1

MICROD

TABLE OF CONTENTS

Abstract	i
Acknowledgements	iii
Table of Contents	iv
List of Tables	vi
List of Figures	
 CHAPTER ONE - INTRODUCTION	 1
 CHAPTER TWO - THE EARNINGS OF IMMIGRANT AND NATIVE-BORN	
CANADIAN MALES	9
Introduction	10
Hypotheses and Estimating Procedures	14
The Dual Selection Process	14
Model	16
Hypotheses	18
Data-Base	24
The Earnings of Native and Foreign-Born Canadians	25
Means	25
Pooled Regressions	25
Native and Foreign-Born Regressions	28
Decomposing the Earnings Gap	35
County of Origin	37
Estimates Using Mincer's Identity	42
The Extended Model	42
The Simplified Model	46
Mincer's Identity and Experience	55
Summary and Conclusions	62
Footnotes	67
References	72
 CHAPTER THREE - COMPENSATING WAGE DIFFERENTIALS IN THE	
CANADIAN LABOUR MARKET	75
Introduction	76
Compensating Wage Differentials: Theory and	
Evidence	78
The Determinants of Individual Incomes	78
Testing for Compensating Wage Differentials	
Using Labour Market Data	88
Other Approaches to Valuing-Risk	103
Earnings Functions	104
Data	104
Sample Selection and Variables	109
Means	116
Earnings Regressions	119
Earnings of Women	135
Comparisons With Other Studies	135

THREE ESSAYS IN LABOUR ECONOMICS

by

Ronald A. Meng, B.Sc., M.A.

A thesis submitted to
the Faculty of Graduate Studies and Research
in partial fulfilment of
the requirements for the degree of
Doctor of Philosophy

Department of Economics

Carleton University

Ottawa, Ontario

February 1987

© copyright

1987, Ronald A. Meng

Permission has been granted to the National Library of Canada to microfilm this thesis and to lend or sell copies of the film.

The author (copyright owner) has reserved other publication rights; and neither the thesis nor extensive extracts from it may be printed or otherwise reproduced without his/her written permission.

L'autorisation a été accordée à la Bibliothèque nationale du Canada de microfilmer cette thèse et de prêter ou de vendre des exemplaires du film.

L'auteur (titulaire du droit d'auteur) se réserve les autres droits de publication; ni la thèse ni de longs extraits de celle-ci ne doivent être imprimés ou autrement reproduits sans son autorisation écrite.

ISBN 0-315-39353-X

The undersigned hereby recommend to
The Faculty of Graduate Studies and Research
acceptance of the thesis,
"Three Essays in Labour Economics"

submitted by

Ronald A. Meng, B.Sc., M.A.

in partial fulfilment of the requirements
for the degree of Doctor of Philosophy.

Douglas A. Smith

.....
Chairman, Department of Economics

Douglas A. Smith

.....
Thesis Supervisor

[Signature]

.....
External Examiner

Carleton University

August 10, 1987

ABSTRACT

Earnings differences between individuals have interested economists for many years. This thesis is composed of three essays and each essay examines the differences in annual earnings for various groups in Canadian society.

The question of restricting or expanding the number of immigrants entering Canada has always been a controversial one. Little is known about the earnings of the foreign-born population in relation to native-born earnings. The first essay of this thesis examines the economic status of immigrant Canadians. I also examine a number of hypotheses concerning the effects of foreign-birth, the length of time spent in Canada and their relationship to the earnings of native-born Canadians. The results indicate that in general immigrants have greater annual earnings than native-born Canadians after a number of years in the country and that their overall yearly earnings exceed the latter's by approximately fourteen percent.

The second essay deals with job hazards and their impact on workers' incomes. Recently there has been a growing body of literature that has argued that occupations that have higher worker fatality rates than other occupations pay some form of wage premium.

This study finds that non-fatal job characteristics have only a minimal impact on individual incomes. However, more serious occupational hazards have a very significant impact on earnings. When included in a hedonic earnings function the coefficient for the occupational fatality rate is statistically significant.

The final essay deals with the earnings of married women in Canada.

11
The central issue is whether, and to what extent, women's current market earnings are affected by previous withdrawals from the labour market.

One factor that may explain the relatively low earnings of women is that women exit and re-enter the market frequently. If multiple exits and entries do influence earnings the earnings gap between the sexes will be primarily a function of women's life-cycle investment patterns in human capital.

The results presented here give little support for this hypothesis. Absence from the market has only a marginal effect on women's earnings in the long run. Although the loss in income due to the depreciation of skills is significant upon re-entering the market these short run patterns do not exist over the longer term.

Acknowledgements

Throughout the course of this thesis I found that all three members of my thesis board were extremely helpful. I would therefore like to thank Felice Martinello, Nick Rowe and especially Doug Smith for their comments. I am also grateful to Ken Innes, Wendy Watkins and Bruce Winer. They helped to solve many of the computing problems I experienced in the course of doing my empirical work. Last, but not least, I wish to thank my wife, Mia Margaret Kerr. She had to put up with numerous inconveniences and difficulties while I was doing my research. It is to her that this thesis is dedicated.

TABLE OF CONTENTS

Abstract	i
Acknowledgements	iii
Table of Contents	iv
List of Tables	vi
List of Figures	
 CHAPTER ONE - INTRODUCTION	 1
 CHAPTER TWO - THE EARNINGS OF IMMIGRANT AND NATIVE-BORN	
CANADIAN MALES	9
Introduction	10
Hypotheses and Estimating Procedures	14
The Dual Selection Process	14
Model	16
Hypotheses	18
Data-Base	24
The Earnings of Native and Foreign-Born Canadians	25
Means	25
Pooled Regressions	25
Native and Foreign-Born Regressions	28
Decomposing the Earnings Gap	35
Country of Origin	37
Estimates Using Mincer's Identity	42
The Extended Model	42
The Simplified Model	46
Mincer's Identity and Experience	55
Summary and Conclusions	62
Footnotes	67
References	72
 CHAPTER THREE - COMPENSATING WAGE DIFFERENTIALS IN THE	
CANADIAN LABOUR MARKET	75
Introduction	76
Compensating Wage Differentials: Theory and	
Evidence	78
The Determinants of Individual Incomes	78
Testing for Compensating Wage Differentials	
Using Labour Market Data	88
Other Approaches to Valuing Risk	103
Earnings Functions	104
Data	104
Sample Selection and Variables	109
Means	116
Earnings Regressions	119
Earnings of Women	135
Comparisons With Other Studies	135

Conclusions	139
Footnotes	141
References	144

CHAPTER FOUR - INTERRUPTED WORK CAREERS, THE DEPRECIATION
OF HUMAN CAPITAL AND THE EARNINGS OF MARRIED WOMEN .....

Introduction	147
Theory, Hypotheses and Existing Literature	148
Earnings Functions	152
Hypotheses	154
Previous Literature on the Earnings of Women	158
Canadian Contributions to the Literature	161
Empirical Results	162
Data and Sample	162
Sample Specification	164
Earnings Regressions	165
Sample Selection Bias	192
Male-Female Differences in Earnings	204
Conclusions	213
Footnotes	217
References	220

LIST OF TABLES

TABLE	DESCRIPTION	PAGE
CHAPTER TWO		
1	Schooling and Earnings of Adult Men	11
2	Variables	20
3	Means	26
4	Pooled Regression Results	27
5	Separate Regression Results	30
6	Education of the Foreign-Born	39
7	Means Tabulated by Place of Birth	40
8	Pooled Regressions by Country of Origin	41
9	Separate Regressions Using Mincer's Identity	44
10	Pooled Regressions Using Mincer's Identity (Small Sample)	47
11	Separate Regressions Using Mincer's Identity (Small Sample)	49
12	Pooled Regressions Using Mincer's Identity (Extended Sample)	52
13	Separate Regressions Using Mincer's Identity (Extended Sample)	56
14	Mincer's Identity and Experience	58
CHAPTER THREE		
1	Empirical Studies Incorporating Fatalities	95
2	Estimated Differentials for Selected Job Characteristics	99
3	Variables	106
4	Expected Impact on Earnings	112
5	Means of Male Workers	117
6	Earnings of All Male Workers	121

7	Earnings of Male Blue-Collar and Service Workers	124
8	Earnings of White-Collar Workers	127
9	Earnings of Women -	130

CHAPTER FOUR

1	Average Hourly Earnings of Women and by Educational Attainment	149
2	Work Histories of Married Women	155
3	Variables	166
4	Earnings of Women (25-44) Spouse Present With Children	168
5	Earnings of Women (25-44) Spouse Present	170
6	Earnings of Women (18-64) Spouse Present With Children	173
7	Earnings of Women (18-64) Spouse Present	175
8	Earnings of Women (18-64) Spouse Present With Children With Less Than 9 Years of Education	180
9	Earnings of Women (18-64) Spouse Present With Children With 9-12 Years of Education	182
10	Earnings of Women (18-64) Spouse Present With Children With 13+ years of Education	184
11	Earnings of Women (25-44) Spouse Present With Children With 13+ Years of Education	187
12	Earnings of Women (18-64) Spouse Present With Children Controlling for Selectivity Bias	195
13	Earnings of Women (18-64) Spouse Present Controlling for Selectivity Bias	199
14	Earnings of Women (25-44) Spouse Present Controlling for Selectivity Bias	205
15	Earnings and Means of Men and Women	209

Percentage of the Income Gap Between
Men and Women Accounted for by Work
History Segments

LIST OF FIGURES

FIGURE	DESCRIPTION	PAGE
CHAPTER TWO		
1.	Earnings by Experience and Mincer's Identity	61
CHAPTER THREE		
1	Indifference Curves for the Tradeoff Between Wages and Risk	84
2	Matching Employees and Employers and the Wage-Risk Frontier	86
CHAPTER FOUR		
1	The Life-Cycle Earnings of Women	191

CHAPTER ONE

INTRODUCTION

This thesis is composed of three essays in the field of labour economics. Each essay develops a human capital earnings function and tests it in the context of a particular labour problem. The three essays are contained separately in each of the following three chapters.

The first essay titled "The Earnings of Immigrant and Native-Born Males" develops an earnings function for immigrant and native-born males and tests this model with a unique data set. Economists, especially in the United States, have studied immigrants for a number of years. Traditionally, emphasis has been placed on examining the foreign-born's contribution to economic growth, the demographic make-up of the immigrant population and the earnings of the foreign-born population.

The primary focus of this chapter is on the relative earnings of immigrant. Male immigrants in Canada earn substantially more income than do the native-born. The data base used for this study shows that the yearly earnings of male immigrants are on average eleven percent higher than Canadian-born male earnings. This is true not only for immigrants from the United States or Europe but the rest of the world.

I have examined the effects of foreign-birth, length of time spent in Canada and their relationship to the earnings of native-born Canadians. Utilizing a human capital earnings model I examine a series of hypotheses that have been discussed in the literature but have not been tested in detail using Canadian data. The major hypotheses tested include the following:

- Passage of time effects on earnings are likely to be important as immigrants absorb new customs and develop language skills. For this reason the initial wage gap, which is largely related to these differences, should diminish with time spent in Canada as the immigrant learns the

dominant language, acquires information about the labour market and generally adjusts to Canadian society.

-The number of years since migration should be less significant for explaining earnings for immigrants from countries that are more similar to Canada in terms of language, educational institutions and culture than those migrants from more culturally diverse nations.

-To the extent that some schooling maybe country-specific, it is likely that such schooling yields a lower return for immigrants.

-As with schooling, training received at work prior to immigration may also be country-specific.

-Most immigrants settle in areas that have a high standard of living.

The income advantage they enjoy over the native-born should be a function of settlement patterns among other factors.

-Employers are often unable to judge the productivity of new Canadians due to a lack of information about the immigrant's homeland, inability to check work references and lack of knowledge of foreign schooling.

One way for immigrants to signal that they are productive workers is to acquire a degree or training certificate. This implies that the returns to a degree or apprenticeship program should be higher for the foreign-born than the native-born.

-If immigrants start at an earnings disadvantage but their earnings rise faster than the native-born, earnings profiles of immigrants should be steepest in the first few years in the country. Immigrants have an incentive to invest in on-the-job training, increase their knowledge about the labour market and learn English (or French) immediately after migrating to Canada.

The empirical results are consistent with all of the above hypotheses with the exception of the last one." After one year of entry immigrants earn 15 percent less than the native-born population. This gap is quickly closed and after 14 years in Canada immigrants have a yearly income that equals the income of the native-born.

Immigrants from the United States, the United Kingdom and western Europe apparently have less difficulty in initially adjusting to the Canadian labour market.. The number of years since immigration is far more important in determining the earnings of other immigrants than it is for immigrants from the regions cited above.

The economic returns to education are greater for the native-born than they are for the foreign-born. The results indicate that there may be country-specific aspects of education. The same general pattern exists for training and work experience. Immigrants and native-born Canadians do not obtain the same returns to experience. However, in this case the financial return to job market experience is greater for the foreign-born than it is for the native-born.

Some of the earnings advantages the foreign-born receive are due to locational considerations. Most immigrants live in large urban centres and reside in the province of Ontario. However, a substantial component of the wage gap cannot be accounted for by locational or human capital investments.

The economic returns to education are lower for immigrants than for the native-born, but signalling is apparently very significant for the foreign-born. Native-born Canadians with a degree earn 23.5 percent more than native male workers without degrees. For the immigrant population as a whole those with a degree earn 34 percent more than other immigrants.

