij}$, $individual_{ik}$, $credential_{il}$, $labour\ market_{im}$, and ϵ_i are as defined in Table 3, was as follows:

$$ln\_wage_i = \alpha + \sum_{j=1}^{J} \beta_j\, performance_{ij} + \sum_{k=1}^{K} \beta_k\, individual_{ik} + + \sum_{l=1}^{L} \beta_l\, credential_{il} + \sum_{m=1}^{M} \beta_m\, labour\ market_{im} + \epsilon_i$$

The analysis was conducted by entering all dichotomously coded credentials into a regression with the log of weekly wages as the dependent variable. The obtained regression weights were then used to determine the credential's relative ranking and to categorize each credential as either a 'low return credential' or a 'high return credential'. A further test of the robustness of the ranking procedure by comparing the results to a ranking based on mean weekly wage yielded similar results. The analysis continued by dichotomously coding each student's obtained credential as either a low return credential or a high return credential and conducting separate regression for both credential groups

using listwise deletion and entering the individual, credential, and labour market characteristics, followed by performance characteristics. An analysis of the estimates of coefficients was undertaken to determine if the magnitude of the effect of each of the performance variables varies between the low and high return credential groups. The obtained R^2s were compared to determine significance and the proportions of variance accounted for by academic performance effects.

Question Four

Does the additional return to post-graduation earnings of a one standard deviation increase in average grade performance in courses in English, mathematics, and student's academic major vary between low and high occupation- and degree-level unemployment rates?

The constructed model designed to measure the additive effect attributable to performance while controlling for individual, credential, and labour market effects, by unemployment rate where ln_wage_i, $performance_{ij}$, $individual_{ik}$, $credential_{il}$, $labour\ market_{im}$, and ϵ_i are as defined in Table 3, was as follows:

$$ln\_wage_i = \alpha + \sum_{j=1}^{J} \beta_j\ performance_{ij} + \sum_{k=1}^{K} \beta_k\ individual_{ik} + + \sum_{l=1}^{L} \beta_l\ credential_{il} + \sum_{m=1}^{M} \beta_m\ labour\ market_{im} + \epsilon_i$$

The analysis was conducted by performing two separate regressions. The first regression selected all graduates in occupations and degree levels with an unemployment rate <= 6% and the second was performed selecting all graduates with a rate >= 7%. Regressions were performed using listwise deletion and entering the clusters of individual, credential, and labour market characteristics, followed by the cluster of

performance characteristics. An analysis of the estimates of coefficients was undertaken to determine if the magnitude of the effect of each of the performance variables changed between low and high unemployment rate groups. The obtained R^2s were compared to determine significance and the proportions of variance accounted for by academic performance effects.

Question Five

What is the additional return to post-graduation earnings of a one standard deviation increase in average grade performance in courses in English, mathematics, and student's academic major in the presence of the Mincer (1974) human capital earnings function?

The constructed model designed to measure the additive effect attributable to performance while controlling for the human capital earnings function where ln_wage_j, $Mincer_{in}$, $performance_{ij}$, and ϵ_i are as defined in Table 3, was as follows:

$$ln\_wage_j = \alpha + \sum_{n=1}^{N} \beta_n Mincer_{in} + \sum_{j=1}^{J} \beta_j performance_{ij} + \epsilon_i$$

Regressions were performed using listwise deletion and entering the cluster of human capital earnings function variables followed by the cluster of performance variables. An analysis of the estimates of coefficients was undertaken to determine if the magnitude of the effect of the coefficients of performance varied from previous analysis. The obtained R^2s were compared to determine significance and proportions of variance accounted for by the academic performance effects.

Question Six

What is the additional return to post-graduation earnings of a one standard deviation increase in average grade performance in courses in English, mathematics, and student's academic major in the presence of the Mincer (1974) human capital earnings function while controlling for differences in individual characteristics, credential characteristics, and labour market characteristics?

The constructed model designed to measure the additive effect attributable to performance while controlling for the human capital earnings function and contextual effects where ln_wage_j, $Mincer_{in}$, $performance_{ij}$, $individual_{ik}$, $credential_{il}$, $labour\ market_{im}$, and ϵ_i are as defined in Table 3, was as follows:

$$ln\_wage_i = \alpha + \sum_{n=1}^{N} \beta_n Mincer_{in} + \sum_{j=1}^{J} \beta_j performance_{ij} + \sum_{k=1}^{K} \beta_k individual_{ik} + \sum_{l=1}^{L} \beta_l credential_{il} + \sum_{m=1}^{M} \beta_m labour\ market_{im}$$

Regressions were performed using listwise deletion and entering the variables comprising the human capital earnings function followed by the clusters of individual, credential, labour market, and performance variables. Due to its exact collinearity with the aggregate of 'years of education' and 'years of work experience', two key variables in the Mincer (1974) framework, 'age' was excluded from the cluster of individual characteristics. An analysis of the estimates of coefficients was undertaken to determine if the magnitude of the effect of the coefficients of performance varied from previous analysis. The obtained R^2s were compared to determine significance and proportions of variance accounted for by the academic performance effects.

Methodological Concerns

There are five key methodological concerns in this research:

1 The endogeneity bias between years of education and academic performance.

2 The linearity assumption between years of education and earnings.

3 Selectivity bias.

4 Data inadequacies.

5 Specification error.

It is speculated that when applying ordinary least squares estimation methods to the human capital earnings function in the presence of measures of productive ability, the coefficient on the years of education variable is biased (see Literature Review for full description). At the present time, the key alternative approach has been to use a two-stage least squares estimation method that replaces the problematic years of education variable with a substitute variable whose disturbance term is not correlated with the disturbance term of the performance variable on which it has a direct effect. However, since exploratory analysis will be conducted to determine the magnitude of the difference, the research questions are focused primarily on determining the return to academic performance, and the specification uses data on specific skills that are more related to job performance than years of education and work experience, the argument for duplicating the entire analyses using both approaches is not warranted.

A second methodological concern is that the specification implicitly assumes that the logarithmic function of weekly wages is linear in education. In other words, each additional year of education and each additional increment in course grade average adds the same percentage increment to post-graduation earnings regardless of the particular

year of education or the particular position in the grade distribution. In recent years, research on the sheepskin effect of credentials has suggested that post-graduation earnings are a non-linear function of years of education and that the phenomenon produces fluctuation in the education and earnings profile because some years of education carry a premium or a penalty over others. However, since basic tests of linearity show the relationship between education and earnings is linear, the current analysis is focused on graduates for whom the sheepskin effects is homogenous, and the vast majority of existing research to which the results will be compared makes the assumption of linearity between years of education and earning, duplicate analyses utilizing an alternative approach to deal with non-linearity is not warranted.

A third methodological concern is selectivity bias. In this research, the examination of post-graduation earnings is conditional upon graduation with a post-secondary degree and employment during the reference week. Thus, the dataset does not facilitate analysis of the effect of academic performance on post-graduation earnings for non-university students, those who failed to graduate, those who were unemployed during the reference week, those who continued with their studies or were engaged in other activities. This limitation precludes the inclusion of a control group and renders the results interpretable conditional upon a student graduating from university and successfully joining the workforce at approximately eighteen months after graduation. In this respect, the coefficients are likely to be biased downwards and the return to performance understated. A further selectivity concern is that students with higher academic performance levels may earn more in the labour market because they self-select into higher paying jobs or higher paying credentials. A final selectivity concern is that the

dataset is underrepresented by higher performing students who have moved out of the province and could not be located or who failed to report their income. There is some evidence to suggest that higher performing students are more mobile and less likely to report their earnings in surveys such as the one used in this research.

Fourth, in addition to methodological concerns, data inadequacies may produce spurious correlations between the independent and dependent variables that impair the analysis and increase the potential for errors of interpretation. In this research, diverse grading practices across instructors and credentials give rise to a standardization problem. However, an argument can be made that aggregate course grades is actually a better measure of an individual's overall ability than any single course grade as the measure represents performance on a variety of products, assessed by different faculty, and across a number of disciplines. A further inadequacy is that is possible for individuals to move from one credential to another, perhaps in response to grades, or perhaps in response to individual characteristics or anticipated labour markets. The phenomenon has the potential to give rise to a problem with multicollinearity among the variables. Finally, a further data limitation is the potential for measurement error in the unemployment rate variable. This variable is based on the National Occupational Classification system. The system is a standard framework for collecting and analyzing labour market data in Canada. However, it is well known that random or systematic measurement error in occupational coding can arise from a number of sources including respondent reports and collection method, and is typically quite large.

Fifth, a key potential specification error is that the dependent variable, weekly wages, was obtained approximately eighteen months after graduation, at a point in time

that permitted graduates sufficient time to obtain employment, but when the returns to academic performance may not have been fully realized. There is some evidence to suggest that some employers who pay higher wages employ graduates into low wage positions for the purpose of screening and preparing the employee for a higher wage position. Thus, to the extent that employers delay remuneration that is differentially based on academic performance, the coefficients may be biased downwards and the return to academic performance understated. Studies investigating the extent to which findings from first destination graduate surveys are indicative of graduates' early career trajectories are inconclusive. Some argue that post-graduation earnings is a misleading proxy for career earnings while others conclude that post-graduation first destination surveys are a reliable indicator of career earnings trajectories. According to Silver, Lavallée, & Pereboom (2000), there is substantial path dependence on earning such that graduates starting their careers with lower wages continue on a lower transitional path. However, Altonji & Pierret (2001) conclude that rewards to cognitive skills increase with work experience as employers have an opportunity to observe skill differences.

A further concern is that the specification may be limited by unobserved earnings-related factors, such as personal attributes like perseverance, leadership ability, and team skills that are correlated with earnings and whose omission may over- or under-estimate the relationship between academic performance and earnings. Finally, to the extent that recent graduates have unemployment rates than differ from those with less education or more labour market experience, the coefficient of return to the unemployment variable will be biased, and the return to academic performance under- or over-stated.

Overall, the methods and data are sufficient to facilitate a focused and detailed analysis of the relationship between academic performance and post-graduation earnings for graduates from the academic year 1999-2000 by individual, credential, and labour market characteristics. A key advantage of the methods is that the dataset contains the individual-level self-reported earnings of graduates in equal-interval small units of analysis. Most research employing measured post-secondary academic performance has relied upon a close proxy for earnings, such as mean occupational earnings. Another key advantage in the dataset is the availability of individual-level course grades. The majority of the limited number of existing studies has relied upon a close proxy for performance such as grade point average, degree class, or other units of analysis that introduce homogeneity into the analysis, and have the potential to obscure the identification of performance effects on post-graduation earnings. Finally, the research dataset contains course grades at the skill level of specificity. Most studies examining performance at this level has utilized data at a career point much further than eighteen months post-secondary graduation.