Finally, immigrants' earnings rise slowly after initially entering Canada and start to increase quickly after they have been in the country a number of years. The economic returns to the number of years in Canada actually increase at a slightly increasing rate.

The second essay is titled "Compensating Wage Differentials in the Canadian Labour Market". The object of this chapter is two-fold. First, the impact of job quality on workers' incomes is assessed. By job quality I mean those aspects of a specific occupation that are either agreeable or disagreeable to an individual worker. Does an occupation that requires heavy lifting, for instance, pay more than an occupation that is more sedentary? Do occupations that have higher worker fatality rates than other occupations pay some form of wage premium?

The theory of compensating differentials is quite different than human capital theory in that the former examines how various aspects of employment influence personal incomes. Rather than concentrating on individual characteristics like education or labour market experience the theory of compensating differences focuses on the demand for specific jobs. This approach argues that unpleasant jobs will pay some form of financial premium.

The second objective of the chapter is to provide numerical estimates of worker valuation of risk. The willingness to pay for increased safety in the work place can be calculated from the hedonic earnings functions in this paper. These estimates are converted to a "value of life" format to make them comparable with existing American and British studies.

For the sample of male workers who face additional risk in terms of

the probability of death due to an occupational accident or disease do receive additional financial rewards. Included in the analysis are a series of non-fatal job characteristics, such as the ability to control one's working hours, doing repetitive work and working under psychologically stressful conditions. In general, the non-fatal job characteristics do not influence earnings in any significant manner. In the regression equations the coefficients for the occupational fatality variables are often statistically significant. However, the coefficients for the non-fatal characteristics are either statistically insignificant or their impact on earnings is opposite to what the theory would predict.

The earnings functions indicate that on average workers are willing to forgo income to reduce the occupational fatality rate. Collectively they are willing to pay approximately \$4.0 million to save an additional "statistical" life. This estimate is obtained by analyzing the coefficient for the occupational fatality variable in the hedonic earnings function.

The estimates presented in this essay have implications for public policy and evaluating the benefits of improved health and safety in the work place. The benefits of reducing the possibility of work related fatalities are difficult to measure. The recent growth in the "value of life" literature is the result of economists trying to develop such estimates. The adoption of this approach in evaluating health and safety in the work place is intended to reduce the role of ad hoc decisions on the part of government regulators.

The title of the third essay in this thesis is "Interrupted Work Careers, the Depreciation of Human Capital and the Earnings of Married Women". This chapter analyzes the earnings of married women in Canada. The central

issue is whether, and to what extent, women's current market earnings are affected by previous withdrawals from the labour market. If the current incomes of women are significantly influenced by time not working it is possible to conclude that human capital depreciates due to the non-use of skills.

The possible depreciation of skills may explain a significant portion of the earnings gap between men and women. Although the differences between men's and women's earnings have fallen over the last decade there still are large differences between them. These differences in incomes are a result of many factors. One factor may be that women exit and re-enter the market frequently. If this argument can be empirically verified the earnings gap between the sexes will be primarily a function of women's life-cycle investment patterns in human capital rather than of other causes, such as discrimination.

Another question addressed in the chapter deals with the different types of skills women acquire. Do women with substantial levels of education suffer a significant loss in current income because of the non-use of their skills? With a greater stock of human capital it would appear likely that women with a great deal of education will be substantially penalized financially for not utilizing their skills. Alternatively, women with less education are likely to experience less depreciation of human capital.

The data base used for the analysis in this chapter allows the calculation of the total amount of work experience for the women being surveyed and the amount of time absent from the market. With this information women's work history patterns can be constructed starting with the time they started their working careers and continuing to the survey date.

A major difficulty with empirical work of this type is selectivity

bias. A woman will decide to work outside the home if her potential productivity in the labour force exceeds her productivity outside the labour force. Failing to control for the fact that the sample of working women being analyzed is a selective group will generate biased results. This is because only a subset of the total female population is being examined.

To account for the possibility of selectivity bias two sets of estimates are provided. The first set of regression equations does not control for the possibility of selectivity bias. The second group of regression equations includes a variable that controls for selectivity bias.

The empirical results indicate that absence from the market has only a marginal effect on women's earnings in the long run. Although the loss in income due to the depreciation of skills is significant upon re-entering the market these short run patterns do not persist over the longer term.

Measures for actual experience plus time spent out of the labour market also explain little of the wage gap between men and women. Only 35.5 percent of the earnings differential between the sexes is explained by the work history segments. An additional 20.5 percent of the gap is explained by the other variables in the model. These results provide a new insight into an important issue in labour market analysis.

When controlling for selectivity bias the results are altered in some cases. However, the loss in current market incomes due to the depreciation of skills is even less significant in this case than in the uncontrolled case. Most of the other coefficients in the human capital earnings equations are only marginally affected when controls for self-selection are included in the analysis.

CHAPTER TWO

~~THE~~ EARNINGS OF IMMIGRANT
AND NATIVE-BORN CANADIAN MALES

I. INTRODUCTION

There has been growing interest over the past several decades in the effect of socio-economic background on incomes. Research in this area has traditionally concentrated on either black-white or male-female differences in earnings. Recently, however, interest has spread into such diverse areas as religion (Chiswick, 1983b; Tones, 1983, 1984a; Meng and Senrance, 1984), ethnic groups (Chiswick, 1983a, 1984; Carliner, 1976), and immigrants (Chiswick, 1977, 1978a, 1978b, 1980a, 1980b, 1984b; Chiswick and Miller, 1984; Carliner, 1980; Borjas, 1982; Long, 1980; Meng and Sentance, 1986).

It is this latter group that concerns this study. In 1981, census figures report that the foreign-born population in Canada was 3.8 million, or 16 percent of the population. In 1980, the average, adult male native-born had earnings of \$16,600. The figure for adult male immigrants was \$18,500. This represents an earnings advantage for immigrants of over eleven percent. Furthermore, 23.7 percent of all immigrant males earned over \$25,000 a year in 1980. For non-immigrants the figure was 19.5 percent (Statistics Canada, 1984).

Table 1 shows the schooling and earnings means for both Canadian and foreign-born males in 1972.¹ Besides having an earnings advantage the foreign-born in general are more educated, possess more degrees, and have completed more apprenticeship and training programs. Those born in either the United States, the United Kingdom, or western Europe earn substantially more on average than those born in the rest of the world. However, the latter still earn approximately six percent more than native-born Canadians.

Table 1

Schooling and Earnings of Adult Men, 1972 (Means)

	<u>Canadian- born</u>	<u>Foreign- born</u>	<u>Born in the US, UK or Western Europe</u>	<u>Born in Eastern Europe, Southern Europe or Elsewhere</u>
Earnings (\$)	7,480	8,540	9,097	7,903
Schooling (years)	11.23	11.40	12.42	10.15
Obtained a Degree (%)	10.5	15.6	17.7	13.1
Completed an Apprenticeship or Training Program (%)	25.5	32.3	39.0	24.0

Source: Canadian National Mobility Survey (adult men aged 22-64 inclusive)

It is interesting to compare these figures with census data from the United States. Chiswick (1978b), using 1972 Bureau of Census estimates, found that in 1970, foreign-born men (aged 25-64) earned \$9,662, while native-born males earned \$9,738. This represents an earnings advantage of about one percent for the native-born. The native-born also had, on average, 11.9 years of education, compared to 10.8 for immigrants. The foreign-born make up 5 percent of the entire population in the United States compared to 16 percent in Canada.

To date, there have been few systematic attempts in Canada to examine explicitly the effects of foreign-birth, length of time spent in Canada and their relationship to the earnings of native-born Canadians.² This paper has two principal objectives. The first is to fill this gap by examining

the earnings of immigrants and non-immigrants alike using a model which incorporates a number of family background variables in the analysis. The second objective is to examine the effect of Chiswick's (1977, 1978b, 1980b) and Tandon's (1977) specification error concerning the use of Mincer's (1974) identity when dealing with the immigrant and non-immigrant population.

In the analysis of Mincer's identity, this paper shows that the now commonly accepted definition for potential labour market experience ($\text{Age} \text{ minus Education} \text{ minus } 5 \text{ equals } T$) underestimates the returns to work experience for foreign-born males. The appropriate measure (actual experience) yields a much higher coefficient than does T . Also, when using Mincer's approach, we find that the return to immigrants' (potential) labour market experience is less than that for native-born Canadians (a result similar to Chiswick's and Tandon's). However, when the actual measure of experience is used, the returns to labour market experience are higher for immigrants than for native Canadians.

This study is unique in measuring how actual labour market experience affects the incomes of native and foreign-born Canadians. Large cross-sectional surveys, such as Canadian or U.S. Census data, do not control for experience. Researchers must approximate actual experience with Mincer's identity. Panel data, such as the Panel Study on Income Dynamics, does control for experience. In such cases though the number of people surveyed is usually much smaller than in large cross-sectional surveys.

The following section discusses the hypotheses that will be tested in this paper. It also includes the specification of the regression equations

and the variables used in this study. Section III contains the earnings functions of native and foreign-born Canadian males. The first regression equations include both immigrants and non-immigrants. It will be shown that in the pooled results, the inclusion of several variables that only apply to the foreign-born significantly alters the regression estimates. In particular, the earnings of the foreign-born are especially dependent upon their length of stay in Canada. Later, separate regressions are estimated for the native-born, the foreign-born in general, and for immigrants from specific countries and regions around the world. This exercise is carried out in order to examine the differences between the slope coefficients for the native and foreign-born in general, as well as the foreign-born who are from specific world regions. When pooling the data, it is not possible to observe the differing rates of return to several key human capital variables. Only by estimating separate earnings functions can this be done.

Section IV deals with Mincer's identity. The basic model specified in Section II, and estimated in III is to be re-estimated using Mincer's approximation instead of actual experience. To test the claim that Mincer's identity inaccurately measures the return to work experience several alternative earnings functions are included in the analysis.

Finally, section V contains a summary and conclusion. The hypotheses discussed in section III are reviewed in the light of the empirical results.

II. HYPOTHESES AND ESTIMATING PROCEDURES

(1) The Dual Selection Process

From 1911 until the Second World War immigrants made up approximately 22 percent of the total Canadian population, but this proportion has now declined to only 16 percent. Traditional immigration policy tended to be discriminatory against non-whites. However, the migrant population itself was still very heterogeneous in terms of skill and educational attainment (Boyd et. al., 1985, Chapter 2). By 1962 however, immigration regulations became more restrictive in terms of skill levels, and less discriminatory in terms of country of origin and ethnic or racial group.

By definition, the foreign-born have migrated to Canada. They do so for a variety of reasons including economic enhancement, political freedom, and refugee status. Immigration laws have ensured that most often, except in the case of refugees, only those people with internationally transferable high-level skills are allowed to enter permanently. The 1962 changes to the Immigration Act sharply changed Canadian immigration policy. The end of a quota system based on national origin ensured that national policy aimed at selecting new Canadians who are highly productive.

The process of immigration is one of dual selectivity. This dual selection process implies that for the same human capital variables (i.e., schooling, experience, etc.) immigrants are more likely to be motivated economically or to have more innate abilities than native-born Canadians (Chiswick, 1978b).³ When analyzing the two groups in question we are comparing one group that has self-selected to reside in Canada with another that has chosen not to incur the adjustment costs of migration.⁴

Immigrants also select themselves for residence in Canada. The self-selection process implies immigrants tend to have a higher level of innate ability and work motivation than their fellow countrymen with similar characteristics who stay home (Chiswick, 1979; Schwartz, 1976).

Self-selection, however, will be more pronounced the greater the cost of migration. Immigrants from the United States face fewer physical and psychological costs than do immigrants from Africa or Asia. This implies that individuals from more culturally distinct and geographically distant regions must be willing to incur greater costs and hardships. These increased costs will discourage those who less motivated.

Immigrants are also likely to be more economically motivated than the native-born population of Canada. If the distribution of motivation and abilities are normally distributed across countries, the average ability would be higher for immigrants than the native-born. This result occurs because the Canadian government primarily selects potential migrants with the greatest skill levels and only the most motivated are willing to migrate.

Since labour is heterogeneous the difficulty of transferring human capital skills is an extremely important criteria in determining who migrates to Canada. Essentially there are two markets potential immigrants can work in. They can either stay in their country of origin or they can migrate. For their part, immigrants who leave their birth-place do so because of relative price effects. Given their skill level, the financial benefits they would receive in Canada must exceed the benefits of staying in their home country. For many residents of low wage countries the net

financial returns will be greater for migrating. However, Canadian immigration policy ensures that only individuals with the appropriate transferrable skills will enter the country.

The above arguments imply that the productivity or 'quality' of the typical immigrant should be greater than most individuals residing in the donor country or those who were born in Canada. This point has been debated recently in the economics literature. Using 1970 and 1980 U.S. census files Borjas (1985) finds that the quality of the typical immigrant in the United States has fallen dramatically in the 1970s. However, this finding has not gone unchallenged. Using the same data sources, but different statistical techniques, Chiswick (1986) finds that the quality of immigrants in the U.S. has not changed significantly over the past several decades. His results are still consistent with the theory of self-selection.

(11) Model

The human capital earnings function is the basis for this study. The form used is, essentially, that developed by Chiswick (1978b) for his study on the Americanization of immigrants. An expanded version of this model allows us to examine explicitly how time spent in Canada affects immigrant earnings.