CHAPTER FOUR: FINDINGS

This chapter describes in detail the key research findings. While some discussion of the findings is necessary to present the results, the full discussion is deferred and presented in Chapter 5. The chapter commences with an analysis of the effect of academic performance on post-graduation earnings followed by an analysis incorporating controls for individual, credential, and labour market characteristics. Next, the effect of academic performance on wages in low return credentials is examined and compared to the effect of performance on wages in high return credentials. This examination is followed by a parallel exploration of the impact of academic performance on earnings in low unemployment occupations that is compared to the effect of performance on earnings in high unemployment rate occupations. The chapter concludes with an investigation of the economic return to academic performance while controlling for the human capital earnings function. Incorporating controls for individual, credential, and labour market characteristics extends this part of the analysis.

Descriptive Statistics

Descriptive statistics, by gender, for the dependent variable and each of the key independent variables are presented in Table 4. The table provides sample sizes, means and, where appropriate, standard deviations. The data is based on the final sample and clustered by performance, individual, credential, and labour market characteristics, and the instrumental variables used in the two-stage least squares analysis. Given the dichotomous nature of the low or high return credential type, degree level, full- or part-time employment status, province of residency, relationship of job to study, and rural-

urban variables, the reported means represent the proportion of the total sample in that category.

Table 4

Sample Sizes, Means, and Standard Deviations for Key Analytic Variables, by Gender

	Male			Female		
	n	*M*	*SD*	*n*	*M*	*SD*
Dependent Variable						
Weekly Wage	416	$790.28	$499.66	655	$604.56	$350.83
Log of Weekly Wage	416	6.50	.61	655	6.23	.63
Performance Variables						
English	373	63.85	7.32	597	66.88	7.32
Mathematics	332	66.35	12.32	534	67.61	12.47
Academic Major	401	73.91	7.09	629	75.13	6.54
Overall Degree	415	72.13	6.99	648	73.25	6.52
Overall High School	334	78.58	7.57	537	80.50	7.55
Individual Variables						
Age	416	28.14	5.79	655	27.71	6.52
Credential Variables						
High Return Credential	416	.52		655	.51	
Less Baccalaureate	416	.10		655	.09	
Equal Baccalaureate	416	.73		655	.79	
Greater Baccalaureate	416	.17		655	.11	
Labour Market Variables						
Full-time Employment	415	.96		654	.88	
Reside Outside Province	408	.34		645	.25	
Unemployment Rate	416	8.38	5.01	655	9.05	5.21
Job Related to Study	332	.76		521	.66	
Mincer Variables						
Years of Education	416	16.96	1.34	654	16.76	1.18
Work Experience	416	5.18	5.28	654	4.97	6.14
Work Experience^2	416	54.59	122.34	654	62.37	149.34
Instrumental Variables						
Parental Education	406	12.96	2.56	633	12.84	2.62
Total Loan At Survey	241	$19,905	$15,480	395	$22,792	$15,738
Rural-Urban	366	.66		610	.62	

Economic Return to Performance

What is the return to post-graduation earnings of a one standard deviation increase in average grade performance in courses in English, mathematics, and student's academic major?

In this analysis each of the performance variables were independently entered into a regression with the log of weekly wages as the dependent variable. As noted in Tables 5 and 6, there is substantial variation in the economic returns to post-secondary course grade performance in English, mathematics, and student's academic major. Average course grade performance one standard deviation above the mean (M = 74.65, SD = 6.78) in student's academic major is associated with a 9.5% ($64.25) increase in weekly post-graduation earnings (M = $676.69, SD = $424.57) and explains 2.4% of the wage variance (F = 24.83, p < .01, n = 1030). A comparable increment in mathematics performance (M = 67.13, SD = 12.42) is associated with a 3.7% increase in post-graduation earnings ($25.21) and explains 0.4% of the wage variance (F = 3.36, p < .10, n = 866), and increased performance in English (M = 65.71, SD = 7.46) is associated with a 6.0% negative return to wages (-$40.40) that explains 0.9% of the wage variance (F = 8.56, p < .01, n = 970).

To determine if the independent returns differ from their collective effects, all performance variables were entered into a second regression concurrently. This model explains 4.6% of the wage variance (F = 13.17, p < .01, n = 832), with coefficients on each of the performance variables that vary substantially from their independent effects. In the presence of English and mathematics, the return to average course grade performance in student's academic major one standard deviation above the mean falls marginally from 9.5% to 8.8% ($59.66), the return to mathematics performance almost doubles from 3.7% to 6.2% ($42.02), and the negative return to English moves from -6% to -12.7% (-$85.86).

Table 5

Model Summaries for Performance Variables, Independently and Collectively

Model	R	R^2	df	F
Independently				
English	.094***	.009***	969	8.56***
Mathematics	.062*	.004*	865	3.36*
Academic Major	.154***	.024***	1029	24.83***
Overall Degree	.150***	.022***	1062	24.27***
Over High School	.028	.001	870	.70
Collectively				
English/Mathematics/Major	.214***	.046***	829	13.17***

Note. * $p < .10$. ** $p < .05$. *** $p < .01$

Table 6

Logarithmic Earnings Equations as a Function of Performance Characteristics, Independently and Collectively

	Independently		Collectively	
Variable	β	Effect	β	Effect
English	-.008***	-6.0%	-.017***	-12.7%
Mathematics	.003*	3.7%	.005**	6.2%
Academic Major	.014***	9.5%	.013***	8.8%
Overall Degree	.014***			
Over High School	-.002			

Note. * $p < .10$. ** $p < .05$. *** $p < .01$

Effect is expressed as a percentage change in wages of a one standard deviation increase in the independent variables being examined and is computed by multiplying β with the sample's corresponding *SD*.

The polarization in the coefficients of return to performance in English and mathematics is somewhat complicated to interpret. The direction of the change and the negative sign on the coefficient of English implies that students who perform better than average in English have lower than average post-graduation earnings. Counter-intuitive to one of the goals of a post-secondary education, the findings can be interpreted to suggest that students may yield higher post-graduation earnings if they invest financial resources and human efforts in improving academic performance in mathematics and decreasing performance in English. However, as with any social research, investigations of the relationship between two or more variables is confronted with the problem that

unobserved characteristics related to the independent variable might also be related to the dependent variable and obscure the results.

In this context, it is possible that the return to each of the performance characteristics, or a portion of the return, is the result of confounding between performance and unobserved factors that are correlated with both earnings and performance. For example, it is possible that students who perform better than average in English than mathematics are earning less in the labour market because they are screened or self-selected into credentials with low mean post-graduation earnings. In a similar vein, it is possible that students who perform better than average in mathematics than English are earning more in the labour market because they are screened or self-selected into credentials with high mean post-graduation earnings. The phenomenon, known as selectivity bias, has the potential to introduce errors in to the estimates of return. However, in this case an argument is made that the phenomenon is the result of credential characteristics, and that incorporating controls for credential effects in the earnings equation will reduce the amount of bias in the estimates.

Economic Return to Performance Controlling for Individual, Credential, and Labour Market Characteristics

What is the additional return to post-graduation earnings of a one standard deviation increase in average grade performance in courses in English, mathematics, and student's academic major in the presence of individual characteristics, credential characteristics, and labour market characteristics?

In this analysis, individual, credential, and labour market characteristics were entered into a regression with the log of weekly wages as the dependent variable, followed by the performance characteristics. As noted in Table 7, the additive effect of academic

performance on post-graduation earnings over and above contextual effects is 1.4% (F = 5.34, $p < .01$ $n = 653$), with the full model explaining 42.3% of the wage variance (F = 47.11, $p < .01$, $n = 653$).

The decrease in the proportion of variance explained by performance effects from the previous regression suggests that contextual effects intervene in the relationship between academic performance and earnings such that 3.2% of the variance in post-graduation earnings can be explained by the impact of individual, credential, and labour market characteristics on earnings through the relationship that these variables have with academic performance. For example, it is possible that the relationship between academic performance and earnings is obscured because employers remunerate some graduates differentially from others not because these graduates have a higher performance level in specific courses, but because those with higher performance levels in specific courses are screened or self-selected into credentials with higher mean post-graduation earnings.

Table 7

Summary of Model Comparisons Adding Performance Characteristics to Individual, Credential, and Labour Market Characteristics

Model	R^2	ΔR^2	*df*	*F*
Individual + Credential + Labour Market + Performance	.423***		643	
		.014***		5.34***
Individual + Credential + Labour Market	.408***		646	

Note. * $p < .10$. ** $p < .05$. *** $p < .01$

As noted in Table 8, the magnitude of the change in the regression coefficients from the reduced model suggest that the primary factors that intervene in the relationship between performance and post-graduation earnings are gender, degree level, and occupational unemployment rate. The findings can be interpreted to suggest that some of the benefit of academic performance on earnings is through role that academic

performance plays in screening or self-selection into low unemployment rate occupations and the continuation on to graduate studies.

Not surprisingly, in the presence of individual, credential, labour market, and performance characteristics, gender remains a strong and statistically significant predictor of wages. The regression coefficient indicates that males earn 17.3% more than their female counterparts. The change in the coefficient from the reduced model to the full model can be interpreted to suggest that females can mitigate some of the impact of gender effects through increased academic performance. Inclusive of contextual effects, each additional year of age is associated with a 2.3% increase in earnings.

The obtained coefficients on labour market characteristics are also consistent with expectations and support the representative nature of the dataset. Graduates with an obtained credential at the master's level earn an average of 23.5% more than those with a baccalaureate degree or lower. Students who move outside the province earn an average of 21.0% more than those who remain and graduates who work in high unemployment rate occupations learn less than those who work in low unemployment rate occupations, such that each increment in the unemployment rate is associated with a 3% reduction in earnings. Finally, graduates who are employed in a job that is closely related to their obtained credential earn an average of 46.4% more than those who work in a job that is unrelated to their post-secondary credential.

The table also shows that including individual, credential, and labour market characteristics in the model has an overall effect that reduces polarization in the returns to English and mathematics and yields a negative coefficient on the return to performance in student's academic major. In the presence of contextual effects, the return to a one

standard deviation increase in student's academic major (M = 74.37, SD = 6.67) falls from 8.8% to -8.0% and yields return to earnings of -$52.90 ($M$ = $661.31, SD = $409.76), the return to mathematics performance (M = 67.48, SD = 12.39) falls from 6.2% to 5.0% ($33.07), and the return to performance in English becomes non-significant. As with the previous regression, the negative return on the coefficient of academic major is complicated to interpret. However, it is likely that the economic return to performance in English and student's academic major is more sensitive to labour market and credential effects than the return to performance in mathematics. Since this is the intended focus of research questions 3 and 4, further exploration is deferred to that point.