For the native-born, human capital investments are assumed to be made in Canada, and the earnings function is:

$$(1) \ln EARN_j = \ln EARN_0 + \beta_1 EDUC_j + \beta_2 EXP_j + \beta_3 EXP_j^2 + \sum_{i=4}^N \beta_i X_{ij} + U_j$$

In equation (1), $EARN_j$ is annual income from employment for the j th person, $EDUC$ is years of schooling, EXP_j is years of experience in the

labour market,⁵ the X_{1j} 's are a series of other explanatory variables, U_j is the error term and $\ln EARN_0$ is the constant.

The foreign-born may have engaged in schooling either before immigration ($EDUC_b$) or after immigration ($EDUC_a$); they may also have worked prior to (EXP_b) or after (EXP_a) immigration. Country-specific aspects of human capital raise the possibility that experience and schooling prior to immigration may have a weaker effect on earnings than that acquired after immigration. This is approximated to be:

$$(2) \ln EARN_j = \ln EARN_0 + \beta_{1b} EDUC_{bj} + \beta_{1a} EDUC_{aj} + \beta_{2b} EXP_{bj} + \beta_{3b} EXP_{bj}^2 + \beta_{2a} EXP_{aj} + \beta_{3a} EXP_{aj}^2 + \sum_{i=4}^N \beta_i X_{ij} + U_j$$

Since $EDUC_j = EDUC_{bj} + EDUC_{aj}$ and $EXP_j = EXP_{bj} + EXP_{aj}$, equation (2) can be rewritten as:⁶

$$(3) \ln EARN_j = \ln EARN_0 + \beta_{1b} EDUC_j + (\beta_{1a} - \beta_{1b}) EDUC_{aj} + \beta_{2b} EXP_j + (\beta_{2a} - \beta_{2b}) EXP_{aj} + \beta_{3b} EXP_j^2 + (\beta_{3a} - \beta_{3b}) EXP_{aj}^2 - 2\beta_{3b} EXP_j \times EXP_{aj} + \sum_{i=4}^N \beta_i X_{ij} + U_j$$

The dependent variable in the regressions is the natural logarithm of income from employment in 1972. The exogenous variables are listed and described in Table II. Standard measures of human capital (time worked, language, locational variables) are included as are two credential or signalling variables (DG, APR), two continuity of work experience variables (BREAK, NPERUN), demographic variables and dummy variables for foreign-birth.

Variables to measure commitment to the labour market are also included. Marriage frequently involves a specialization in market activities by one

family member. Traditionally, this has led to a relatively greater attachment to the labour force for male workers than female workers. This will be reinforced by the size of the family measured by the number of children. The quality-quantity tradeoff of children is captured by including the number of brothers and sisters the respondent has and whether their mother worked.

Equations (1) to (3) imply that the basic testing procedure will be multiple regression analysis. I first include both the foreign-born and native-born in a set of pooled regressions. This is to see if years in Canada (YRIC) makes a significant difference in earnings for the foreign-born. After this has been completed the individual regressions [(1) and (3)] are estimated for the two groups separately. I also estimate various earnings functions for the immigrant population based on country of origin.

(111) Hypotheses

Several hypotheses regarding the earnings of foreign-born males and their children have been advanced and tested in previous work. These are considered here, where the data permit.⁷ In addition, I compare Canadian and U.S. results, and discuss some differences resulting from the different data set used.

(1) The first hypothesis deals with the possible earnings disadvantage immigrants may face as they enter the country. Since many immigrants have different customs and language skills they are likely to start at a lower wage rate than otherwise comparable individuals already residing in Canada. The foreign-born may also have acquired less information concerning labour

market conditions and are less likely to start at a job yielding them maximum possible benefits.

(2) The initial wage gap, which is largely related to the differences mentioned above, should diminish with more time spent in Canada as the immigrant learns the dominant language, acquires information about the labour market and generally adjusts to Canadian society. If immigrants had the same schooling, experience, and other demographic characteristics, as well as motivational skills, their earnings should catch up to but not exceed those of native Canadians. If, on the other hand, immigrants have more human capital or are more motivated, their incomes are likely to surpass those of the Canadian population. I test to see if and when this crossover in incomes occurs. I also decompose the earnings of the two groups using Blinder's (1973) methodology to see how much of the earnings gap is due to human capital endowments, and how much is due to other factors.

(3) The number of years since migration should be less significant for explaining earnings for immigrants from the United States, for example, than from Poland. Those individuals from countries that are more similar to Canada in terms of language, educational institutions and culture will face fewer informational problems about the labour market since they already know the dominant language. Their certificates will be accepted more easily and they can forego much of the initial adjustment costs of relocation. Therefore we expect that years since immigration will be less significant for immigrants from countries similar to Canada.

TABLE II

Variables

LNEARN	Natural log of income from employment, 1972.
EDUC	Number of years in school.
FORED	Number of years in school if individual is foreign born.
EXP	Number of years worked.
YRIC	Years in Canada.
EEA	Number of years worked x years in Canada.
EXP ²	Number of years worked squared.
YRIC ²	Years in Canada squared.
LNWKS	Natural log of weeks worked, 1972.
DG*	University degree.
APR*	Apprenticeship or training program completed.
SELF*	Self-employed.
FTIME*	Employed full-time.
BREAK*	Did not work for a period of at least one year after first full-time job.
NPERUN	Number of periods of 3 months or more of unemployment since first full-time job.
DR1*	Atlantic provinces (reference group)
DR2*	Quebec
DR3*	Ontario
DR4*	Prairie provinces
DR5*	British Columbia
URBAN1*	Large urban centre (pop. greater than or equal 100,000-reference group).
URBAN2*	Other city (pop. 5,000-100,000).
URBAN3*	Small urban centre (pop. 1,000-5,000).
URBAN4*	Rural area (farm and non-farm).

LANG1* English and other language (not French).
 LANG2* French or other language (not English-reference group).
 LANG3* Bilingual (English and French) and other language.

 LAF11* English first language spoken (reference group).
 LAF12* French first language spoken.
 LAF13* Other first language spoken.

 MAR* Married (spouse present).

 CHILD Number of children ever born.

 BRSI Number of brothers and sisters.

 REL1* Jewish.
 REL2* Protestant (Anglican, United Church, Presbyterian, Dutch Reform, Lutheran).
 REL3* Other religion.
 REL4* Roman Catholic (reference group).
 REL5* No religion

 NOTLI* Mother or other female head of household when individual was 16.

 MWORK1* Mother worked less than one year while individual at school age.
 MWORK2* Mother worked 1 to 5 years.
 MWORK3* Mother worked more than 6 years.
 MWORK4* Mother did not work (reference group).

 FAOC Blisshen index for father's occupation when respondent was 16.

 FEAGE Father's years of education x own age.

 MEAGE Mother's years of education x own age.

 FOR* Born outside Canada.

 EDYC Years of schooling x years in Canada.

* Indicates dummy variable = 1 if condition satisfied

(4) To the extent that some training received is country-specific, it will yield a lower return than schooling after immigration. Given different qualities of education throughout the world it is also likely that the return to a year of education will be different for the native and foreign-born. The fourth set of tests is to see if pre and post returns to schooling differ for the foreign-born. I also examine whether the returns to education differ for the native and foreign-born.

(5) As with schooling, training received in work prior to immigration may also be country-specific. It is also possible that returns to post-immigration job experience will be lower than post-immigration returns.

(6) Some of the earnings advantage that immigrants experience may be due to the settlement practices of new Canadians. Over 52 percent of immigrants but only one third of the population reside in Ontario, Canada's richest province. The incomes of urban dwellers are significantly higher than those living in smaller cities or rural areas. About 74 percent of immigrants live in cities of more than 100,000 inhabitants, compared with just 48 percent of the non-immigrant population (Statistics Canada, 1984). The effects of settlement patterns are dealt with in the regression framework by controlling for city size and region.

(7) An important aspect of the data base is that we are able to control for several key credential effects (DG, APR). Employers are often less able to judge the productivity of new Canadians due to lack of information about the immigrant's homeland, inability to check previous work references and lack of knowledge of foreign schooling. One way for immigrants to signal that they are productive workers is to acquire a degree or a training

certificate. In this way potential employers are better able to judge worker productivity. (Spence, 1973).

The above argument implies that the returns to a degree or apprenticeship program should be higher for the foreign-born than the native-born. A further subtle distinction is also implied. Given information problems concerning worker productivity, credential effects are likely to be more significant for immigrants from countries and societies that are more linguistically and ethnically different from Canada.

Human capital models emphasize that time spent in school is a way to acquire skills. They do not identify the discrete increase in earnings associated with obtaining a degree or completing a training program. Tomes (1983) argues that it is plausible to view these credential effects as proxies for ability or differences in college or training quality.

(8) A further hypothesis relates to the pattern of incomes through time. If immigrants start at an earnings disadvantage but their incomes rise faster than the native-born, earnings profiles of immigrants are likely to be steepest in the first few years in the country. Immigrants have an incentive to invest in on-the-job training, increase their knowledge about the labour market and learn English (or French) immediately after migrating to Canada. Therefore we would predict that earnings increase quickly soon after they enter the country. However, as time in Canada increases and their incomes approach those of the native-born the pace at which the income gap closes should slow down.

(iii) Data-Base

The data base used in this study is the Canadian National Mobility Survey (1973). The study is often referred to as "CARMAC". It is a micro data set containing observations on over 44,000 individuals eighteen years of age and over who were not full-time students in March 1973.⁸ The sample is a group of males, aged 22 to 64, who had positive weeks worked and income earned in 1972.⁹

The experience variable used in this study differs from that found in Canadian (or U.S.) Census data in that it is not a construct of age and years of education. A year of experience is defined as having worked on a full-time basis (i.e., 35 hours a week or more) for at least seven months in a given calendar year. The data base also provides direct observations on actual years since immigration, a variable of considerable importance in what follows. It is also possible to control for numerous socio-economic background variables, such as father's occupation, mother tongue and number of brothers and sisters. Other work history variables not found in census data, such as the number of periods of unemployment and the existence of a major break in one's career are included as well.¹⁰

There are, however, certain drawbacks in using CARMAC. Most notably weeks worked (LNWKS) are taken from data given in the form of intervals (e.g. 1 to 13 weeks becomes 7 weeks). As well, I cannot account for specific hours worked in 1972. Instead, I can only control for full-time and part-time work (FTIME). This problem becomes particularly important in subsequent sections dealing with the earnings advantage of immigrants. Some of the earnings differentials may be due to the fact that immigrants work

more hours per week or work at more than one job. I can only partially account for this possibility.¹¹

III. THE EARNINGS OF NATIVE AND FOREIGN BORN CANADIANS

(i) Means

The foreign born men in the sample earn more than the native-born by about 14 percent (see Table III). This compares favourably with the census data cited earlier. Foreign-born men have slightly more schooling and experience, significantly more have a university degree, and more have completed some form of apprenticeship training. As with census data, immigrants tend to congregate in high income regions (47 percent in Ontario, compared to 24 percent for native-born), and in large urban centres (61 percent versus 33 percent).

(ii) Pooled Regressions

The earnings advantage of the foreign-born is reduced substantially when differences between native and foreign-born are controlled for. The regression reported in the first column of Table IV includes a dummy variable which indicates a 3.5 percent disadvantage to foreign-birth.

The second and third columns of Table IV show that the inclusion of years in Canada clarifies the relative earnings differences.¹² Column (2) demonstrates that the partial effect of foreign-birth on earnings evaluated at the mean of years in Canada squared indicates a 3.2 percent advantage to foreign-birth. The set of foreign-birth variables (FOR, YRIC, YRIC², EEA) are all highly significant.

The results change dramatically over time. Column (2) demonstrates that when controlling for other impacts, the foreign-born start at a

TABLE III

<u>Variables</u>	<u>Means</u>			
	<u>Native Born</u>	<u>Foreign Born</u>	<u>UUWE</u>	<u>EESEOT</u>
EARN	7480.	8540.	9097.	7903.
EDUC	11.2	11.4	12.4	10.1
EXP	20.3	21.0	22.5	19.1
LNWKS	3.81	3.82	3.83	3.80
DG (%)	10.5	15.6	17.7	13.1
APR (%)	25.5	32.3	39.0	24.0
BREAK (%)	11.5	14.2	11.1	18.0
NPERUN	1.379	1.070	0.964	1.200
CHILD	2.58	2.32	2.38	2.24
YRIC	-	17.629	19.411	15.441
DR1 (%)	21.4	4.6	6.8	2.0
DR2 (%)	23.1	10.9	8.3	14.0
DR3 (%)	24.1	46.8	41.5	53.2
DR4 (%)	21.4	18.6	20.8	15.9
DR5 (%)	10.0	19.1	22.6	14.9
URBAN1 (%)	33.3	61.2	53.6	70.5
URBAN2 (%)	16.6	12.6	12.8	12.4
URBAN3 (%)	16.5	9.1	12.2	5.3
URBAN4 (%)	33.6	17.1	21.4	11.8
MWORK1 (%)	0.9	1.0	1.3	0.6
MWORK2 (%)	6.1	6.8	9.2	3.8
MWORK3 (%)	8.3	15.5	16.2	14.6
MWORK4 (%)	84.7	76.7	83.3	81.0
FAOC	34.213	36.868	39.295	33.889
BRS1	4.778	3.662	3.196	4.146

TABLE IV

Pooled Regression Results

<u>Independent Variables</u>	(1)	(2)	(3)
Education	0.0357* (15.063)	0.0360* (15.245)	0.0394* (15.391)
Experience	0.0344* (18.595)	0.0336* (18.065)	0.0340* (18.280)
Experience Squared	-0.000674* (16.850)	-0.000688* (16.700)	-0.000669* (16.725)
LN (weeks worked)	0.681* (37.82)	0.675* (37.50)	0.673* (37.41)
University Degree	0.229* (10.16)	0.233* (10.35)	0.232* (10.31)
Foreign-Born	-0.0356*** (1.950)	-0.184* (5.534)	-0.00610 (0.098)
Years in Canada	-	0.0136* (4.387)	0.0127* (4.084)
Years in Canada Squared	-	-0.000336* (5.600)	-0.00030* (5.000)
Experience x Years in Canada	-	0.000176* (2.933)	0.000129*** (1.843)
Foreign x Education	-	-	-0.0131* (3.385)
Constant	5.179	5.219	5.171
$\bar{R}^2$	.45581	.45825	.45904
N	7277	7277	7277

t-statistics are in brackets *significant at 1%, **significant at 5%, ***significant at 10%. Also controlled for but not reported in these results are: APR, PTIME, SELF, BREAK, NPERUN, DR2-DR5, URBAN2-URBAN4, LANG1 and LANG3, LAF12 and LAF13, MAR, CHILD, BRS1, REL1-REL3 and REL5, MWORK1-MWORK3, PAOC, NOTL1, FEAGE and MEAGE.

significant earnings disadvantage. However, their earnings eventually surpass those of the native-born population. The predicted changes through time ($\partial \ln E / \partial \text{FOR}$) are seen below.¹³

Years in Canada	1	5	10	14	20	30	40
Earnings of foreign-born relative to native-born earnings (%)	-15.4	-10.2	-4.3	0	+5.1	+11.3	+14.3

After 14 years in Canada the income gap disappears. The earnings advantage of the foreign-born is maximized after 45 years with a 14.6 percent advantage. This pattern is consistent with the self-selection argument that since the foreign-born are more motivated, the eventual difficulties with language, culture and perhaps accreditation can be overcome.¹⁴

Controlling for differences in the return to education (FORED) also appears to be particularly important. Including the foreign-born and education interaction term in the analysis drops the dummy variable for foreign-birth from negative and significant to a negative and insignificant level. The return to education for immigrants for an additional year of schooling is significantly lower than for the native-born (2.63 percent versus 3.94 percent).

(iii) Native and Foreign-Born Regressions

The native and foreign-born samples were separated to allow the individual regression coefficients to differ. Pooling the data does not allow for differences between the two groups concerning the returns to work

experience, obtaining a degree, completing an apprenticeship training program, and the effect unemployment spells.

The separate native and foreign-born regressions are reported in Table V. For the same set of human capital, demographic and socioeconomic variables (excluding YRIC, YRIC², EEA, FORD) a Chow test indicates that there are significant differences in the coefficients of the native and foreign-born regressions.¹⁵

The separate regressions on native and foreign-born Canadians bring out some differences in detail that are not clear in the pooled data. The foreign-born regressions indicate that the partial effect of a year of schooling is only two percent, somewhat less than the 2.6 percent indicated by the pooled sample. The difference is likely the result of a higher payoff not allowed for in the pooled sample to a degree for the foreign-born (34.0 percent versus 23.5 percent for the native-born)¹⁶. In addition, the coefficients on the experience variables differ for the foreign and native-born, an effect not allowed for in the pooled regressions.

The variation of earnings with years in Canada (YRIC) shows that the interaction term (EEA) is significant and positive. The coefficient apparently outweighs the negative effect of YRIC², so that earnings actually rise at a slightly increasing rate with years in Canada. The predicted percent increase in earnings ($\partial \ln E$) for different years of residence (YRIC) (assuming that the mean difference between YRIC and EXP of 3.336 exists on entry) is 1.0 after 1 year, 5.0 after 5 years, 10.1 at 10 years, 21.0 at 20 years, 32.5 at 30 years and 44.8 after 40 years.¹⁷

TABLE V

Separate Regression Results

VARIABLES	NATIVE BORN	FOREIGN BORN	UUWE	EESEOT
EDUC	0.0410* (15.018)	0.0195* (4.079)	0.0184* (2.722)	0.0271* (3.0722)
EXP	0.0331* (16.305)	0.0387* (8.341)	0.0372* (6.098)	0.0366* (4.952)
EXP ²	-0.000639* (15.975)	-0.00095* (9.500)	-0.000891* (6.854)	-0.000926* (5.786)
LNWKS	0.661* (33.317)	0.717* (16.894)	0.895* (14.371)	0.608* (9.871)
DG	0.211* (8.301)	0.293* (6.066)	0.229* (3.801)	0.409* (4.983)
YRIC	-	0.00848* (2.609)	-0.00104 (0.265)	0.02108* (3.641)
YRIC ²	-	-0.000353* (5.043)	-0.000229* (2.863)	0.000535* (3.344)
EEA	-	0.000389* (3.536)	0.000407* (3.131)	0.000333 (1.45)
FTIME	0.140* (5.445)	0.101*** (1.664)	0.132 (1.581)	0.068 (0.751)
BREAK	-0.0951* (4.830)	-0.158* (4.133)	-0.105** (1.998)	-0.213* (3.804)
NPERUN	-0.00631* (3.525)	0.000832 (0.171)	-0.00199 (0.315)	0.00375 (0.496)
APR	0.0795* (5.699)	0.0763* (2.601)	0.0273 (0.772)	0.1324* (2.601)
SELF	-0.257* (14.87)	-0.0937** (2.250)	-0.116** (2.168)	-0.0967 (1.476)
LANG1	0.0877** (2.270)	0.125 (1.608)	0.436*** (1.864)	0.04731 (0.503)
LANG3 /	0.134* (5.186)	0.199* (2.471)	0.527** (2.344)	0.108 (1.072)

TABLE V (continued)

Separate Regression Results

VARIABLES	NATIVE BORN	FOREIGN BORN	UUWE	EESEOT
MAR	0.146* (5.0222)	-0.00839 (0.115)	0.151*** (1.773)	-0.2568** (2.005)
CHILD	0.0149* (4.257)	0.00893 (1.024)	0.0201*** (1.877)	0.00637 (0.455)
DR2	0.0874* (3.207)	0.0951 (1.224)	0.0794 (0.886)	0.1365 (0.803)
DR3	0.155* (8.162)	0.192* (2.942)	0.135** (1.969)	0.276*** (1.758)
DR4	0.0141 (0.710)	0.0388 (0.568)	-0.0238 (0.328)	0.1298 (0.791)
DR5	0.205* (8.409)	0.141** (2.066)	0.0612 (0.852)	0.309*** (1.919)
URBAN2	-0.0107 (0.575)	0.00169 (0.040)	0.0063 (0.122)	-0.0211 (0.293)
URBAN3	-0.0869* (4.655)	-0.139* (2.942)	-0.135* (2.600)	-0.0635 (0.658)
URBAN4	-0.209* (12.237)	-0.0606 (1.588)	-0.125* (2.789)	0.03447 (0.478)
LAF12	-0.0616*** (1.857)	-0.0357 (0.449)	0.0739 (0.741)	-0.1391 (0.921)
LAF13	0.0387 (1.438)	-0.0144 (0.435)	-0.0146 (0.371)	-0.0218 (0.311)
FAOC	0.00198* (3.600)	0.00129 (1.132)	0.00219 (1.599)	-0.00076 (0.400)
REL1	0.258* (2.921)	-0.144 (1.555)	-0.0699 (0.465)	-0.176 (1.364)
REL2	-0.0191 (1.024)	-0.0124 (0.334)	0.0284 (0.635)	-0.0989 (1.319)

TABLE V (continued)

<u>Separate Regression Results</u>				
VARIABLES	NATIVE BORN	FOREIGN BORN	UUWE	EESEOT
REL3	-0.0922* (3.990)	-0.0937** (2.487)	-0.0725 (1.307)	-0.1267** (2.391)
REL5	0.0034 (0.122)	-0.0199 (0.420)	0.0357 (0.642)	-0.1785*** (1.869)
BRSI	0.00054 (0.255)	-0.00698 (1.332)	-0.011 (1.578)	0.00104 (0.130)
NOTLI	-0.0309 (0.913)	0.00699 (0.125)	0.0439 (0.586)	-0.00210 (0.026)
MWORK1	-0.0213 (0.343)	-0.133 (1.007)	-0.132 (0.939)	-0.278 (0.992)
MWORK2	-0.0675* (2.626)	-0.00314 (0.057)	-0.108*** (1.891)	0.252** (2.250)
MWORK3	0.0461** (1.968)	0.00105 (0.027)	-0.0416 (0.847)	0.0161 (0.252)
FEAGE	-0.000017 (0.348)	0.000107 (0.892)	-0.0000199 (0.142)	0.000221 (1.052)
MEAGE	0.000047 (0.932)	0.000124 (0.954)	0.0000799 (0.533)	0.000079 (0.395)
CONSTANT	5.202	5.231	4.255	5.822
$\bar{R}^2$	.46677	.42092	.45805	.39962
N	6054	1222	674	548

More complex effects of foreign labour market experience can be considered by assuming some particular values for EXP and YRIC. At, for example, EXP=10 and YRIC=5, an additional year of experience in the country of origin ($\partial \ln E / \partial \text{EXP}$) raises the earnings of the Canadian-born by 2 percent. The foreign-born receive 1.97 percent more due to EXP and EXP². Holding YRIC=5, the impact of another year of experience increases earnings through the interaction term by an additional 0.2 percent. The foreign-born with an additional year of experience in Canada ($\partial \ln E / \partial \text{YRIC}$) receive a further 0.5 percent from YRIC, YRIC², and the effect of the interaction term provides a further 0.4 percent. The total effect for the foreign-born of an additional year of experience in Canada [$(\partial \ln E / \partial \text{EXP}) + (\partial \ln E / \partial \text{YRIC})$] is 3.05 percent. The difference is consistent with the evidence presented in the pooled regressions: an initial disadvantage of 15 percent is made up in approximately 14 years.

Differences also emerge between the foreign and native-born when examining other variables. The regional dummy variables, as expected, are more significant for native-born Canadians. This result occurs because the foreign-born do not appear to have the same "roots" in a particular province. To some extent this also appears to be the same for urban/regional locations.

Linguistic ability demonstrates that the differential between bilingual and unilingual French and other (the reference group) among the foreign-born is close to that for the native-born. In both cases there is a substantial return to learning both English and French. However the gap between unilingual English and unilingual French or other is considerably greater

for the native-born. Presumably the restrictions on mobility that fluency only in French imposes on the native-born (staying in Quebec) are relatively greater than for the foreign-born. The insignificance of MAR may be of the same nature. Marriage allows for greater commitment to and specialization in the labour market, but it also restricts geographical mobility within a market by putting more emphasis on job and income continuity. This appears to be relatively more important for immigrants.

The effect of language first spoken also does not appear to hinder non-English speaking immigrants. Although 58 percent of all immigrants do not have a mother tongue of English or French (Table III) the differences in returns to languages first spoken other than English (LAF12, LAF13) do not adversely effect foreign-born Canadians.¹⁸

Concerning the continuity of work variables the number of periods of unemployment (3 months or more), while strongly negative for the native-born, is insignificant in its effects on the foreign-born. Unemployment in relatively short breaks like this could be associated with movement in the labour market searching and gaining valuable information on what is occurring in terms of potential employment (Chiswick 1978a). Given a greater fraction of degrees (15.6 percent to 10.5 percent) and apprenticeship and training programs completed (32.3 percent to 25.5 percent) for foreign-born males, their human capital appears to be less job-specific, than for Canadian-born males. Therefore, immigrants are less adversely affected by short-term unemployment spells as they are more likely to be associated with a productive search for alternative employment. The presence of a long gap in one's work history (BREAK) is more of a negative factor in the earnings of

the foreign-born. Given greater human capital endowment (years of schooling, degrees and apprenticeship programs) it is possible that long breaks can be associated with a greater depreciation of human capital for the foreign-born than the native-born.

(iv) Decomposing the Earnings Gap

The methodology employed in this section follows that developed by Blinder (1973, 1976) and Oaxaca (1973) in their analysis of discrimination. Once the separate earnings equations are estimated for the native and foreign-born, the average earnings differential between the two groups can be decomposed into one portion accounted for by different income-generating endowments and another due to different pay structures. The endowment portion of the wage gap is that portion 'explained' by the return to the acquisition of human capital skills by immigrants. The differing pay structure is the remaining 'unexplained' portion. In estimating the differences between male and female earnings, Blinder and others consider this to be discrimination against women in the market place.

The earnings differential of the native and foreign-born can be decomposed in the following manner:

$$(4) \quad \ln \text{EARN}_I - \ln \text{EARN}_N = \beta_I \bar{X}_I - \beta_N \bar{X}_N$$

where I stands for immigrants, N for native-born, β_N are the coefficients for the native-born, β_I are the coefficients for immigrants, $\bar{X}_N$ are the endowments of the foreign-born and $\bar{X}_I$ are the endowments of the foreign-born.

Decomposing the right-hand side by subtracting and adding $\bar{\beta}_I \bar{X}_N$ yields:

$$(5) \quad \ln EARN_I - \ln EARN_N = \bar{\beta}_I (X_I - X_N) + (\beta_I - \bar{\beta}_I) X_N.$$

The first term on the right hand side of equation (5) represents the difference in earnings due to differences in human capital endowments (Blinder, 1973). The second term represents the difference in pay structures of the two groups--traditionally labelled the discrimination effect. In this case it measures that part of the earnings gap which can be attributed to greater motivation or innate abilities of immigrants.