Table 8

Logarithmic Earnings Equations as a Function of Individual, Credential, Labour Market, and Performance Characteristics

	Reduced	Full	
Variable	β	β	Effect
Individual			
Male	.189***	.173***	
Age	.022***	.023***	
Credential			
Greater Baccalaureate	.179**	.235***	
High Return Credential	.038	.055	
Labour Market			
Reside Outside Province	.216***	.210***	
Unemployment Rate	-.028***	-.030***	
Job Related to Study	.457***	.464***	
Performance			
English		-.002	
Mathematics		.004**	5.0%
Academic Major		-.012***	-8.0%

Note. * $p < .10$. ** $p < .05$. *** $p < .01$

Effect is expressed as a percentage change in wages of a one standard deviation increase in the independent variables being examined and is computed by multiplying β with the sample's corresponding *SD*.

To determine if the economic return to academic performance was further dispersed by gender, a second regression was performed adding the cluster of performance characteristics to individual, credential, and labour market characteristics,

separately for males and females. Table 9 shows that, on average, the additive effect of academic performance on post-graduation earnings over and above contextual effects is 4.9% ($F = 5.88, p < .01$) for males with the full model explaining 35.3% of the wage variance ($F = 14.22, p < .01, n = 244$). For females, however, the return to performance characteristics over and above contextual effects is weak and non-significant with the full model explaining 8.4% more of the wage variance than their male counterparts. The results suggest that there is substantial inter-gender variation in the determinants of post-graduation earnings.

Table 9

Summary of Model Comparisons Adding Performance Characteristics to Individual, Credential, and Labour Market Characteristics, by Gender

Model	R^2	ΔR^2	*df*	*F*
Males				
Individual + Credential + Labour Market + Performance	.353***		235	
		.049***		5.88***
Individual + Credential + Labour Market	.304***		238	
Females				
Individual + Credential + Labour Market + Performance	.437***		399	
		.008		1.81
Individual + Credential + Labour Market	.429***		402	

Note. * p < .10. **p < .05. ***p < .01

As shown in Table 10, the inter-gender variation can be explained, in part, by individual, credential, labour market, and performance characteristics. For males, the average return to wages ($M = \$792.01$, $SD = \$499.57$) of a one standard deviation increase in mathematics ($M = 66.59$, $SD = 12.63$) is 10.1% ($80.00), the average return to a comparable increment in academic major ($M = 73.90$, $SD = 7.08$) is -12.04% (-$95.33), and the return to English ($M = 63.90$, $SD = 7.38$) is non-significant. For females, the

return to performance in English ($M = 66.32$, $SD = 7.11$), mathematics ($M = 68.01$, $SD = 12.23$), and academic major ($M = 74.65$, $SD = 6.41$) are non-significant. However, relative to their male counterparts, females yield a 13.8% higher return to earnings for obtaining a degree at the master's level or higher, a 13.7% premium over males for working in a job that is closely related to their obtained post-secondary credential, a 16.5% return for graduating with a high return credential, a 5.9% lower premium for working outside the province, and a negative impact on wages of unemployment rate that is almost 50% (1.7%) lower than their male counterparts. As with earlier regressions, negative returns to increased performance in academic major is counter-intuitive to the goals of a post-secondary education. However, it is possible that the negative coefficient arises because the measure is more sensitive to labour market effects than performance in mathematics. This is the focus of the next set of research questions.

Table 10

Logarithmic Earnings Equations as a Function of Individual, Credential, Labour Market, and Performance Characteristics, by Gender

	Females	Males	
Variable	B	B	Effect
Individual			
Age	.020***	.027***	
Credential			
Greater Baccalaureate	.341***	.203**	
High Return Credential	.165**	-.089	
Labour Market			
Reside Outside Province	.183***	.242***	
Unemployment Rate	-.021**	-.038***	
Job Related to Study	.491***	.354***	
Performance			
English	-.006	.004	
Mathematics	.001	.008***	10.1%
Academic Major	-.006	-.017***	-12.0%

Note. * $p < .10$. ** $p < .05$. *** $p < .01$

Effect is expressed as a percentage change in wages of a one standard deviation increase in the independent variables being examined and is computed by multiplying β with the sample's corresponding *SD*.

Economic Return to Performance Across Low and High Return Credentials

Does the additional return to post-graduation earnings of a one standard deviation increase in average grade performance in courses in English, mathematics, and student's academic major vary between low return credentials and high return credentials?

There may be a logical flaw in comparing two analyses in which there is no test of significance of the difference between the two coefficients or effects. However, the overall analysis is consistent with recent findings that there is more heterogeneity between credential groups than there is within credentials groups in the factors that influence post-graduation earnings (Boothby, 2002). In addition, there are several studies that suggest it is not unreasonable to cluster graduates from low return credentials and those from high return credentials and run separate analyses for both groups. For example, Naylor, Smith & McKnight (2000), examining graduate occupational earnings across different degree subjects, perform separate gender-specific regressions for subsets of `low' and `high' premium degree subjects and find differences in the additional earnings premiums associated with a first class degree over a third class degree across subject area that is greater for subject groups with relatively high earnings, and significant at the 5% level for males and 10% level for females.

In a second study, Tobias (2003), exploring the relationship between performance and earnings using flexible estimation techniques, finds evidence that performance sorting into higher education creates problems for accurately identifying the returns to education over the entire performance support as the wage premium for college graduates is increasing for the 'more' able and increased over the period 1984 to 1994 for individuals at all points in the performance distribution. Tobias concludes that the longitudinal growth

of the wage premium appears to have followed a 'smoother' linear path for high-performing individuals than low-performing individuals. In this respect, failing to examine differences between high and low return credential groups when examining the return to academic performance may obscure important group effects.

Table 11 shows that in the presence of individual, credential, and labour market characteristics, the additive effect of performance is 2.1% ($F = 3.10$, $p < .01$, $n = 286$) in low return credentials with the full model explaining 36.2% of the variance in post-graduation earnings and 1.9% ($F = 3.12$, $p < .01$, $n = 366$) in high return credentials with the full model explaining 28.7% of the wage variance. The results suggest that the additive effect of academic performance does not vary substantially between low and high return credentials. However, it is interesting to note that individual, credential, and labour market characteristics explain 7.5% more of the wage variance in low return credentials than in high return credentials, suggesting that the composition of human capital is substantially different between these two groups.

Table 11

Summary of Model Comparisons Adding Performance Characteristics to Individual, Credential, and Labour Market Characteristics, by Low and High Return Credentials

Model	R^2	ΔR^2	*df*	*F*
Low Return				
Individual + Credential + Labour Market + Performance	.362***		277	
		.021***		3.10***
Individual + Credential + Labour Market	.340***		280	
High Return				
Individual + Credential + Labour Market + Performance	.287***		357	
		.019***		3.12***
Individual + Credential + Labour Market	.268***		360	

Note. * p < .10. **p < .05. ***p < .01

As noted in Table 12, in high return credentials, a one standard deviation increase in English performance (M = 64.85, SD = 7.02) is non-significant, while increased performance in mathematics (M = 67.94, SD = 11.57) is associated with a 5.8% ($44.51) return to wages ($M$ = $769.49, SD = $353.47) and increased performance in student's academic major (M = 76.20, SD = 5.61) is associated with a -4.5% (-$34.54) return to wages. In low return credentials, a one standard deviation increase in mathematics performance (M = 66.89, SD = 13.37) is associated with an 8.0% ($41.95) return to wages ($M$ = $522.97, SD = $435.03), a comparable increment in student's academic major (M = 72.04, SD = 7.18) is -12.2% (-$63.85), and performance in English (M = 66.13, SD = 7.60) is a non-significant predictor of post-graduation earnings.

Lack of variation in the additional explanatory power of performance effects across low and high return credentials in conjunction with a higher explanatory power of the model in low return credentials and variation in the returns to independent effects suggests that in addition to a rising wage inequality between high school graduates and those with a post-secondary degree, there is further inequality among graduates that is based upon course grade performance in mathematics and student's academic major, or on other factors that are correlated with performance in mathematics and student's academic major. The findings also suggest that the human capital of graduates in low return credentials is different from the human capital of graduates in high return credential and the differential is due to factors other than performance in English, mathematics, and student's academic major.

In terms of contextual effects, the return to each additional year of age is 3.5% higher in low return credentials than in high return credentials, the premium for males is

almost four times higher in low return credentials, the premium for a degree at the master's level is 10.1% higher in low return credentials, the premium for moving outside the province is 3.9% higher in low return credentials, the negative impact of each additional increment in occupational unemployment rate is 2.6% higher in low return credentials, and the return for working in a job related to the graduates' obtained credential is 4.2% lower in low return credentials than in high return credentials.

Table 12

Logarithmic Earnings Equations as a Function of Individual, Credential, Labour Market, and Performance Characteristics, by Low and High Return Credentials

	Low Return		High Return	
Variable	β	Effect	β	Effect
Individual				
Age	.049***		.014***	
Male	.300***		.088**	
Credential				
Greater Baccalaureate	.330***		.229***	
Labour Market				
Reside Outside Province	.223***		.184***	
Unemployment Rate	-.020***		-.046***	
Job Related to Study	.442***		.484***	
Performance				
English	-.001		-.001	
Mathematics	.006**	8.0%	.005**	5.8%
Academic Major	.017**	-12.2%*	-.008*	-4.5%

Note. * $p < .10$. ** $p < .05$. *** $p < .01$

Effect is expressed as a percentage change in wages of a one standard deviation increase in the independent variables being examined and is computed by multiplying β with the sample's corresponding *SD*.

Economic Return to Performance Across Low and High Unemployment Rate Fields of Study

Does the additional return to post-graduation earnings of a one standard deviation increase in average grade performance in courses in English, mathematics, and student's academic major vary between low and high occupation- and degree-level unemployment rates?

This analysis required two separate regressions. In the first regression cases were selected with an occupation- and degree-level unemployment rate less than or equal to 6% (52.4% of the sample). In the second regression cases were selected with an unemployment rate greater than or equal to 7% (47.4% of the sample). As with previous analysis, individual, credential, and labour market characteristics were entered into the regression first followed by the cluster of performance characteristics. Since previous analyses showed gender-based differential effects, the regressions were performed separately for males and females.

Table 13 shows that, on average, the additive explanatory power of performance characteristics in low unemployment rate occupations is 7.9%% ($F = 5.71$, $p < .01$, $n = 148$) for males with the full model explaining 35.6% of the variance in post-graduation earnings and non-significant for females with the full model explaining 28.7% of the variance in earnings. In high unemployment rate occupations the comparable increments are 8.1% ($F = 3.28$, $p < .05$, $n = 95$) for males with the full model explaining 28.6% of the variance and 4.7% ($F = 3.84$, $p < .05$, $n = 185$) for females with the full model explaining 28.4% of the wage variance. The magnitude of the differential in the R^2s (6.9%) suggest that the human capital of graduates in low unemployment rate occupations is further differentiated by gender.