Of the total earnings gap of \$1,060; 54.3 percent, or approximately \$576 can be attributed to human capital differences. The remainder, \$484, cannot be explained. This test implies that only about one-half of the earnings advantage of the foreign-born is due to superior endowments.

(v) Education

The lower returns to years of education for the foreign born is one result that seems uniform in this and other studies. The return to an additional year of schooling for the foreign-born is 1.95 percent, while it is 4.1 percent for the native-born. This gap is partially made up when I include the credential effect of a degree. However, the conclusion is that the foreign-born are not able to transmit a year of schooling into income as effectively as the Canadian-born.

Following Chiswick (1978b), the pre and post-immigration levels of schooling have been separated. If some schooling is country-specific the returns to pre-immigration schooling should be less than for post-immigration schooling. Pre-immigration schooling (EDUCPRE) is the lesser of

(1) age at immigration or (11) the age at which schooling was completed (EDUC+5). This assumes the immigrant was in school continuously from age 5. All other education is defined as schooling after immigration. The impact of pre and post-immigration education is assessed through regressions including combined and separate schooling variables.

Column (2) of Table VI reveals that there appears to be no systematic difference between pre and post-immigration schooling. The Canadian data indicate that the argument for the country-specific educational effect is a weak one. The argument that the interaction of years inside Canada makes a significant difference in returns to education is also not confirmed by the results in column 5.

(vi) Country of Origin

As in the case of foreign-birth in general, allowing for birth in areas outside Canada does not reveal much in the way of significant earnings differences. Specific regional foreign-birth dummy variables similar to those seen in Table IV were included in the pooled regression equations. All the dummy variables were insignificant except the very heterogeneous group that was born outside Europe, the United States and United Kingdom.¹⁹ However, this group has the least number of years in Canada and the lowest level of experience.

Table VII shows the means of the key variables tabulated by place of birth for the immigrant population. The five groups display very different characteristics. Those from the United States and the United Kingdom have the greatest earnings and are the largest group. Those immigrants from southern Europe have significantly less education and number of degrees and

slightly less earnings. Immigrants from the rest of the world sample have the lowest earnings, however they have also been in the country the fewest number of years.

The estimates in Table IV were redone to allow for differences between native-born Canadians and immigrants from the five regions. The results reported in Table VIII show marked similarities among some of the groups. Those from the United States, the United Kingdom and western Europe diverge significantly from the native-born reference group in terms of the foreign-birth dummy variable and the foreign education variable. Years in Canada does not appear to influence these immigrants' incomes. Immigrants from eastern Europe, southern Europe and the rest of the world display similar patterns to each other. Years in Canada and years in Canada squared are both highly significant for the latter group of immigrants, and the foreign-birth dummy variable and foreign education variable are insignificant.

TABLE VI
Education of Foreign-Born

	(1)	(2)	(3)	(4)	(5)
EDUC	0.0195* (4.079)	-	0.0172* (3.447)	0.0238 (1.587)	0.0141** (2.143)
EDUCPRE	-	0.0167* (3.243)	-	-	-
EDUCPOST	-	0.0145* (2.710)	0.00714 (1.638)	-	-
EDUC ²	-	-	-	-0.00213 (0.349)	-
EDYC	-	-	-	-	0.000332 (1.185)
DG	0.293* (6.066)	0.261* (5.255)	0.236* (6.130)	0.304* (5.697)	0.291* (6.136)
R ²	.42092	.38307	.42172	.41245	.42111

Also controlled for but not included here are the other explanatory variables listed in Table IV.

Based on the above results the immigrant population has been split into two groups: those from United States, United Kingdom and western Europe (UUWE); and those from eastern Europe, southern Europe and other (EESEOT). The former are culturally and linguistically most similar to native Canadians, whereas the EESEOT group is more diverse. The means for these two groups differ substantially. The UUWE group earns considerably more (\$9097) than the EESEOT group (\$7903) or the native-born group (\$7480). To some extent this is expected: they have on average over three years more experience and nearly four more years in Canada than the EESEOT group. Beyond what may just be timing differences, however, the UUWE group also appears to be more highly qualified and to have worked longer than EESEOT

TABLE VII
Means Tabulated by Place of Birth

		United States, United Kingdom	Western Europe	Eastern Europe	Southern Europe	Rest of the World
EXP	(years)	23.211	21.111	24.180	18.074	14.956
EDUC	(years)	12.825	11.639	10.800	7.296	13.000
DG	(%)	21.2	11.1	12.0	1.5	30.4
YRIC	(years)	20.196	18.175	23.024	13.368	9.491
EARN	(\$)	9330	8734	7951	7998	7739
Sample Size		414	262	197	182	167
% of Total		5.7	3.6	2.5	2.7	2.3
% of Foreign- Born		33.9	21.4	16.1	14.9	13.7

immigrants. They have over two more years of education, more than one-third as many more degrees, more have completed an apprenticeship or training program, and more work full-time. Despite longer workforce histories, nearly 7 percent fewer have had a spell of absence from the labour market exceeding a year (11.1 percent versus 18 percent) and the average number of spells of unemployment over 3 months is lower (.96 versus 1.20).

The regression results are reported in Table V. The place of birth does seem to make some differences to the returns to education, experience, years in Canada and the interaction between these. The UWE group appear to behave much as the foreign-born as a whole, with coefficients marginally lower in absolute value in most cases. However the weeks worked and the interaction of years in Canada and experience coefficients are higher for

TABLE VIII
Pooled Regressions By Country of Origin

<u>ORIGIN</u>	<u>FORED</u>	<u>YRIC</u>	<u>YRIC²</u>	<u>FOR</u>
United States & United Kingdom	-0.0258* (2.674)	0.00569 (1.168)	-0.000101 (1.263)	0.223*** (1.708)
Western Europe	-0.0295* (2.744)	0.00599 (0.723)	-0.000224 (1.493)	0.317*** (1.913)
Eastern Europe	-0.0181 (1.632)	0.0318* (3.131)	-0.000419* (1.676)	-0.120 (0.932)
Southern Europe	-0.00862 (0.775)	0.0271* (2.892)	-0.000438* (2.744)	-0.255 (1.419)
Other World	-0.00432 (0.351)	0.0204** (2.497)	-0.000327*** (1.721)	-0.246 (1.517)

t-statistics in brackets. Also controlled for but not reported in these results are the other explanatory variables listed in and at the bottom of Table IV.

the UUWE group. The EESEOT group, however, is somewhat different. The return to the 'credential' effect of having a degree and completing an apprenticeship or training program is significantly higher for this group.

The rates of return to education and years spent in Canada are also considerably different for the two groups. In both cases the returns are higher for those from eastern Europe, southern Europe and the rest of the world. Finally, the continual work experience variables (NPERUN and BREAK) appear to exhibit different patterns. Not working for at least one year after their first job affects the EESEOT group significantly more than the UUWE group. Although insignificant, the number of periods of unemployment variable takes on different signs for the two.

At 10 years of experience and 5 years in Canada for the UUWE group the total effect on earnings for both an additional year of experience and

Canadian residence is 2.3 percent. Similar immigrants from EBSEOT on the other hand register 3.4 percent earnings gain, whereas the input is 2.0 percent for the native-born with the same level of experience.

IV. ESTIMATES USING MINCER'S IDENTITY

(1) The Extended Model

With cross-sectional data it is not usually possible to measure labour market experience directly in a human capital model because data on the relevant variables do not exist. Two alternatives are generally presented in the labour market literature. The first is to use actual age as a proxy for experience.²⁰ The second, and more common approach, is to use Mincer's T. This is defined as age minus education minus five (or six). Mincer (1974) and many others, have successfully used T to approximate actual experience, especially for males.

The problem with using T is that it measures potential labour market experience. Mincer's T is an accurate measure of experience only if there are no major work interruptions after leaving school. If, however, there are various interruptions in one's working life they will not be accounted for when using T. As seen in Table III, 11.5 percent of all native-born Canadians have had at least a one year break in their working lives. The figure for the foreign-born is 14.2 percent.

Some of these interruptions may be a result of individuals going back to school to further their education. In such cases there would still be no difference between using T or the experience variable. However, this does not appear to be the case for most of the individuals sampled. The average age for the native-born is 39.7 years, and for immigrants it is 41.5 years.

Given the educational means found in Table III, potential experience for the native-born is 23.5 years. Potential experience for the foreign-born is 25.1 years. The gap between potential and actual experience for the native-born is 3.1 years. For the foreign-born the gap between potential and actual experience is even bigger at 4.1 years. These sizeable differences cannot be ignored.²¹ Some of these gaps are due to students not starting school at age 5, the possible lengthy time it took immigrants to transport themselves to Canada, or the inability of immigrants to acquire employment immediately upon entering Canada.

Since potential experience is a proxy for actual experience, some of the previously cited earnings functions were re-estimated using Mincer's identity. Table IX presents the results. Column (1) is the re-estimation of equation (3). As previously stated when using actual experience the variable measuring post-immigration education was insignificant [see Table VI, Column (3)]. When using Mincer's approach the same result holds. However, the interaction term ($EXP \times YRIC$) was significant at the one percent level. Now this term ($YRIC \times T$) is insignificant, a result similar to Chiswick's (1978b, p.904, footnote 12).

Column (2) reproduces the foreign-born regression found in Table V, excluding the interaction term. The return to experience, using T , drops from 3.87 percent to 2.97 percent. This represents a drop of almost one percent a year. The decay variable (T^2) also drops in value.

What is important to note in Column (2) is that the predicted percent increase in earnings ($\Delta \ln E$) at different years of residence ($YRIC$) has changed dramatically. It is 1.2 percent after 1 year, 5.0 percent after 5

TABLE IX

Separate Regressions Using Mincer's Identity

Variables	(1) FOREIGN BORN (Equation 3)	(2) FOREIGN BORN (Table V)	(3) NATIVE BORN (Table V)
EDUC	0.0130* (2.891)	0.01351** (2.386)	.04075* (13.58)
EDUCPOST	-0.00999 (1.009)	-	-
T	0.0262* (4.396)	0.02975* (6.222)	.03426* (16.16)
T ²	-0.000623* (4.153)	-0.000737* (8.189)	-0.000623* (15.58)
YRIC	0.0171* (2.850)	0.01205* (3.651)	-
YRIC ²	-0.000256 (1.506)	-0.000398* (4.433)	-
EEA (YRIC x T)	0.000075 (0.242)	-	-
LNWKS	0.7481* (17.567)	0.7499* (17.628)	0.6635* (35.31)
DG	0.305* (6.244)	0.302* (6.163)	0.223* (8.92)
Constant	5.16	5.128	5.125
R ²	.40965	.40964	.46797
N	1222	1222	6054

Controlled for but not shown here are the other explanatory variables listed in Table V.

years, 8.1 percent after 10 years, 8.2 percent after 20 years, and -15.5 percent after 40 years. Returns to another year in Canada are maximized at 9.8 percent; with 15.1 years in Canada.²²

As in Section III one can see the effect on earnings assuming $T=10$ and $YRIC=5$. An additional year of experience ($\partial \ln E / \partial T$) raises foreign incomes by 1.50 percent. In this case the years in Canada times potential experience term is not included because of the insignificant coefficient. An additional year in the country ($\partial \ln E / \partial YRIC$) raises earnings by 0.81 percent. The total return is now 2.31 percent. Previously the total return was 3.05 percent.

Column (3) of Table IX also contains the estimates for the native-born also using potential experience. In this case the rate of return to experience is 3.43 percent, where previously it was 3.31 percent. There is little change in in the two cases. For $T=10$ the return for an additional year of experience is 2.18 percent, compared to a previous estimate of 2 percent.

Again, similar to Chiswick (1978b), one can find the coefficient for native-born born experience to be greater than foreign born experience when controlling for education, T , T^2 , log of weeks works and years of residence in Canada. Tandon (1977, p. 56, p.71) also finds that the rate of return to potential experience for Canadian males born in the United Kingdom, western Europe, southern Europe and the rest of the world is lower than for Canadian born males. This result is opposite to the one using actual experience. The only group that has a higher return than the native-born are immigrants born in the United States. However, this last group only has a sample of 111.

(ii) The Simplified Model

In this section I re-estimate the results found in Tables IV and V using the variables found in Chiswick's (1978b) seminal paper. The reason for this exercise is straightforward. Given the rather substantial differences found when comparing Mincer's identity to actual experience it maybe useful to change the specification of equations (1 and 3) to fit Chiswick's model. In this way it is possible to determine if the differences cited above are a result of the inclusion of many of the explanatory variables found in Table II, or if they are due to using potential rather than actual experience.

Two different sets of regressions are estimated. The first [Tables X and XI], are based on the same population used throughout this paper (N=7277). Tables XII and XIII are based on more (N=11202) observations but the final results change very little.²³

The earnings function for the native-born is:

$$(6) \ln EARN_j = \ln EARN_o + \beta_1 EDUC_j + \beta_2 T_j + \beta_3 T_j^2 + \sum_{i=4}^N \beta_i X_{ij} + U_j.$$

For the foreign-born the earnings function is:

$$(7) \ln EARN_j = \ln EARN_o + \beta_{1b} EDUC_j + (\beta_{1a} - \beta_{1b}) EDUC_{aj} + \beta_{2b} T_j + (\beta_{2a} - \beta_{2b}) T_{aj} + \beta_{3b} T_j^2 + (\beta_{3b} + \beta_{3a}) T_{aj}^2 - 2\beta_{3b} T_j T_{aj} + \sum_{i=4}^N \beta_i X_{ij} + U_j.$$

As previously done, years in Canada (YRIC) is substituted for T_a and years in Canada squared ($YRIC^2$) for T_a^2 . The following regressions also included: the natural logarithm of weeks worked (LNWKS), urban-rural variables (URBAN2-URBAN4), regional variables (DR2-DR5), a marriage variable

TABLE X

Pooled Regressions Using Mincer's Identity
(Small Sample)

	(1)	(2)	(3)
EDUC	0.0561* (29.683)	0.05644* (29.841)	0.0602* (16.270)
T	0.0367* (20.734)	0.0359* (20.169)	0.0364* (21.411)
T ²	-0.000649* (21.633)	-0.000640* (21.333)	-0.000645* (21.500)
LNWKS	0.735* (43.235)	0.730* (41.954)	0.727* (41.782)
MAR	0.142* (6.605)	0.141* (5.127)	0.138* (5.111)
DR2	0.0401** (2.228)	0.0402** (2.197)	0.0420** (2.333)
DR3	0.153* (8.567)	0.150* (8.449)	0.145* (8.185)
DR4	-0.0190 (1.056)	-0.0199 (1.106)	-0.0221 (1.227)
DR5	0.181* (8.419)	0.182* (8.667)	0.179* (8.524)
URBAN2	-0.0192 (1.129)	-0.0213 (1.238)	-0.0198 (1.165)
URBAN3	-0.119* (7.000)	-0.122* (7.176)	-0.119* (7.000)
URBAN4	-0.273* (18.446)	-0.274* (18.639)	-0.267** (19.071)
FOR	-0.00379 (0.243)	-0.160* (4.907)	0.0279 (0.481)
YRIC		0.0164* (5.467)	0.0145* (4.769)
YRIC ²		-0.000263* (4.383)	-0.000242* (4.033)

TABLE X (continued)

Pooled Regressions Using Mincer's Identity
(Small Sample)

	(1)	(2)	(3)
FORED			-0.0144* (3.861)
Constant	5.018	5.042	5.005
$\bar{R}^2$	0.408	0.410	0.411
N	7277	7277	7277

Note: The equations in this table are based on equation (3) in the text.

TABLE X1

Separate Regressions Using Mincer's Identity
(Small Sample)

Variables	(1) Foreign-Born	(2) Foreign-Born	(3) Native-Born
EDUC	0.0441* (11.574)	0.0435* (11.447)	0.0597* (27.137)
T	0.0321* (5.701)	0.0355* (8.392)	0.0365* (18.622)
T ²	-0.000693* (4.620)	-0.000671* (8.387)	-0.000641* (16.025)
LNWKS	0.782* (18.619)	0.786* (18.647)	0.714* (37.579)
MAR	0.0963 (1.356)	0.0922 (1.291)	0.148* (4.983)
DR2	0.0691 (0.922)	0.0673 (0.894)	0.0366*** (1.937)
DR3	0.128** (1.969)	0.122*** (1.877)	0.144* (7.579)
DR4	-0.0111 (0.163)	-0.0127 (0.187)	-0.0278 (1.471)
DR5	0.0736 (1.082)	0.0692 (1.018)	0.205* (8.913)
URBAN2	-0.0256 (0.624)	-0.0194 (0.463)	-0.0253 (1.339)
URBAN3	-0.139* (2.957)	-0.134* (2.851)	-0.123* (5.828)
URBAN4	-0.0979* (2.597)	-0.0895** (2.419)	-0.294* (18.375)
YRIC	0.0159* (2.695)	0.0145* (4.833)	
YRIC ²	-0.000311 (1.829)	-0.000236* (3.933)	
EEA (TxYRIC)	0.000156 (0.503)		

TABLE XI (continued)
Separate Regressions Using Mincer's Identity
 (Small Sample)

Variables	(1) Foreign-Born	(2) Foreign-Born	(3) Native-Born
EDUCPOST	-0.00854 (0.862)		
Constant	4.975	4.921	5.058
R^2	0.358	0.354	0.420
N	1222	1222	6054

(MAR), an interaction variable controlling for experience and years in Canada (TxYRIC), years of education (EDUC), post-immigration education (EDUCPOST), foreign education (FORED), and dichotomous variables for foreign-birth (FOR).

Equation (7) is reported in the first column of Table XI. Again when using T, the interaction term (TxYRIC) is statistically insignificant. The coefficient for post-immigration education is also statistically insignificant. In the larger sample [Table XIII, Column 1], both coefficients are still insignificant.

Whether one uses a full set of explanatory variables or a reduced set, with either potential or actual experience, the results demonstrate that the coefficient for post-immigration education is insignificant. The continual insignificance of this variable is consistent with Chiswick's (1978b) work. When using T, either with an extended set of explanatory variables or the extended sample, the coefficient for the interaction term (EEA) is also insignificant. As shown previously, the same is not true for the latter when using actual experience. Given the lack of significance for these variables they are dropped from the remaining earnings functions.

The pooled regressions are reported in Table X and Table XII. The coefficient of the foreign-born men variable (FOR) in column (1) of both tables implies that, ceteris paribus, foreign-born men do not have different earnings than the native-born. The conclusion from these regressions, is that there are no significant differences between the native and foreign-born.

TABLE XII

Pooled Regressions Using Mincer's Identity
(Extended Sample)

	(1)	(2)	(3)
EDUC	0.0521* (32.563)	0.0521* (32.562)	0.0557* (30.757)
T	0.0342* (23.101)	0.0334* (22.416)	0.0339* (22.752)
T ²	-0.000599* (19.967)	-0.000590* (19.667)	-0.000595* (19.833)
LNWKS	0.707* (52.897)	0.703* (52.857)	0.701* (52.549)
MAR	0.303* (21.983)	0.304* (22.189)	0.303* (21.153)
DR2	0.0615* (4.025)	0.0612* (4.080)	0.0621* (4.075)
DR3	0.178* (11.927)	0.176* (12.571)	0.172* (11.544)
DR4	0.0135 (0.882)	0.0119 (0.793)	0.00955 (0.637)
DR5	0.234* (13.706)	0.233* (13.706)	0.230* (13.165)
URBAN2	-0.0294** (2.100)	-0.0319** (2.279)	-0.0308** (2.124)
URBAN3	-0.125* (8.929)	-0.128* (8.767)	-0.125* (8.582)
URBAN4	-0.276* (23.000)	-0.279* (22.500)	-0.273* (22.750)
FOR	-0.0107 (0.823)	-0.189* (7.000)	-0.0191 (0.398)
YRIC		0.0187* (6.233)	0.0172* (6.880)
YRIC ²		-0.000295* (5.900)	-0.00251* (5.620)

TABLE XII(continued)

Pooled Regressions Using Mincer's Identity
 (Extended Sample)

FORED			-0.0135* (4.219)
Constant	5.003	5.030	4.994
$\bar{R}^2$	0.426	0.429	0.430
N	11202	11202	11202

When controlling for the number of years in Canada (YRIC) the partial effect of foreign-birth (FOR) on earnings is highly significant. This is true for both sample sizes. However, as opposed to Table IV column 2 the coefficient is now negative, whereas before it was positive.

In Table X the earnings of the foreign-born increase at a decreasing rate with time spent in Canada. Other things being equal, the earnings of the foreign-born ($\Delta \ln E / \Delta \text{FOR}$) are 14.4 percent less than the native-born after one year in Canada, 8.5 percent after 5 years, 2.2 percent after ten years, equal after about 12 years, and 6.3 percent greater after 20 years. With the reduced set of explanatory variables we still see that the earnings of the foreign-born eventually exceed those of the native-born.

Previously it was observed that foreign-born earnings rise at an increasing rate when using actual experience. The same general pattern emerges with the present estimates, an initial earnings gap of 14 to 17 percent is closed after less than 16 years.

Controlling for differences in the return to foreign education still appears to be important. Including foreign-education (FOREN) in Table X reduces the coefficient for FOR to an insignificant level. The return to the native-born for an additional year of schooling is 6.02 percent, while it is 4.58 percent for the foreign-born. This is a substantial increase in the returns to education reported in Table IV. The exclusion of many key variables, especially the acquisition of a degree and completing an apprenticeship or training program may explain these differences.

When examining the separate regressions [Table XI] it can be seen that the partial effect of a year of school for the foreign-born is 4.35 percent

and 5.97 percent for the native-born. The returns are slightly lower for the extended sample [Table XIII]. The coefficients for the experience increase in earnings ($\Delta \ln E$) at different years since immigration is 1.4 variables (T , T^2) are marginally lower in absolute terms for the foreign-born in both tables. This might indicate a smaller effect on earnings in Canada of labour market experience prior to immigration. However, the results reported in Table V appear to contradict this assumption. Pre-immigration experience has a larger effect on earnings in Canada for the foreign-born than does total Canadian experience by the native-born.

Among foreign-born persons, earnings rise at a decreasing rate [Table X] as time spent in Canada increases (peaking at 31 years). The predicted gains are: .2 after 1 year; 6.7 percent after five years; 12.1 percent after 10 years; 19.6 percent after 20 years; 22.3 percent after 30 years; and 20.2 percent after 40 years.

Referring to Table X, an additional year of experience evaluated at 10 years of experience ($T=10$) and 5 years in Canada ($YRIC = 5$) raises native-born earnings by 2.37 percent. For the foreign-born an additional year of experience raises incomes by 2.21 percent. For an additional year in Canada earnings are raised by 1.21 percent. The total return to the foreign-born is 3.42 percent.

(111) Mincer's Identity and Experience

The notable differences when comparing Mincer's identity to actual experience are summarized in Table XIV. Column (2) reports the results using Mincer's identity based on column (2) reported in Table IX. Columns (2) and (3) are based on the results reported in this section. The former

TABLE XIII

Separate Regressions Using Mincer's Identity
(Extended Sample)

	(1) Foreign-Born	(2) Foreign Born	(3) Native-Born
EDUC	0.0409* (12.852)	0.0402* (12.681)	0.0552* (29.519)
T	0.0319* (6.702)	0.0335* (10.667)	0.0352* (20.552)
T ²	-0.000673* (5.608)	-0.000659* (9.414)	-0.000584* (11.680)
LNWKS	0.750* (23.438)	0.756* (23.262)	0.689* (47.192)
MAR	0.235* (6.714)	0.237* (6.639)	0.314* (21.074)
DR2	0.0516 (0.819)	0.0533 (0.888)	0.0569* (3.601)
DR3	0.103 (1.873)	0.102*** (1.813)	0.173* (10.881)
DR4	-0.0349 (0.602)	-0.0331 (0.564)	0.00665 (0.413)
DR5	0.0816 (1.407)	0.0823 (1.470)	0.254* (13.368)
URBAN2	-0.0393 (1.126)	-0.0372 (1.063)	-0.0336** (2.094)
URBAN3	-0.124* (3.024)	-0.122* (2.976)	-0.131* (8.259)
URBAN4	-0.112* (3.487)	-0.105* (3.228)	-0.296* (21.765)
YRIC	0.0188* (38.286)	0.0171* (6.790)	
YRIC ²	-0.000333** (2.379)	-0.000267* (5.340)	
EDUCPOST	0.00802 (1.002)		

TABLE XIII (continued)

Separate Regressions Using Mincer's Identity
(Extended Sample)

	(1) Foreign-Born	(2) Foreign Born	(3) Native-Born
EEA(YRICxT)	0.000129 (0.029)		
Constant	4.965	4.899	5.039
R^2	0.381	0.378	0.436
N	1855	1855	9347

is from the restricted sample and the latter are for the extended sample. Column (4) is derived from my earlier results in section III.

The first three columns in Table XIV using Mincer's T report very similar results. However, column (4) demonstrates that there are indeed some important differences between using potential and actual experience.

TABLE XIV
Mincer's Identity   Actual Experience

Returns to Coefficient from	Results obtained from			
	Table IX	Table XI	Table XIII	Table V
Mincer's T or Experience	Greater for the native-born.	Greater for the native-born.	Greater for the native-born.	Greater for the foreign-born.
Returns to Years in Canada	Increase at a decreasing rate. Maximized at 15.1 years in Canada.	Increase at a decreasing rate. Maximized at 31 years in Canada.	Increase at a decreasing rate. Maximized at 32 years in Canada.	Increase at a slightly increasing rate.
YRIC or EXP	Insignificant.	Insignificant.	Insignificant.	Significant.
Returns to 10 years of experience and 5 years in Canada.	Foreign-born 2.31% Native-born 2.18%	Foreign-born 3.42% Native-born 2.37%	Foreign-born 3.65% Native-born 2.18%	Foreign-born 3.05% Native-born 2.00%

Why are there so many differences when using T rather than EXP? Also why, when using T, do the results appear to be so similar to equivalent American studies or Tandon's (1977) Canadian study? The answer appears to be the large gaps between EXP and T. Immigrants appear to be more efficient in translating a given year of work experience into greater income than the native-born. This is verified by the large unexplained portion found when there was a decomposition of the earnings functions and by the results from estimating equation (5). Only one-half of the foreign earnings advantage can be explained by superior endowments.

The differing rates of return to experience between the native and foreign-born may be attributed to several causes. First, immigrants may have received superior training in job related skills prior to immigration. Second, they could have the same job related skills but be more motivated. Finally, since it is only a select group that migrate to Canada they may have greater abilities.