Table 13

Summary of Model Comparisons Adding Performance Characteristics to Individual, Credential, and Labour Market Characteristics, by Low and High Unemployment Rate Occupations and Gender

Model	R^2	ΔR^2	*df*	*F*
Rate <= 6%				
Males	.356***	.079***	140	5.71***
Females	.287***	.008	214	0.82
Rate >= 7%				
Males	.286***	.081**	87	3.28**
Females	.284***	.047**	177	3.84**

Note. * $p < .10$. ** $p < .05$. *** $p < .01$

As noted in Table 14, in the presence of contextual effects, mathematics performance is a statistically significant predictor of wages for males in both low and high unemployment rate occupations. In financial terms, a one standard deviation above the mean increment in mathematics performance ($M = 68.21$, $SD = 11.02$) is associated with a 11.0% ($98.93) return to wages ($M = 897.76, $SD = 391.65) in low unemployment rate occupations while a comparable increase ($M = 64.07$, $SD = 14.49$) is high unemployment rate occupations is associated with a 13.0% ($81.88) return to wages ($M = 627.89, $SD = $597.73).

Somewhat more interesting, English performance is a statistically significant negative predictor of wages for males ($M = 63.97$, $SD = 7.21$) in low unemployment rate occupations with a return of -5% (-$45.28) and non-significant for females ($M = 65.48$, $SD = 6.97$) in the comparable group. However, in high unemployment rate occupations, English is a strong and statistically significant positive predictor of wages for males ($M = 63.78$, $SD = 7.69$) with a return of 13.1% ($72.06), but a strong and statistically significant negative predictor for females ($M = 67.33$, $SD = 7.16$) with a return of -11.5% (-$47.95).

Increased performance in student's academic major is associated with a -25.9% (-162.65) return to wages for males in high unemployment rate occupations.

The findings can be interpreted to suggest that through labour market supply and demand effects males in low unemployment rate occupations are being screened into the labour market based on academic performance in mathematics. However, in high unemployment rate occupations where competition for jobs is more competitive, males are being screened into the labour market based on performance in both English and mathematics. For females in high unemployment rate occupations, the strong and statistically significant negative return to English can arise as a result the relationship between English performance, labour market supply and demand, and credential effects. The findings support the previous interpretation that performance in English and academic major are more sensitive to credential and labour market effects than performance in mathematics. The results also support the interpretation that in addition to a rising wage inequality between high school and post-secondary graduates, there is a rising inequality among university graduates based on academic performance in specific courses and sets of courses and are cconsistent with findings by Blackburn & Neumark (1993), Dolton & Makepeace (1990), Naylor, Smith & McKnight (2000), and Tobias (2003).

Table 14

Logarithmic Earnings Equations as a Function of Individual, Credential, and Labour Market Characteristics, by Low and High Unemployment Rate Occupations and Gender

	Rate <= 6%			Rate >= 7%		
Variables	Males	Effect	Females	Males	Effect	Females
Individual						
Age	.015*		.013**	.052**		.032**
Credential						
High Return Credential	-.113		-.106	-.644**		.293
Greater Baccalaureate	.235***		.248**	.543**		.614**
Labour Market						
Reside Outside Province	.180***		.099**	.210		.251**
Job Related to Study	.469***		.620***	.410***		.431***
Performance						
English	-.007*	-5.0%	.004	.017*	13.1%	-.016**
Mathematics	.010***	11.0%	-.001	.009*	13.0%	.003
Academic Major	-.007		.006	-.039**	-25.9%	-.009

Note. * $p < .10$. ** $p < .05$. *** $p < .01$

Effect is expressed as a percentage change in wages of a one standard deviation increase in the independent variables being examined and is computed by multiplying β with the sample's corresponding *SD*.

Economic Return to Performance Controlling for the Human Capital Earnings Function

What is the additional return to post-graduation earnings of a one standard deviation increase in average grade performance in courses in English, mathematics, and student's academic major in the presence of the Mincer (1974) human capital earnings function?

This analysis required a multiple regression entering first the Mincer (1974) framework comprised of years of education, years of work experience, and years of work experience squared, followed by the cluster of performance characteristics. As shown in table 15, the additive effect of academic performance over and above the human capital earnings function is 2.8% ($F = 8.93$, $p < .01$, $n = 829$) with the full model explaining 15.4% of the variance in post-graduation earnings ($F = 25.00$, $p < .01$, $n = 829$).

Table 15

Summary of Model Comparisons Adding Performance Characteristics to the Human Capital Earnings Function

Model	R^2	ΔR^2	*df*	*F*
Mincer + Performance	.154***		823	
		.028***		8.93***
Mincer	.127***		826	

Note. * $p < .10$. ** $p < .05$. *** $p < .01$

Focusing on the returns to independent factors, Table 16 notes that, exclusive of performance effects, each additional year of education raises earnings by an average of 11.8%, and each additional year of work experience raises earnings by an average of 7.8%. The findings are consistent with estimated rates of return at the post-secondary level. For example, Hossain & Psacharopoulos (1994), examining the returns to an additional year of education by education level, estimate a return of 18.6% at the primary school level, 10.2% at the secondary school level, and 11.0% at the post-secondary level. The finding is also consistent with rates of return in Canada. According to Lemieux (2000), based on large nationally representative datasets such as the Census and *Survey of Consumer Finances*, on average, the causal effect of education on earnings in Canada is 10%.

The table also shows that incorporating post-secondary academic performance in the model has little effect on the coefficients associated with years of education and work experience. The stability of the returns suggests that academic performance and years of education are mutually exclusive determinants of post-graduation earnings, efforts to increase post-secondary academic performance are not likely to diminish the return to years of education and work experience, and efforts to enhance course grade performance appear likely to increase the return to investment of human effort and financial resources

in a post-secondary education. In economic terms, the return to wages (M = $676.69, SD = $424.57) of average course grade performance in English (M = 65.71, SD = 7.46) one standard deviation above the mean is -7.5% (-$50.51), the return to academic major (M = 74.65, SD = 6.78) is non-significant, and the return to a one standard deviation increase in mathematics performance (M = 67.13, SD = 12.42) is 9.9% ($67.24).

Table 16

Logarithmic Earnings Equations as a Function of Performance and the Human Capital Earnings Function

	Reduced	Full	
Variable	β	β	Effect
Mincer Framework			
Years of Education	.118***	.114***	
Work Experience	.078***	.079***	
Work Experience^2	-.002***	-.002***	
Performance Characteristics			
English		-.010***	-7.5%
Mathematics		.008***	9.9%
Academic Major		.003	

Note. * $p < .10$. ** $p < .05$. *** $p < .01$

Effect is expressed as a percentage change in wages of a one standard deviation increase in the independent variables being examined and is computed by multiplying β with the sample's corresponding *SD*.

In exploratory analysis, to determine the extent to which the regression results might be impacted by the endogeneity bias, the regression was repeated using a two-stage least squares approach with exogenous controls for a number of instrumental variables available in the dataset including highest level of parental education, socio-economic status, and rural-urban location.

Table 17 shows that compared with the above analysis where selection is assumed to be random, the income effects of years of education, years of work experience, and work experience squared increase marginally when endogeneity is taken into account. The findings lend further support to the argument that an ordinary least squares approach introduces a downwards bias into estimates of the economic return to education.

However, in this case, the low magnitude of the increase in the years of education variable when using a two-stage least squares approach over an ordinary least squares approach is likely the result of heterogeneity in the years of education variable in relation to previous studies. Overall, the analysis suggests that employing an ordinary least squares approach at the intersection of post-secondary and the labour market is likely to yield approximately accurate estimates of the economic return to education.

The analysis also supports the interpretation that years of education and academic performance are mutually exclusive determinants of post-graduation earnings and that including post-secondary course grade performance in a prediction model of the determinants of post-graduation earnings further uncovers part of the heterogeneity in the returns to education which is unobserved in the standard human capital earnings function. Somewhat more interesting, while the coefficients of return on the variables in the human capital earnings function and performance variables increase marginally when utilizing a two-stage least squares approach over an ordinary least squares approach, the coefficients of returns to performance increase in the presence of exogenous controls for socio-economic status. The findings suggest that post-secondary academic performance is exogenously determined by socio-economic status and that failing to incorporate controls for this variable may introduce bias in the coefficients of return to performance.

Table 17

Logarithmic Earnings Equations as a Function of the Human Capital Earnings Function and Performance with Instrumental Variables

Extended Human Capital Earnings Function with Instrumental Variables				
	Reduced Model	Parental Education	Socioeconomic Status	Rural-Urban
R	.393***	.393***	.350***	.387***
R^2	.154***	.155***	.122***	.150***
F	25.00***	24.41***	12.09***	22.52***
Years of Education	.114***	.117***	.119***	.117***
Years of Work Experience	.079***	.077***	.082***	.073***
English	-.010***	-.010***	-.015***	-.010***
Mathematics	.008***	.008***	.009***	.008***
Academic Major	.003	.003	.006	.003

Note. * $p < .10$. ** $p_- < .05$. *** $p < .01$

Economic Return to Performance Controlling for the Human Capital Earnings Function, Credential, and Labour Market Characteristics

What is the additional return to post-graduation earnings of a one standard deviation increase in average grade performance in courses in English, mathematics, and student's academic major in the presence of the Mincer (1974) human capital earnings function while controlling for differences in individual characteristics, credential characteristics, and labour market characteristics?

This analysis required a multiple regression entering the contextual effects followed by the cluster of performance characteristics. Due to its exact collinearity with the aggregate of 'years of education' and 'years of work experience', two key variables in the Mincer (1974) framework, 'age' was excluded from the model. Table 18 shows that, on average, the additive return to academic performance over and above the human capital earnings function, individual, credential, and labour market characteristics is 1.3% ($F = 4.70, p < .01, n = 654$) with the full model explaining 42.8% of the variance in post-graduation earnings.

Table 18

Summary of Model Comparisons Adding Performance Characteristics to the Human Capital Earnings Function, Credential, and Labour Market Characteristics

Model	R^2	ΔR^2	*df*	*F*
Mincer + Credential + Labour Market + Performance	.428***		642	
		.013***		4.70***
Mincer + Credential + Labour Market	.416***		645	

Note. * $p < .10$. ** $p < .05$. *** $p < .01$

As noted in Table 19, including academic performance in the model does not change the coefficients in the Mincer (1974) framework substantially. In the presence of the human capital earnings function and contextual effects, a one standard deviation increase in mathematics performance ($M = 67.48$, $SD = 12.39$) is associated with a 6.2% ($40.98) return to post-graduation earnings ($M = 661.31, $SD = 409.76), a one standard deviation increase in performance in academic major ($M = 74.37$, $SD = 6.67$) is associated with a -7.3% (-$48.53) return to wages, and the return to increased performance in English ($M = 65.41$, $SD = 7.30$) is weak and non-significant. Focusing on the return to contextual factors, in the presence of the human capital earnings function, academic performance mitigates the impact of gender effects by 0.9% and improves the return to a degree at the master's level by 2.9%

Table 19

Logarithmic Earnings Equations as a Function of the Human Capital Earnings Function, Credential, Labour Market, and Performance Characteristics

Variables	Reduced β	Full β	Effect %
Mincer Framework			
Years of Education	.007	.032	
Work Experience	.060***	.057***	
Work Experience^2	-.002***	-.002**	
Male	.171***	.162***	
Performance			
English		-.001	
Mathematics		.005***	6.2%
Academic Major		-.011***	-7.3%
Credential			
High Return Credential	.053	.061	
Greater Baccalaureate	.160**	.189**	
Labour Market			
Unemployment Rate	-.026***	-.027***	
Reside Outside Province	.218***	.214***	
Job Related to Study	.467***	.469***	

Note. * $p < .10$. ** $p < .05$. *** $p < .01$

Effect is expressed as a percentage change in wages of a one standard deviation increase in the independent variables being examined and is computed by multiplying β with the sample's corresponding *SD*.

To determine if the differential effects were further dispersed by gender a third set of regressions was conducted entering the human capital earnings function, individual characteristics, credential characteristics, and labour market characteristics, followed by the cluster of performance characteristics, separately for males and females. Table 20 shows that, on average, the additive effect of performance characteristics is 3.4% for males with the full model explaining 36.2% of the variance in post-graduation earnings, and non-significant for females with the full model explaining 44.7% of the wage variance. As with previous analysis, the 8.5% increase in the explanatory power of the model for females over males suggests that the human capital of males is substantially different from the human capital of females.

Table 20

Model Summaries for the Human Capital Earnings Function, by Gender

Model	R^2	ΔR^2	*df*	*F*
Females				
Mincer + Credential + Labour Market + Performance	.447***		397	
		.006		1.43
Mincer + Credential + Labour Market	.441***		400	
Males				
Mincer + Credential + Labour Market + Performance	.362***		233	
		.034*		4.12***
Mincer + Credential + Labour Market	.328***	.	236	

Note. * $p < .10$. ** $p < .05$. *** $p < .01$

As noted in Table 21, for males, in the presence of the human capital earnings function, individual, credential, and labour market characteristics, the return to academic performance is substantial. A one standard deviation above the mean increase in average course grade performance in mathematics ($M = 66.59$, $SD = 12.63$) is associated with a 10.1% ($80.00) return to earnings ($M = \$792.01$, $SD = \$499.57$), the same increment for academic major ($M = 73.91$, $SD = 7.08$) is associated with a -9.9% (-$78.48) return to wages, and the return to English performance ($M = 63.90$, $SD = 7.38$) is non-significant.

The finding is consistent with previous Canadian research that notes that females accrue higher returns to years of education and males accrue higher returns to performance. For example, Charette & Meng (1998), using Canadian data from the 1989 *Survey of Literacy Skills Used in Daily Activities*, find that including literacy and numeracy measures in the income equation increases the return to years of education for females but decreases the return for males. Osberg (2000) also concludes that the rate of return to years of education is higher for females and less influenced by prose, document, and quantitative literacy proficiency than males. The findings suggest that for males it

matters less how many years they spend engaged in a post-secondary education and more how well they perform while they are there. For females, it may be that the key determinants of post-graduation earnings are the number of years they spend engaged in a post-secondary education, the highest degree level they achieve, and whether the credential they obtain has a low or high return.

Table 21

Logarithmic Earnings Equations as a Function of the Human Capital Earnings Function, Performance, Credential, and Labour Market Characteristics, by Gender

	Females	Males	
	β	B	Effect %
Mincer Framework			
Yrs of Education	.064**	-.010	
Wrk Experience	.053***	.062**	
Wrk Experience^2	-.002**	-.002	
Performance			
English	-.003	.004	
Mathematics	.002	.008***	10.1%
Academic Major	-.008	-.014**	-9.9%
Credential			
High Return Credential	.171**	-.077	
Greater Baccalaureate	.257*	.198*	
Labour Market			
Unemployment Rate	-.018**		
Reside Outside Province	.183***	.247***	
Job Related to Study	.490***	.357***	

Note. * $p < .10$. ** $p < .05$. *** $p < .01$

Effect is expressed as a percentage change in wages of a one standard deviation increase in the independent variables being examined and is computed by multiplying β with the sample's corresponding *SD*.

In conclusion, the findings show that academic performance is a strong and statistically significant predictor of post-graduation earnings. However, the return is sensitive to individual, credential, and labour market characteristics. On average, the return to academic performance is higher for mathematics courses, higher for males, stable across low and high return credentials, and higher in high unemployment rate occupations. The findings confirm the economic return to post-graduation earnings of

targeted efforts to improve post-secondary academic performance. The research finds that, on average, even after taking into consideration the high premiums associated with individual, credential, and labour market characteristics, the impact of post-secondary academic performance on post-graduation earnings over a broad range of performance outcomes and lifetime of earnings can be substantial.

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CHAPTER FIVE: DISCUSSION AND CONCLUSIONS

This chapter commences with a discussion that contextualizes the research findings. The discussion is followed by a synopsis of the research conclusions that are based upon the findings. The chapter closes with a number of recommendations for the most promising and productive lines of future investigations based upon the research conclusions.

In Canada, previous research has shown that there is a 40% earnings premium for high school completion over dropping out of school in Grade 10 (Human Resources Development Canada, 2000b). Existing research has also demonstrated that there is a significant earnings premium for post-secondary graduation over high school completion. Boothby & Rowe (2002), comparing the distributions of lifetime earnings for high school and post-secondary graduates, find that median lifetime earnings for graduates with a post-secondary degree are higher than lifetime earnings for high school graduates at the 75^{th} percentile. Research has also shown that both years of education and the sheepskin effects of credentials have a substantial impact on earnings. According to Lemieux (2001), the causal effect of education on earnings in Canada is approximately 10.0% per year of education. Ferrer & Riddell (2002) conclude that the effect of credential increases with educational attainment and accounts for almost 33% of the return to the first 16 years of education and more than 50% of the return to each additional year of education over and above 16 years.

In is important to note that the findings of this research are interpretable as an examination of the variation in post-graduation earnings around these averages. It is likely that the absence of a comparison group of students who did not complete high

school or obtain a post-secondary credential introduces a downward bias in the coefficients of both performance and years of education. Thus, this research yields estimates of the additional earnings premium associated with academic performance over and above high school graduation, acceptance into a post-secondary institution, admission into a credential, completion of a post-secondary degree, and individual, credential and labour market characteristics.

Discussion of Findings

Academic Performance Predicts Earnings and Differentiated by Gender

This research finds that, inclusive and exclusive of contextual effects, academic performance is a statistically significant predictor of post-graduation earnings. Despite the high returns associated with individual, credential, and labour market characteristics, the predictive ability of performance is retained over and above contextual effects in both the basic model and the human capital earnings model. Although the coefficients of return are small, assuming that they exert a cumulative and longitudinal impact over a range of performance outcomes and years of employment, the economic return to academic performance has the potential to account for tens of thousands of dollars of variation in lifetime earnings. The research notes that the returns are sensitive to specific groups, performance measures, and contextual effects. However, on average, the findings support the investment of human effort and financial resources in the improvement of post-secondary academic performance for the purpose of yielding individual, social, and economic returns.

This research finds that when performance in English, mathematics, and student's academic major are collectively entered into a regression with the logarithm of weekly

wages as the dependent variable, in both the basic model and in the human capital earnings model, the coefficients of return to English and mathematics polarize, with a negative coefficient on the return to English and a positive coefficient on the return to mathematics. Adding controls for individual, credential, and labour market characteristics changes the direction of the return on the coefficient of academic major from positive to negative and reduces the magnitude of the negative coefficient of returns to English with one exception. The coefficient on the return to English performance in high unemployment rate occupations is negative for females and positive for males. While no definitive explanation for the polarizations could be found in the data, subsequent analysis support the interpretation that the relationship between the performance in English and academic major and post-graduation earnings is primarily through the relationship between the performance measures and individual, credential, and labour market characteristics, or other unobserved factors that are correlated with individual, credential, and labour market characteristics.

The phenomenon can occur through a variety of avenues. For example, it is well known that, on average, males earn more than females in the labour market. It is also well known that at the secondary level males outperform females on standardized testing in science and mathematics while females outperform males in reading, writing, and verbal skills. The differential performance effects continue beyond high school, post-secondary, and into adulthood. Using data from the *International Adult Literacy Survey*, Willms (1997) finds that females outperform males in prose literacy, males outperform females in quantitative literacy, and there are no gender differences in performance for document literacy.

Thus, negative returns to post-graduation earnings of increased performance in English and academic major are likely the result of employers remunerating graduates with strong skills in English and academic major differentially from graduates with strong mathematics skills through labour market supply and demand effects. For example, the screening or self-selection of a higher proportion of males than females, with historically higher performance levels in mathematics, into jobs with higher mean post-graduation earnings. Differential remuneration practices for skill in English and mathematics based on supply and demand effects is consistent with findings by Krahn & Lowe (1998) who conclude that under employed Canadians outnumber over employed Canadians by about two to one for quantitative literacy, three to one for prose literacy, and four to one for document literacy.

This interpretation has significant policy implications. There is a large body of research that contends that student selection of undergraduate major is not an unrestricted choice as the pipeline of future mathematics and science majors is established long before students enter post-secondary. As cited in Maple & Stage (1991), Berryman (1983) notes, "the quantitative talent pool has emerged by grade nine and is essentially complete by grade twelve. After grade twelve, migration is almost entirely out of, not into, the quantitative pool. Thus the pool from which undergraduate and graduate quantitative degree recipients emerge is essentially formed by the senior year of high school" (p. 40). In this context, if post-secondary academic performance in English and mathematics are consistent predictors of post-graduation earnings across credentials and unemployment rates, and in the presence of individual, credential, and labour market conditions, funding intended to reduce the rising wage inequality might achieve a higher return on investment

and increase social and economic externalities if directed toward improving academic performance at the elementary and secondary levels, where academic performance and credential choice is more amenable to change.

Returns to Performance Stable Across Low and High Return Credentials and Vary Across Low and High Unemployment Rates

This research finds that the return to academic performance is stable across low and high return credential groups and varies across low and high unemployment rates. For males and females in low and high return credentials, the economic return to academic performance in mathematics and academic major is retained in the presence of individual, credential, and labour market characteristics. The economic return to performance in English is weak and non-significant for both groups. However, in low and high unemployment rate occupations, the return to academic performance in mathematics is strong and statistically significant for males and non-significant for females. The return to academic performance in English and academic major is strong, statistically significant, and sensitive to unemployment rate and gender effects.

One possible explanation for the dispersion is that competitive admission protocols in conjunction with rising post-secondary participation rates and historical differential performance effects between males and females is resulting in a higher proportion of males, who traditionally outperform females in mathematics, being screened or self-selected into high return credentials and low unemployment rate occupations with high mean post-graduation earnings. Similarly, the phenomenon would lead to a higher proportion of females, who traditionally outperform males in English, being screened or self-selected into low return credentials and high unemployment rates occupations with

low mean post-graduation earnings. This interpretation is consistent with findings by Grogger & Eide (1995) who conclude that there is a change in the distribution of males across college majors away from low skilled subjects toward highly skilled fields of study. The researchers conclude that the change accounts for 25% of the higher returns to additional years of education for males.