Using Mincer's identity obscures these estimated efficiency differences between the two groups. There are two reasons for this. First, using T instead of actual experience causes a proportionate downward bias in the estimated coefficient due to the standard errors-in variables problem (Judge et. al., 1982, pp. 532-535). Since the foreign-born receive greater returns to actual experience, the same proportionate downward bias translates into a smaller absolute difference in estimated efficiency. Second, T overstates actual experience by 4.14 years for the foreign-born, but by only 3.11 years for the native-born.

The differences between experience and Mincer's identity can be highlighted with the use of a simple figure and a few equations. Income will be determined by experience (EXP) or Mincer's identity (T) in the following form:

$$\ln y = \beta_1 (\text{EXP}) + \epsilon$$

$$\ln y = \beta_1 (T) + \epsilon$$

where $T = \text{EXP} + U$, U is an error term with a non-negative expected value $E(U) > 0$. Using F (foreign) and N (native) as subscripts for the two populations we can write:

$$\ln y_F = \beta_1 (\overbrace{EXP_F} + U_F) + \varepsilon_F$$

$$\ln y_N = \beta_1 (EXP_N + U_N) + \varepsilon_N$$

where $U_F > U_N$. For the foreign-born the unexplained difference between experience and $T(U_F)$ is quite large. This would indicate, especially for those with greater experience, a pronounced difference in β_1 in the foreign-born regressions.

Figure I helps to illustrate this point more clearly. The figure shows the relation between earnings, experience and Mincer's identity for the foreign-born. Line (a) is the 'true' relation between experience and earnings. Line (b) is the estimated relation between earnings and T . Since T is greater than experience, and as workers get older the difference between the variables gets larger the slope of (b) will be flatter than (a). Finally, since the gap between the native-born variables is less significant than the foreign-born, the differences in the slope for the former's earnings functions should be less pronounced.

The above situation is akin to the problem of using potential experience in regression analysis when analyzing the earnings of women. With significant interruptions in actual experience the use of Mincer's identity becomes less useful. Meng and Sentance (1986) have shown that Long's (1980) estimates are also biased when analyzing the earnings of immigrant and foreign-born women because he uses Mincer's identity in his analysis as well.

Figure I

V. Summary and Conclusions

This paper analyzes the economic progress of foreign-born men in Canada. Overall this group earns 11 to 14 percent more than Canadian-born males, depending on the data base used. Some of the results of this paper are consistent with equivalent American and Canadian studies. However, there are enough differences to merit explicit mention below. The hypotheses stated in section II (ii) are also reviewed in detail.

Immigrants do start at an earnings disadvantage - 15 percent one year after entry. This is consistent with the argument that the foreign-born either have not acquired significant information about the labour market or that they face other obstacles such as language proficiency. This result is also similar to Chiswick's (1978b) finding that foreign-born Americans earn 14.9 percent less than the native-born one year after entry.

The initial wage gap diminishes with time spent in Canada. The crossover point occurs after approximately 14 years and immigrants earn more than the native-born. If human capital characteristics and abilities are measured correctly, the earnings of the foreign-born should catch up to native Canadians, but should not exceed their incomes. However, the immigrant earnings advantage appears to be a function not only of measured human capital endowments but also of unmeasured innate abilities or motivation. The human capital variables included in the analysis only accounted for 54 percent of the income gap.

The number of years in Canada is significant in explaining earnings for immigrants from eastern Europe, southern Europe and the rest of the world. It is less significant in determining the incomes of immigrants from the

United States, the United Kingdom or Western Europe. Immigrants from countries similar to Canada appear to adjust more quickly to the Canadian environment.

Like Chiswick (1978b), I find that there is little evidence to indicate that there are country-specific aspects of schooling. The returns to education are lower for first generation Canadians, a result similar to Tandon (1977), Carliner (1980) and Chiswick (1978b).

There may be aspects of country-specific work experience, but there is some ambiguity in the results. The coefficients for the experience variables (EXP , EXP^2) are larger in absolute terms for the foreign-born. This could indicate a larger effect on earnings in Canada of labour market experience prior to migration. This would imply that immigrants receive more productive training outside Canada.

The results reported here conflict with Chiswick's (1978b, pp. 908-909) findings. The lower return to potential experience for the foreign-born leads Chiswick to conclude that there is a smaller effect on earnings of experience prior to immigration in the United States.

As argued above, however, the higher rates to experience for the foreign-born only imply they are more efficient than the native-born. This result could occur because they receive superior training outside the country or because they are more productive due to motivation, self-selection or a host of other possibilities.²⁴

Some of the uncorrected earnings advantages immigrants receive is due to their settlement patterns. They are primarily found in large urban centres and the more industrialized provinces. However, these patterns do

not account for the substantial growth in earnings once they enter the country. When controlling for region and for city size, years in Canada and the other key variables listed above are still generally significant.

Unlike other researchers in the area, I have controlled for two credential effects (DG and APR). Both are significant in determining native and foreign-born earnings. However, the degree effect for the native-born (23.5 percent), and those born in the United States, United Kingdom and western Europe (25.7 percent) are almost identical. Those from the rest of the world on the other hand receive a much greater return (50.5 percent). The return to an apprenticeship or training program is also more significant for the latter group (14.2 percent) than the native-born (8.3 percent) or from the U.S., U.K. or western Europe (insignificant).

These results indicate that the return to signalling is much greater for the EESEOT group. Evidently questions concerning lack of knowledge of the immigrant's homeland, educational quality, and related factors are best dealt with by signalling with a degree or obtaining some form of training certificate.²⁵

The final hypothesis dealt with the pattern of income through time. It was hypothesized that immigrants' earnings profiles should be steepest in the first few years in the country. As time passes and their incomes equal and eventually exceed those of the native-born their earnings curve should become flatter.

When using Mincer's identity in the simplified model we find this to be the case. Immigrant incomes increase at a decreasing rate and the returns to years in Canada are maximized at 31 or 32 years [Table XIV, columns (2)

and (3)). Controlling for the same number of explanatory variables, Chiswick (1978b) finds very similar results - earnings for immigrants in America also increase at a decreasing rate and are maximized after 39 years in the country.

When using actual experience I find that a very different pattern emerges. The earnings of immigrants now rise at an increasing rate. However, this relationship is almost linear with the predicted percent increase in earnings with one year of residence being 1.0 percent and 44.8 percent with 40 years. When actual experience is used, there is no evidence to indicate that the earnings profile is steepest in the first few years in Canada. Implications?

Immigrants have steeper experience-earnings profiles after they arrive in Canada than do the native-born. Becker (1964) has shown that experience-earnings profiles are steeper for individuals with less firm-specific training. Due to the dual selection process it is possible that immigrants invest in more general types of training. In this way they may move from one job to another, or one firm to another, in order to gain information and about where their productivity and incomes would be the highest.²⁶

Most of the socio-economic background variables used in this study do not appear to be significant.²⁷ This could mean either that the background effects are generally unimportant or they effect the respondent's income in some other manner that has not been accounted for here.²⁸ When the variables are significant, such as: father's occupational status, mother tongue, respondent's religion and mother working, they appear to be more important for the native-born. This result may be due more to the

self-selection of immigration than anything else. Given that the foreign-born appear to be highly motivated, it seems likely that this motivational aspect (and the accompanying acquisition of additional human capital), rather than any socio-economic criteria, is the key determinant of their earnings.

FOOTNOTES

1. I used 1972 figures since this is the reference year for this paper. All relevant data come from the Canadian National Mobility Survey (1973).
2. Tandon (1977), in a more limited study, examines the earnings of immigrants and non-immigrants in Ontario. However, he infers the years of labour market experience and had to assign as year of immigration the mid-point of a several year period which immigration took place. He also excludes the self-employed, people living in rural areas, and only controls for a limited number of explanatory variables. Sociological studies have been carried out by Kalback and McVey (1979) and Richmond and Kalback (1980). These latter studies tend to be descriptive and they avoid using a theoretical model.
3. It is important to distinguish between economic migrants and refugees. The former, as shown by Chiswick (1979) are likely to catch up and surpass the incomes of the native-born faster than refugees.
4. Manski and Wise (1983) apply a double choice model to college enrollment in the United States. Although the questions of university attendance and immigration are analytically similar I will use the more traditional approach in analyzing immigration.
5. This is total number of years worked for pay or profit. A year of work is defined as having been employed, on a full-time basis (at least 35 hours a week) for at least seven months in a given calendar year.
6. After estimating (3) it was found that the coefficient for $EDUC_a$, in representing the difference between β_{1a} and β_{1b} , is insignificant at the 10 percent level ($t = 1.634$). The coefficient for $EXP_j \times EXP_a$, however, is highly significant, taking on a value of 0.000461 (23.842). On this basis the latter term is included in the analysis where appropriate. Chiswick (1978b) finds this interaction term to be insignificant ($t = 0.11$).
7. Chiswick (1977, 1978b, 1980b) and Carliner (1980) have both looked at immigrants and their native-born sons.
8. Use requires me to acknowledge the investigators responsible - M. Boyd, H.A. McRoberts, and J. Porter of Carleton University; F. Jones and P.C. Pineo of McMaster University; and J. Goyder, University of Waterloo--as well as the Canada Council and Statistics Canada.
9. CARMAC was a mobility study done by researchers at Carleton University, McMaster University and the University of Waterloo in conjunction with Statistics Canada and the Canada Council. The survey itself was fielded as an adjunct to the Statistics Canada Labour Force Survey.

Once completed the questionnaires were returned to Statistics Canada and edited by them.

The obvious advantages of such a process is that the Labour Force Survey is a continuous large Canadian cross-sectional study that attempts to select a representative sample of the Canadian population. In order to ensure the reliability of the results it was also useful for the principal researchers to work directly with Statistics Canada. (See Boyd et. al., 1985, Chapter 1, for a discussion of the sample design and implementation.)

10. Given the superior variables found in CARMAC it was felt that even though the latest Canadian Census was in 1981 it was best to use the former data base in this paper. By using CARMAC I can replicate existing studies, such as Chiswick's (1978b), as well as extend previous work in order to examine other key questions and issues. This option would not be available to me with census data.
11. All the coefficients for the natural log of weeks worked are less than one. Although this may indicate a backward bending supply of labour curve, it is more likely that this result is due to having to use a less than ideal variable for weeks worked.
12. The observed incremental F-ratios for the inclusion of the foreign variables with the critical F-ratios (F^*) at the one-percent level are:

Table IV	Added Variables	F	F^*
Column 1	1	3.81	6.63
Column 2	3	11.87	3.78
Column 3	4	11.54	3.32

13. $\Delta \ln E / \Delta \text{FOR} = -0.184 + .0136 (\text{YRIC}) - .000336 (\text{YRIC}^2) + .000176 (\text{EEA})$, where $\text{EEA} = (\text{YRIC} \times (\text{YRIC} + 3.336))$. However, the marginal effect of the dummy coefficient is -0.169 .
14. Individuals from various parts of the world will catch up to the native population at different points in time. The results seen in the text are only an average.
15. The critical F statistic at the one percent level ($F_{9, 7428}^* = 1.59$) is significantly less than the F statistic produced by the Chow test ($F = 3.08$).
16. This is calculated as $e^{\hat{\beta}} - 1$, where $\hat{\beta}$ is the estimated coefficient for the degree variable.
17. This result is in contrast to Chiswick's (1978b) findings for the United States that demonstrate that earnings rise at a decreasing rate. Rather than differences in U.S. and Canadian conditions, however, this appears to be a problem with some bias inherent in the proxy for experience.

18. It is possible that although most immigrant's mother tongue is not English they were still fluent in the language. The only variable reported on CARMAC is native tongue, the respondents were not asked if they spoke a second language while they were growing up.
19. The partial effect on LN earnings of country of origin variables are:

U.S. and U.K.	-0.0298 (1.220)
Western Europe	-0.0229 (0.651)
Eastern Europe	-0.0247 (0.605)
Southern Europe	0.0509 (1.192)
Other Foreign	-0.135* (3.458)

t-statistics in brackets

20. This is the approach adopted by Carliner (1980) when he examined the earnings of first, second and third generation Americans. See Blinder (1976) for a critical discussion concerning estimates using Mincer's identity, especially when developing earnings functions for women.
21. The unexplained gap between EXP and T does not necessarily mean the respondent was unemployed or out of the labour force for the entire calendar year. If one were unemployed, out of the labour force, or only working part-time for at least six months in a calendar year thus would not count as one year of working experience.
22. Chiswick (1978b) finds that rates of return are maximized at 29.61 percent at 39 years in the United States.
23. The means for this sample are:

	<u>Foreign-Born</u>	<u>Native-Born</u>
LEARN	8.989	8.838
EDUC	11.300	11.024
T	24.934	23.058
LNWKS	3.801	3.786

DR1 (%)	4.58	22.59
DR2 (%)	11.91	22.64
DR3 (%)	46.42	23.62

23. (continued)

	<u>Foreign-Born</u>	<u>Native-Born</u>
DR4 (%)	18.11	19.97
DR5 (%)	18.98	11.18
URBAN1 (%)	61.80	33.39
URBAN2 (%)	13.32	16.15
URBAN3 (%)	8.87	16.24
URBAN4 (%)	16.01	34.22
MAR (%)	88.03	84.97
YRIC	17.645	-
N	1855	9347

The extended sample means demonstrate that earnings for both immigrants and non-immigrants are now slightly lower than before. The same is true for years of schooling, weeks worked and potential experience. Unfortunately, the Canadian National Mobility Survey does have a large number of non-responses. Since it was necessary to remove records that did not adequately answer various questions, the total sample size was reduced substantially. With fewer explanatory variables in the equations it is not necessary to place so many restrictions on the data. Therefore, a second set of regressions [Tables XII and XIII] excludes only those records that failed to answer the questions that relate to the dependent variable (LNEARN) and the explanatory variables listed in the regressions below.