A second possible explanation for gender based differential returns is that equitable hiring practices in conjunction with labour market supply and demand effects has created an oversupply of males in low unemployment rate occupations that is leading to further sorting of potential employees from this group based upon performance in mathematics and English. For example, if the predicted wage for a credential that is oversupplied by males is too high to clear the market, a high performing male with a high unemployment rate credential might take a job that yields a lower wage. The phenomenon would be manifested in a decline in the return to credential effects and an increase in the return to performance effects and result, in the long run, in a decline in the coefficient in the average return to credentials and an increase in the coefficient in the average return to performance for this group. High returns to credential effects and low returns to academic performance for females in conjunction with low returns to credential effects and high returns to academic performance for males is consistent with current Canadian research by Charette & Meng (1998) and Osberg (2000) who conclude that females are accruing higher returns to years of education and credential effects and males are accruing higher returns to performance effects. The interpretation is also consistent with findings emerging from the United States that conclude that the rising return to education is the

result of rising returns to performance sorting variables (Blackburn & Neumark, 1993; Murnane, Willett & Levy, 1995, Taber, 2001).

The phenomenon poses critical challenges for individuals, institutions, and governments because of its potential to erode individual returns and provincial and national externalities. The challenges are particularly acute in view of two current lines of research that conclude that a large proportion of the population is overeducated and that underutilized skills atrophy over time. According to the Organisation for Economic Cooperation and Development (1995), "Formal education provides only the raw material for adult literacy. The evidence shows that the lack of application of literacy in daily life is associated with lower levels of performance" (p. 116).

Khran & Bowlby (1999) speculate that declining performance effects arises because some employability skills required by employers are not widely taught in university programs and that graduates simply do not have the opportunity to use all of their employment-related skills. The phenomenon is not exclusive to Canada. In a study of Spanish vocational school graduates, Green, McIntosh & Vignoles (1999), find evidence that over-education and over-skilling have a negative effect on wages. Similar to Khran & Bowlby, the researchers speculate that the decline is largely the result of overeducated employees becoming less productive as a result of being underutilized by employers. In the United Kingdom, Allen & Van de Velden (2001) conclude that over-education has a negative effect on wages. In this context, it may be that funding directed toward increasing academic performance might achieve higher social and economic returns if coordinated with evolving labour market supply and demand effects. The just in time delivery of skills to the labour market appears likely to yield higher social and economic

returns. However, the early delivery of skills appears equally as likely to depreciate before the investment has had the opportunity to yield social and economic externalities.

Statistical Modelling

A key point of this research was not to determine whether performance characteristics, individual characteristics, credential characteristics, or labour market characteristics were more important in explaining the variation in post-graduation earnings, but rather to determine if there was a statistically significant earnings premium associated with performance that could not be explained by the contextual effects. In the presence of each other, and in the absence of contextual effects, academic performance in English, mathematics, and student's academic major explain 4.6% of the variance in post-graduation earnings. In the most complete model, incorporating controls for individual, credential, and labour market characteristics, performance explains between 0.8 and 8.1% of the wage variance.

This research also attempted to advance the knowledge base on the interrelationships among performance, individual, credential, and labour market characteristics by presenting and estimating a simple model. Overall, by using information on individual characteristics (gender, years of education, years of work experience), credential characteristics (obtained credential, degree level, low or high return credential), labour market characteristics (occupation- and degree- level unemployment rate, province of residency, relationship between post-secondary credential and employment), and performance characteristics (average course grade performance in English, mathematics and student's academic major), the most complete model reduces errors of prediction by 33% for males and 44% for females. In the basic model, without differentiating by gender,

individual characteristics account for 14.8% of the wage variance, credential characteristics increase the explanatory power of the model 12.6%, labour market characteristics add 13.5%, and performance effects add a further 1.5%. The model should be regarded as a starting point and suggests that, whenever possible, individual, credential, and labour market characteristics should be included in empirical studies of post-graduation earnings.

This research also finds that, in contrast to previous studies that include measures of unobserved ability in the Mincer (1974) human capital earnings function, including post-secondary course grade performance has no substantial impact on the coefficients of years of education or years of work experience. The finding suggests that performance, as operationalized in this research, is a key determinant of post-graduation earnings that has low multicollinearity and little net effect on years of education and years of work experience, and that the economic return to performance and years of education are mutually exclusive determinants of post-graduation earnings. Thus, each additional year of education does not influence a student's level of academic performance, and each additional increment in academic performance does not influence a student's ability to acquire additional years of education.

Finally, this research finds that using an ordinary least squares approach over a two-stage least squares approach introduces a downwards bias into the coefficient of years of education. However, due to homogeneity in this variable among post-secondary graduates the method is likely to yield accurate estimates when used in a prediction model of the economic return to post-graduation earnings. The research also finds that socio-economic status is an exogenous determinant of academic performance.

Conclusions

Five key conclusions arise from this research. First, the economic return to academic performance is a function of performance measure, gender, low and high return credential grouping, and occupational unemployment rate. Second, despite the high average wage premium associated with the acquisition of a post-secondary degree over high school graduation, there are differences in post-graduation earnings across graduates according to academic performance, individual, credential, and labour market characteristics. Third, there is no evidence that efforts to improve academic performance diminish the economic return to years of education and years of work experience. However, there is evidence to suggest that the return to years of education and work experience is attenuated by individual, credential, and labour market characteristics. Fourth, investment of human efforts and financial resources by students, institutions, and governments in the improvement of post-secondary academic performance appear likely to yield an economic return in the form of enhanced individual earnings and provincial and national externalities. Finally, this research provides support for a specification in which post-graduation earnings are concomitantly determined by labour market segmentation theory (individual characteristics), credential theory (credential characteristics), and achievement theory (performance characteristics).

Consider the case of high performing students who do not focus their efforts on academic performance, perhaps because they are from disadvantaged backgrounds and need to work to finance their post-secondary education, or perhaps because they come from a family background in which the importance of academic performance was not emphasized. For these students, tax, tuition, and student loans policies that offset the need

to work and provide an incentive to increase academic performance can optimize private incentives with social optimality, narrow the earnings gap between disadvantaged and advantaged students, and increase social and economic externalities.

Next, take the case of the average graduate male. For this group of students, the span around a one standard deviation change in academic performance in mathematics is 20.2%, the range around two standard deviations is 40.2%. In financial terms, a one standard deviation above the mean increase in average course grade performance in mathematics is estimated to be worth an additional $4,160 in annual earnings approximately eighteen months after graduation. Two standard deviations are estimated at an additional $8,320 annually. Furthermore, for males, the marginal return to increased academic performance in mathematics exceeds the return to an additional year of work experience. Therefore, policies that encourage males to advance through their post-secondary programs as quickly as possible while maintaining or improving academic performance in mathematics, appear likely to yield higher individual, social, and economic returns.

Finally, consider the case of the average graduate female. For this group of students, each additional year of education is estimated to be worth an additional 6.4% in post-graduation earnings while performance effects are non-significant. For females, the well-defined and positive return to credential effects, years of education and work experience, in conjunction with low and non-significant returns to academic performance, suggests that females interested in maximizing the economic return to their post-secondary education should consider first the economic consequences of their credential choice.

However, this does not imply that females should discard efforts to increase academic performance. Mathematics performance is a statistically significant predictor of earnings for females in both low and high return credential groups. It is also possible that growth in the supply of females with a university credential will make the labour market more competitive for this group and that the premium for years of education will decrease in tandem with a rise in the return to academic performance. The trend toward homogeneity in the returns to education across genders, and more specifically in the premium for a university education over high school completion has been noted by Easton (2002). Furthermore, it is also possible that early post-secondary academic performance influences a female's ability to enter a high return credential or low unemployment rate occupation that leads to higher post-graduation earnings. It is also possible that academic performance has an economic return at a point later than eighteen months after graduation. Nevertheless, policies that encourage females to offset the cost of their post-secondary experience through employment appear likely to yield higher individual returns and social and national externalities in the form of reduced debt and higher returns to years of education.

This research also concludes that there is substantial variation around the average return to academic performance according to factors such as gender, credential, and unemployment rate. The research notes that there is an element of risk attached to investments in higher education that is greater for those credentials associated with relatively low unemployment rates, or credentials that are the most likely candidates for differential fees. Previous research has demonstrated that the ranking of degree subjects in terms of their estimated effects on graduates' earnings are stable over time (Naylor, Smith

& McKnight, 2000), and that there is wide variation in post-graduation earnings within credentials (Boothby, 2002). Therefore, policy changes that increase tuition fees for credentials with high mean post-graduation earnings and significant intra-credential variation dependent on performance may disproportionately deter participation from high performing students from low socio-economic backgrounds, increase participation from low performing students from high socio-economic backgrounds, and have an adverse impact on the quality of the students admitted to these credentials. Under these circumstances, differential tuition fees, student loan programs, and tax incentives that are positively scaled to unemployment rates and negatively scaled to performance appear likely to yield individual, social, and economic returns and foster inter-generational mobility and equality of opportunity.

In closing, preparing students to participate effectively in the labour market is an important outcome of a post-secondary education. However, it is only one of many rationales for pursuing a post-secondary degree. There is more that informs a student's decision about which credential to pursue or how high to set performance targets than the prospect of future earnings. There are also a variety of non-pecuniary returns to academic performance that are not captured by this research. In this context, by focusing exclusively on the economic return to performance, this research understates the many direct and indirect social and economic benefits of a better-educated individual and a better-educated society such as reduced crime, improved health, and improved social functioning. Nevertheless, when making informed decisions on the investment of human efforts and financial resources in a post-secondary education it is important to consider the individual

returns and positive externalities that accrue from improved post-secondary academic performance.

Potential for Future Research

Given that the effect of academic performance on post-graduation earnings is quantitatively and statistically significant, varies across genders, is stable across low and high return credential groups, varies across low and high unemployment rates, and is retained in the presence of a variety of contextual effects, this research posits that the economic return to education and the post-graduation wage structure is more complex than suggested by most current estimates of graduate first destination outcomes. The research speculates that recent changes to the wage structure are likely to be impacted by this complexity and that more precise mapping of the variance in post-graduation earnings as it relates to performance, individual, credential, and labour market characteristics is warranted to identify, clarify, and reconcile the variety of potential relationships.

The research findings point to a need to ensure that attempts to improve post-secondary academic performance do not effectively erode returns to other post-secondary outcomes, that the returns to performance are stable across time, and that the magnitude of the returns are sufficient to make it viable to warrant a change in policy directions and investment priorities. This requires an examination of the stability of the returns across institutions, years, provinces, and nations.

Second, research spanning multiple institutions in multiple provinces across multiple levels of education is also recommended to take into account regional and national differences in the returns to performance, and differences across the various levels of education. Riddell (2001) notes substantial variation across provinces in

performance outcomes at the elementary and secondary level. For example, Quebec ranks on the high end in terms of mathematics performance, Alberta ranks neat the top in terms of science performance, and Ontario falls below the Canadian average in both mathematics and science performance. This variation provides a natural source from which to assess provincial and national social and economic externalities that accrue from efforts to improve academic performance to inform provincial and national public policy making.

In this respect, in depth, cross-sectional, and longitudinal analysis on datasets constructed on national level data can significantly advance the current understanding of the linkage between academic performance and earnings, both in relative and absolute terms, so that the conclusions of the current research can be substantiated, validated, fully contextualized, and generalized. Such databases may be compiled utilizing a representative sample from the *National Graduates Survey*, *Survey of Labour and Income Dynamics, International Adult Literacy Survey, Survey of Literacy Skills Used in Daily Activities*, *Survey of Consumer Finances*, and longitudinal provincial and national graduate follow-up surveys, each containing an abundance of information on years of education, education attainment, obtained credential, job characteristics, and family background. The Census questionnaire also collects information about diplomas, certificates and degrees obtained, as well as years of completed education. This data can be matched to individual-level post-secondary academic performance data and labour market data from Statistics Canada.

Third, longitudinal and time-series analysis on cohorts of graduates in differential credentials and labour markets is warranted to confirm or deny the diversity of inter-

unemployment rate and inter-credential returns and build the knowledge base in this area. The research notes that credential and labour market characteristics are critical factors that attenuate the economic return to academic performance. Therefore, it is important to determine if shifts occur within the same credential and unemployment rate over low and high-unemployment rate periods and how those returns vary over time. For example, it is possible that earnings growth varies substantially by credential, with some credentials enjoying initial above average post-graduation earnings coupled with below average earnings growth, and others experiencing below average initial post-graduation earnings in conjunction with above average earnings growth.

Fourth, and possibly as a direct result of a lack of empirical evidence on the effect of academic performance on post-graduation earnings, there is a void in the knowledge base on the influence of family background, high school performance, and satisfaction characteristics on post-graduate earnings through their impact on performance and credential. A variety of research has found earnings differences across individuals according to pre-entry qualifications and characteristics (Naylor, Smith, & McKnight, 2000). The current study also notes that socio-economic status is an exogenous determinant of post-secondary academic performance. It would be worthwhile to analyze the effects on post-graduation earnings of interactions between social, school, and family background characteristics and academic performance to inform the knowledge base in this area.

Sixth, previous studies have shown that the largest source of heterogeneity in post-graduation earnings is within, rather than between, credentials (Boothby, 2000). The findings suggest that there are other factors that operate within credential effects to

determine post-graduation earnings. One possible explanation is that growing post-secondary participation rates are changing the structure of the Canadian labour market and enabling employers to make finer distinctions among potential employees first on the basis of credential, and second, on the basis of performance within a credential. Longitudinal, cross-sectional, and hierarchical analysis to explore the returns to performance and how the returns are nested within credential effects could confirm or deny inter-credential diversity in the return to performance and its logical extension that rising returns to education are through rising returns to performance within a credential.

Finally, extending the current analysis to control for pre-entry high school English, mathematics, and overall performance would inform the research in this area and provide comparative information on the relationship between targeted efforts to improve academic performance at the high school and post-secondary level and labour market outcomes. This analysis would be relatively inexpensive to undertake, as this information is currently available in the dataset for recent graduates who entered university from high schools in the province in which the analysis was undertaken. Preliminary analysis on the dataset shows that overall high school performance is a weak and non-significant predictor of post-graduation earnings ($R^2 = .01$, $F = .70$, $n = 871$). However, the analysis was not extended to subsets of courses or contextual effects and the limitation might obscure the return to performance in specific skills. This analysis could be extended further to examine if students who perform well in English and mathematics are more likely to graduate from high return credentials or low unemployment rate occupations as opposed to students who perform less well in these subject areas.

Notwithstanding the above, this research provides insight into how the economic return to academic performance varies with, and in the presence of, individual, credential, and labour market characteristics. The research confirms that the range of potentially relevant variables that effect post-graduation earnings goes well beyond years of education and work experience, and supports the need for further empirical research on the linkage between academic performance and post-graduation earnings in the presence of individual, credential, and labour market characteristics, and its relationship to the rising wage inequality, changing return to skill, and evolving wage structure.

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Appendix A – Instrument (Career Search 2002 Survey)

1. According to records provided for this survey, you graduated in 2000?

   From: _____

   IS THIS CORRECT? YES NO

   Received a degree/diploma/certificate in: _____

   with majors in: _____
   _____
   _____

   with minors in: _____
   _____

2. Did your program include co-op placements or employment internships in outside organizations as part of its course of study?

   YES NO

   (b) Were any of your work placements paid positions?

   YES NO

3. In what month and year did you begin your program?

   MONTH: _____ YEAR: _____

4. In what month and year did you actually complete the requirements for your degree/diploma/certificate? That is, when did you write the last exam - submit the last paper or defend your thesis - not the date when you actually received your degree, diploma or certificate?

   MONTH: _____ YEAR: _____

5. If you had your time back, which ONE of the following options would you select? (PICK ONE ONLY) (READ OUT LIST)

   1 The same program at the same institution
   2 A different program at the same institution (Specify below)
   3 No post-secondary program
   4 The same program at a different institution
   5 A different program at a different institution (Specify below)
   6 Other (Specify) _____

6. Was the program from which you graduated your first choice for a post-secondary program?

   YES NO

(b) What was the MAIN reason why you were not able to do your first program of choice?
(PICK ONE ONLY) (READ OUT LIST)

1 Program was not offered in this location
2 Did not have the prerequisites for program
3 Program was filled
4 Waiting list was too long
5 Other (Specify) _____

7. Have you taken further studies since graduating from this program?

YES NO

(b) Regarding these further studies, did you attend:
(READ OUT OPTIONS)

1 Full-time
2 Part-time

Name of Institution: _____
Campus Location: _____
Program Name: _____

(c) Why did you take these further studies?
(PICK ALL THAT APPLY) (READ OUT LIST)

1 Your job required further training
2 To upgrade qualifications in present field
3 Could not find a job related to your training
4 Personal interest
5 To enrol in apprenticeship program
6 To pursue purely academic interests
7 Could not find any job
8 Other (Specify) _____

Now we want to ask a few questions about your activities before you actually started to work towards your degree/diploma/certificate...

8. Before you enrolled in your program, what other levels of education had you completed?
(PICK ALL THAT APPLY) (DO NOT READ OUT LIST)

1 Grade 9 or Less
2 Some high school but did not graduate
3 Adult Basic Education Diploma
4 General Education Diploma
5 Completed high school
6 Partial completion of public/private college diploma/certificate
7 Completed public/private college diploma/certificate
8 Some previous university experience
9 University Diploma/certificate below bachelor level
10 Bachelor degree (BA, BSc, 4-year BEd)
11 Diploma/certificate above bachelor level
12 Professional degree (MD, DDS, DMD, DVM, Law, OD, MDiv or 1-yr>bachelor's)
13 Master's degree (MA, MSc, MEd)
14 Doctorate (PhD, DSc, DEd)
15 Other (Specify) _____

9. Upon entering this program how knowledgeable were you about the opportunity for employment in this field? (READ OUT LIST)

   1 Very
   2 Somewhat
   3 Not at all

10. How strongly did employment opportunities influence your choice of occupation?

   1 Very Strong
   2 Strong
   3 Somewhat Strong
   4 Not At All

In the next series of questions, we would like to have you use a 4-point scale to indicate how satisfied you are with the educational program you completed. On this scale, a '1' is 'Very Satisfied', '2' is 'Somewhat Satisfied', '3' 'Somewhat Dissatisfied' and '4' 'Very Dissatisfied'. You may also indicate that the question is not applicable. [NOTE: '5' 'NOT APPLICABLE']

11. When you consider the education program you completed how satisfied are you NOW with:

___ The overall quality of the program
___ The overall quality of the teaching/instruction
___ The opportunity to access the program (when you wanted to access it/them)
___ The opportunity to access the courses (when you wanted to access it/them)
___ The content of the material covered by the program/courses
___ The level of technology available to the students
___ The instructional facilities in the educational institution you attended (e.g. labs, libraries, etc.)
___ That your program was worth the financial investment required
___ That your program was worth the personal investment of time required for classes and study
___ The adequacy of financial assistance programs to cover your basic educational & living expenses
___ The overall cost of the program (tuition, books, etc.)
___ The student facilities in the educational institution you attended (study space, library, cafeteria, etc.)
___ The extent to which the program provided you with the skills you needed for related employment
___ The class sizes for courses in your field of study
___ The methods by which your work was assessed/graded

Ask the next question to co-op students only.

___ The extent to which your co-op work experience prepared you for work in your chosen field

Now we want to turn to some questions about your employment experiences from January 2001 to December 2001.

12. First of all, we would like to get an indication of what you have been doing for each month since January 2001

Example: For most of April, 2000 I worked full-time in a job related to my training and I attended school part-time. This answer is reflected by the checked boxes in the shaded column labeled example.

For MOST of that month; *example*

Activities	Dec 2000	Jan 2001	Feb 2001	Mar 2001	Apr 2001	May 2001	June 2001	July 2001	Aug 2001	Sept 2001	Oct 2001	Nov 2001	Dec 2001
I was employed fulltime in a job related to my training.	✓												
I was employed full-time in a job unrelated to my training.													
I attended school full-time.													
I was employed part-time in a job.													
I looked for work but could not find any.													
I WAS NOT EMPLOYED,NOT A FULL-TIME STUDENT AND NOT LOOKING FOR WORK (in other words, the person was out of the labour market for some reason)													

(b) If at any time from January 2001 to December 2001, you were NOT EMPLOYED, NOT A FULL-TIME STUDENT AND NOT LOOKING FOR WORK, why?

1 Temporary layoff
2 Maintained Household
3 Wasn't Interested in Working
4 Other (Specify) _____

13. How many different EMPLOYERS have you had SINCE COMPLETING THIS PROGRAM? If you have been self-employed, please include yourself as one employer.

NO. EMPLOYERS _____

14. How many months did it take you to find your FIRST job upon graduation from this program? (PICK ONE ONLY)

MONTHS: _____

RESPONDENT had a job before completing program: _____

RESPONDENT was on leave from a job or continued working in the job while completing the program: _____

15. Do you usually work 30 or more hours a week at this job?

YES NO

If NO, how many hours? HOURS: _____

I now want to ask some questions about your employment activities during the last full week of June, 2001 - that is June 24 - June 30, 2001.

16. During the last week of June 2001 were you:
(READ EACH - PICK ONE ONLY)

    1 Employed, either full-time or part-time
    2 Unemployed
    3 Enrolled in an education or training program (NOTE - IF EMPLOYED AND A STUDENT - ENTER AS EMPLOYED)
    4 Out of labour market due to disability or illness
    5 Retired
    6 Other _____

FOR THOSE EMPLOYED IN REFERENCE WEEK:

17. Were you working for an employer or self-employed?

    1 Working for an employer
    2 Self-employed
    3 Other (specify - e.g. unpaid family worker) _____

18. Was/Is this a temporary, casual, contractual or seasonal position?
(READ OUT LIST)

    1 Permanent
    2 Temporary / Contractual - fixed end date
    3 Casual-employed on an on –call basis
    4 Seasonal

19. In what month and year did you start this job/start self-employment?

    MONTH: _____ YEAR: _____

20. Do you usually work 30 or more hours a week at this job?

    YES NO

21. What kind of work were you doing during the week of June 24-30?

    PROBE - WHAT DO THEY DO EXACTLY? WHAT IS THEIR POSITION?
    WHAT PRODUCT OR SERVICE IS DELIVERED OR PRODUCED?

    Job Title or Position Held: _____
    (E.g. civil engineer, office manager, hairdresser)

    Most Important Duties:
    _____
    _____

22. In what types of business, industry or service were you working?
PROBE - NAME OF COMPANY/ADDR, MANUFACTURING? SELLING? SERVICING? CONSULTING? FIND OUT WHAT THE COMPANY DOES.

Company Name: _____
Type of Business: _____
(E.g. construction company, accounting practice, hair salon, provincial government department)
Street or Postal Box or Route: _____
City/Town: _____
Province: _____
Postal Code: _____

23. Would you say that your job during the week of June 24-30 was directly, indirectly or not at all related to this program of study?
(READ OUT LIST)

1 Directly related
2 Indirectly related
3 Not at all related

If the respondent chose 3, then ask 23 (b)

(b) Nonetheless, would you say that the program you took was good preparation for the job you held in the reference week?

YES NO

24. What were your gross wages for the week of June 24-30, 2001 - the total amo unt paid before taxes and other deductions?

(IF INCOME VARIED PROBE: well, what is your average gross wage per week? (DO NOT RECORD DECIMAL AMOUNTS - ROUND TO NEAREST DOLLAR)

GROSS WAGES: _____

25. What was/is your hourly wage before taxes?
(DO NOT READ LIST)

01	under $6.00	09	$20.01-$22.00
02	$6.01 -$8.00	10	$22.01-$24.00
03	$8.01 -$10.00	11	$24.01-$26.00
04	$10.01-$12.00	12	$26.01-$28.00
05	$12.01-$14.00	13	$28.01-$30.00
06	$14.01-$16.00	14	more than $30.00
07	$16.01-$18.00	15	Commission
08	$18.01-$20.00	16	Other: _____

26. Are you still working for the same employer that you worked for during the reference week?
YES NO

The next series of questions will provide a profile of how graduates have financed their education.

27. Were any of the following used to finance your program?
(READ EACH AND ENTER YES/NO FOR EACH ITEM)

1 Scholarships or bursaries
2 Assistance or grants from employers or the government other than any student loans
3 Workers' compensation
4 Government student loans
5 Other types of loans (i.e. Families, Employers, Banks, Credit Unions)
6 Work-term employment
7 Employment during the school year (not work-term)
8 Employment during the summer months (not work term)
9 HRDC/UIC/EI/TAGS/Manpower
10 Social Assistance
11 Parents
12 Native Band Association
13 Personal Savings (RESP, etc.)
14 Other: _____

What was your MAIN source of funds to support your education?

SOURCE: _____

28. (a) Altogether, how much did you borrow through government student loans?

AMOUNT: _____

(b) Approximately how much of this amount was borrowed for the program being reported on in this interview? (In dollars)

AMOUNT: _____

(c) How much of your government student loans (in dollars) do you have left to be paid back?

AMOUNT: _____

In the next series of questions, we would like to have you use a 4-point scale to indicate how satisfied you are with the educational program you completed. On this scale, a '1' is 'Very Satisfied', '2' is 'Somewhat Satisfied', '3' 'Somewhat Dissatisfied' and '4' 'Very Dissatisfied'. You may also indicate that the question is not applicable. [NOTE: '5' 'NOT APPLICABLE']

29. (a) How satisfied are you with the overall quality of service provided by the bank/ service provider?

(b) How satisfied are you with the overall quality of service provided by Student Aid?

(c) How satisfied are you with the overall quality of service provided by the federal government?

30. From which sources did you borrow money to finance your education other than government student loans? (READ EACH AND ENTER Y OR N FOR EACH ITEM)

    1 Family
    2 Employers
    3 Financial institutions such as banks or credit unions
    4 Any other sources? Specify: _____

(b) Altogether, how much (in dollars) did you borrow from these sources?

AMOUNT: _____

(c) How much, in total, do you now owe on these loans?

AMOUNT: _____

31.

a) TOTAL GOVERNMENT LOANS	_____$
b) TOTAL OTHER LOANS	_____$
c) TOTAL BORROWED	_____$
d) TOTAL GOVERNMENT LOANS OWING	_____$
e) TOTAL OTHER LOANS OWING	_____$
f) TOTAL DEBT OUTSTANDING	_____$

According to the information you provided you borrowed a total amount of _____. You currently owe _____. And for the program reported on this interview, you borrowed $ _____ in government student loans? Is this correct?

YES NO

Now, just before we end ... a few questions about you so that we can compare the experiences of different groups of graduates...again no personal information will ever be reported.

32. In what year were you born?

YEAR _____

33. Are you currently single, married, separated, divorced or widowed?

    1 Single/never married
    2 Married or living common-law
    3 Separated or divorced
    4 A widow or widower

34. Do you have any children financially dependent on you?

YES NO

35. What is the highest level of education completed by your father (or male legal guardian)?
(DO NOT READ LIST)

1 Grade 9 or less
2 Some secondary but did not graduate
3 Completed secondary/technical high school
4 Some community college
5 Completed community college
6 Some university
7 Diploma/certificate below bachelor level (inc CEGEP)
8 Bachelor degree (BA, BSc, 4-year BEd)
9 Diploma/certificate above bachelor level
10 Professional degree MD, DDS, DMD, DVM, Law, OD, MDIV OR 1-yr > bachelor's
11 Master's degree (MA, MSc, MEd)
12 Earned doctorate (PhD, DSc, DEd)
13 Other (Specify) _____

36. What is the highest level of education completed by your mother (or female legal guardian)?
(DO NOT READ LIST)

1 Grade 9 or less
2 Some secondary but did not graduate
3 Completed secondary/technical high school
4 Some community college
5 Completed community college
6 Some university
7 Diploma/certificate below bachelor level (inc CEGEP)
8 Bachelor degree (BA, BSc, 4-year BEd)
9 Diploma/certificate above bachelor level
10 Professional degree MD, DDS, DMD, DVM, Law, OD, MDIV OR 1-yr > bachelor's
11 Master's degree (MA, MSc, MEd)
12 Earned doctorate (PhD, DSc, DEd)
13 Other (Specify) _____

37. Since completing your program have you received...
(READ EACH AND ENTER YES/NO FOR EACH ITEM)

1 income from employment
2 income from self-employment
3 income from investments
4 income from a pension
5 payments through social assistance
6 payments through UIC (OR EI)

38. This question only applies to graduates who have been working full-time in the labour force prior to graduation and who have returned to a postsecondary institution to upgrade their skills and/or qualifications. An example of this may be: A person who has been working for a number of years at accounting but did not have a certificate or diploma and has decided to take educational leave to return to college to complete the requirements needed to graduate.

Do you consider yourself to be in this category?

YES NO

39. The last item we have to do in this survey is to collect up-to-date contact information in case there are other follow-up surveys on the people who received their diplomas/certificates in 2000.

    Just to make sure that we have the most recent information, and to make sure that our records are correct, could I have your current telephone number, beginning with the area code?

    Telephone Number: _____

    And may I have the address for your current residence.

    Street or Postal Box or Route: _____
    City/Town: _____
    Province: _____
    Postal Code: _____

    Is this address the same as your permanent residence?

    YES NO

    And may I have your permanent residence

    Street or Postal Box or Route: _____
    City/Town: _____
    Province: _____
    Postal Code: _____

40. We would like to contact employers to find out their views on how well our post-secondary programs fit with their needs. WE ARE NOT INTERESTED IN EVALUATING YOU PERSONALLY. RATHER , WE ARE INTERESTED IN EVALUATING THE TRAINING YOU RECEIVED . Is it ok with you if we contact this employer?

    YES NO

    If YES, what was the name of your employer?

    NAME: _____

That's all the questions we have. Thanks very much for your time. We really appreciate your help.

Respondent's Gender: _____

POST INTERVIEW COMMENTS:

Appendix B – Career Search 2002 Survey Methodology

The information in this report was derived from the Department of Youth Services and Post-Secondary Education's follow-up survey of those who graduated from Memorial University of Newfoundland in the academic year 1999-2000. Memorial University was asked to provide and confirm lists of graduates with telephone numbers to be used by interviewers in contacting graduates. An attempt was also made to find missing phone numbers by cross-referencing students' names with other data available from the Department of Youth Services and Post-Secondary Education. The overall objective was to obtain a list of graduates as complete as possible to ensure the survey was representative of the graduate population. A computer-assisted telephone interviewing system was used in the administration of the surveys. Employed interviewers called and surveyed all graduates entered in the system whether they were living in the province or not with instructions to pursue graduates with up to ten calls at the listed telephone number or at numbers provided by parents, roommates, or other people contacted during the process. This strategy was intended to enable the reporting of detailed information at all levels of aggregation including the individual program level and to ensure the best possible representation of the 1999-2000 post-secondary graduates' experience. The survey was conducted from February to May of 2002.

Appendix C – Permission and Consent Form

INFORMATION REQUEST FORM

Part I
Requester Information

Name: Stephanie Dalton

Organization: Faculty of Education (Student)
Memorial University of Newfoundland

Address: St. John's, NL, AIC 5S7

Phone: Fax:

Data Required

a) Data requested: Graduate Follow-Up Survey (Memorial University and Marine Institute Graduates).

b) Years requested: 1998 & 2000

Purposes for which data are being requested (describe briefly)

Purpose: To undertake thesis work in the area of labour market transitions.

Part II
Agreement

I, Stephanie Dalton, under the supervision of Dr. Robert Crocker, Memorial University of Newfoundland, hereby agree to the following conditions in relation to the release of data from the Department of Youth Services & Post Secondary Education.

- Access to the data will be restricted to the above mentioned and for the purpose(s) for which it was requested;
- Security is established to ensure there is no unauthorized access to the data;
- Data will be destroyed upon completion of the project;
- Subsequent disclosure of information obtained from the data will protect the confidentiality of the individuals, will be in aggregate form, and will not contain individual identifiers.

June 10, 2003
Date

June 10, 2003
Date

June 12, 2003
Date