24. Tones (1983, 1984) and Meng and Sentence (1984) find that this same pattern emerges across religious groups. Jews receive a greater return to experience than do Protestants, Roman Catholics or other denominations. At the present time there is simply no way of telling if this difference is due to discrimination, motivation, or innate abilities.
25. Unfortunately the data do not provide information on where the degree was obtained. It would have been useful to see if there were any differences in obtaining a foreign degree or a Canadian degree.

26. Chiswick (1978a) examines the occupational mobility of immigrants in the United States. He finds that in general there is downward occupational mobility when the 'last job' in the country of origin is compared to the 'first job' in the country of destination. About 38 percent of the immigrants in the U.S. with less than 5 years in the country displayed occupational changes from 1965 to 1970. Among the native-born population 24 percent changed occupations from 1965 to 1970.
27. Corcoran et. al. (1976) find that after examining four major U.S. data bases: 'The only background characteristic that has a substantial effect on earnings with everything controlled is race' (p. 433). Griliches (1979) also finds that: 'Measured parental characteristics (except for race and religion) appear to affect earnings primarily via their effect on the level of schooling. The market does not appear to pay for them directly' (p. 559).
28. Bowles (1972), in particular, is highly critical of models that exclude parental incomes. He argues that there is a direct link between the respondent's own income and his parents. The returns to the various human capital variables are likely to be overestimated if this link is not explicitly examined.

REFERENCES

- Becker, G. (1964) Human Capital New York: NBER.
- Blinder, A. (1973) 'Wage discrimination: reduced form and structural estimates', Journal of Human Resources, 8, 436-455.
- Blinder, A. (1976) 'On dogmatism in human capital theory'; Journal of Human Resources, 11, 8-22.
- Borjas, G.J. (1985) 'Assimilation, changes in cohort quality, and the earnings of immigrants', Journal of Labor Economics, 3, 463-489.
- Borjas, G.J. (1982) 'The earnings of male Hispanic immigrants in the United States', Industrial and Labor Relations Review, 35, 343-353.
- Bowles, S. (1972), 'Schooling and Inequality from generation to generation'; Journal of Political Economy, 80, S219-S251.
- Boyd, M; J. Goyder, F. Jones, H. McRoberts, P. Pineo and J. Porter (1985) Ascription and Achievement: Studies in Mobility and Attainment in Canada, Ottawa: Carleton University Press.
- Carliner, G. (1976) 'Returns to education for blacks, anglos, and five Hispanic groups', Journal of Human Resources 11, 172-184.
- Carliner, G. (1980) 'Wages, earnings and hours of first, second and third generation American males', Economic Inquiry, 18, 87-102.
- Chiswick, B. (1977) 'Sons of immigrants: are they at an earnings disadvantage?' American Economic Review Papers and Proceedings, 67, 376-380.
- Chiswick, B. (1978a) 'A longitudinal analysis of the occupational mobility of immigrants', in Proceedings of the 30th Annual Winter Meeting, Industrial Relations Research Association, ed. by B. Dennis, Madison, Wisconsin.
- Chiswick, B. (1978b) 'The effect of Americanization on the earnings of foreign-born men', Journal of Political Economy, 86, 897-921.
- Chiswick, B. (1979) 'The economic progress of immigrants: some apparently universal patterns', in Contemporary Economic Problems, ed. by W. Fellner, Washington: American Enterprise Institute.
- Chiswick, B. (1980a): An Analysis of the Economic Progress and Impact of Immigrants, Final Report to the U.S. Dept. of Labour, NIIS No. PB. 80-20054.

Chiswick, B. (1980b) 'The earnings of white and colored male immigrants in Britain', Economica, 47, 81-87.

Chiswick, B. (1983a) 'An analysis of the earnings and employment of Asian-American men', Journal of Labor Economics 1, 197-214.

Chiswick, B. (1983b) 'The earnings and human capital of American Jews', Journal of Human Resources, 18, 313-336.

Chiswick, B. (1984a) 'Differences in educational attainment among racial and ethnic groups: patterns and hypotheses regarding the quality and quantity of children', (memo).

Chiswick, B. (1984b) "Human capital and the labour market adjustment of immigrants: testing alternative hypotheses" in Migration Theory Human Capital and Development, ed. by I. Sirageldin and O. Stark, Greenwich: JAI press.

Chiswick, B. (1986) 'Is the new immigrant less skilled than the old?' Journal of Labour Economics, 4, 168-192.

Chiswick, B., and P. Miller (1984) 'Immigrant generation and income in Australia', Hoover Institute Stanford University Working Papers in Economics, No. E-84.

Corcoran, M., C. Jencks, and M. Olneck (1976) 'The effects of family background on earnings', American Economic Review Papers and Proceedings, 66, 430-435.

Griliches, Z. (1979) 'Sibling models and data in economics: beginning of a survey', Journal of Political Economy, 87, 537-564.

Judge, G., R. Hill, W. Griffiths, H. Lutkepohl and T. Lee (1982) Introduction to the Theory and Practice of Econometrics, New York: J. Wiley.

Kalback, W. and W. McVey (1979) The Demographic Bases of Canadian Society, Toronto: McGraw-Hill Ryerson.

Long, J. (1980) 'The effect of Americanization on earnings: some evidence for women', Journal of Political Economy, 88, 620-629.

Manski, C., and D. Wise (1983) College Choice in America, Cambridge: Harvard University Press.

Masters, S. (1972) 'Are black migrants to the south to the northern cities worse off than blacks already there?', Journal of Human Resources, 7, 411-423.

Meng, R., and J. Sentence (1984) 'Religion and the determination of earnings: further results', Canadian Journal of Economics, 17, 481-488.

- Meng, R., and J. Sentence (1986) 'The earnings of immigrant women: Canadian evidence', Brock University, Economics Working Paper.
- Mincer, J. (1974) Schooling, Experience and Earnings, New York: NBER.
- Oaxaca, R. (1973) 'Male-female wage differentials in urban markets' International Economic Review, 14, 693-709.
- Richmond, A., and W. Kalback (1980) Factors in the Adjustment of Immigrants and Their Descendants, Ottawa: Supply and Services.
- Robinson, C. and N. Tomes (1982) 'Self-selection and interprovincial migration in Canada', Canadian Journal of Economics, 15, 474-503.
- Sjaastad, L. (1962) 'The costs and returns to human migration', Journal of Political Economy, 70, 580-593.
- Statistics Canada (1984) Canada's Immigrants, Ottawa, 1984.
- Schwartz, A. (1976) 'Migration, age and education', Journal of Political Economy, 84, 701-719.
- Spence, M. (1973) 'Job Market Signalling' Quarterly Journal of Economics, 87, 355-374.
- Tandon, B. (1977) "An empirical analysis of the earnings of foreign-born and native-born Canadians", Ph.D. dissertation, Queen's University.
- Tomes, N. (1983) 'Religion and the rate of return on human capital: evidence from Canada', Canada Journal of Economics, 16, 122-138.
- Tomes, N. (1984) 'The effects of religion and demonination on earnings and returns to human capital', Journal of Human Resources, 19, 472-488.

CHAPTER THREE

COMPENSATING WAGE DIFFERENTIALS

in the CANADIAN LABOUR MARKET

I. INTRODUCTION

"The whole of the advantages and disadvantages of the different employments of labour and stock must, in the same neighborhood, be either perfectly equal or continually tending to equality." The theory of compensating wage differentials originates with the quotation above from Adam Smith. In The Wealth of Nations Smith argued that there were five principal determinants of income: "first, the agreeableness or disagreeableness of the employments themselves; secondly, the easiness and cheapness, or difficulty and expense of learning them; thirdly, the constancy and inconstancy of employment in them; fourthly, the small or great trust which must be reposed in those who exercise them; and fifthly, the probability or improbability of success in them"¹.

All five determinants of income listed above are the basis for compensating wage differentials. This paper focuses primarily on the agreeableness of employment. Occupations that have greater risks in terms of the probability of death or injury, or are less desirable in some other way should, ceteris paribus, pay higher wages than more desirable occupations.²

Until recently there has been very little theoretical and empirical work done on this subject. The rebirth of this theory has occurred for two reasons. First, economists have started to become more aware of the role of risk and uncertainty in determining incomes. Human capital theory and signalling models concentrate on individual characteristics in determining market outcomes. These models emphasize the ability of workers to acquire certain skills or credentials. Little attention is paid to the work process

itself to explain individual incomes. Human capital theory and the screening hypothesis both assume homogeneous employment, whereas Smith's theory of compensating differentials does not make such an assumption. Second, detailed micro data bases were not available until the 1960s and 1970s. Micro data, although not essential to the theory of compensating differentials, do help to link individual incomes to the risks that workers face.

Recently, Smith's theory of equalizing differences has been extended in a number of ways. One of the most interesting areas of research, from a public policy perspective, has dealt with the "value of life". From the earnings equations, it is possible to impute what workers are willing to pay for variations in the extent of work place risk. These estimates of worker valuations of risk are very useful in applied cost-benefit analysis. With limited resources, governments often must decide whether or not to improve health and safety in the work place. The benefits of reducing the possibility of work fatalities have traditionally been hard to measure. To avoid ad hoc decisions on the part of regulators the value of life literature has attempted to estimate the benefits of greater safety.³

The second objective of this paper is to give numerical estimates of worker assessments of risk using Canadian data. To the author's knowledge there have been no other studies done in this country that have presented such estimates. In a recent survey of the literature, Digby and Riddell (1986) point out that given the high injury and fatality rates in Canadian industry the amount of research done in this area by economists is inadequate. They cite numerous American and British studies that have

estimated the willingness to pay for increased safety in the work place.

But, to date there have been no serious Canadian attempts that have analyzed this important policy issue.⁴

The plan of this paper is as follows. Section II presents the basic theory of compensating wage differentials and a summary of some of the empirical research done in this area in North America and Great Britain. Section III presents the earnings model, a description of the data, and the empirical estimates. Section IV compares the results presented here with the results of other studies. The last section provides a summary and conclusion.

II. COMPENSATING WAGE DIFFERENTIALS:

THEORY AND EVIDENCE

This section is divided into three parts. The first sub-section discusses the theory of compensating wage differentials and presents a simple model of the relationship between income and job hazards. The second sub-section presents a short summary of the empirical literature. It also includes some of the problems associated with estimating compensating differentials using labour market data. The third and final sub-section reviews the related literature on risk valuation that does not utilize labour market data.

(i) The Determinants of Individual Incomes

Human capital theory argues that education and other productive investments have a payoff in terms of higher incomes. The greater the level of education the greater the level of income. The signalling hypothesis also emphasizes individual characteristics as an important determinant

of personal income. According to this hypothesis, education is a productivity signal to potential employers. The signalling theory argues that education is useful for distinguishing between high productivity workers and low productivity workers rather than for altering productivity levels.

The post-Smithian theory of equalizing differences does not deny the importance of human capital variables like education or signalling in explaining earned income. The theory of compensating wage differentials simply attempts to go beyond individual characteristics to examine how other aspects of employment also affect income. Rather than being a substitute for human capital theory or signalling models the theory of compensating differentials examines the other side of the exchange relationship. Whereas the former theories tend to concentrate on the supply of workers for various occupations the latter explicitly analyzes the demand for jobs.

Thaler and Rosen (1975) relate equalizing differences to a tied sale. Workers sell their labour to companies and buy non-pecuniary aspects of their jobs in return. Companies hire labour and sell non-financial job characteristics to workers. There are demand and supply curves for market safety and job quality. As opposed to other markets, however, the market clearing price for job quality must be imputed, since we do not see health and safety sold separately.

The theory of compensating differentials is based on several key assumptions. First, workers care both for monetary rewards from working as well as the 'quality' of their jobs. The quality of a job is the unique set

of characteristics attached to it. Examples of occupational characteristics are the ability to control one's working hours or work pace, the amount of stress in the job or the exposure to risk of injury or death.

Second, workers are assumed to be aware of the different characteristics of most occupations. More risky occupations than others in terms of the probability of injury or death are known to the workers in those jobs as well as to possible new entrants into them. Perfect information may not be available but it is assumed that there is enough information at hand for workers to make rational choices. Workers are on average aware of the risks associated with a given occupation.

The third assumption is that workers have a range of jobs to choose from. A compensating differential for risk of death, for example, can only occur if workers are able to choose from a variety of safe and potentially hazardous jobs. Changing occupations is neither costless, nor instantaneous. Choice of employment within this context can come about in several ways. First, individual workers may change jobs over time. Flanagan, Ehrenberg and Smith (1984, p. 185) point out that one in five American blue-collar workers were employed in a completely different occupation in 1970 than the occupation they held in 1965. Second, new labour market entrants may have several occupational choices to choose from. With a range of job offers individuals will choose the one that maximizes their utility. Even if only one job offer is available, workers are not excluded from searching for other forms of employment once they have started working.

Under these conditions, workers make occupational choices just as consumers choose among products. In this case, however, health and safety in the work place has a shadow price rather than a price that is quoted in the market. But in principle, there is little difference between basic consumer theory and a worker's job decision in the labour market.

Researchers in consumer theory argue that the quality of a good is related to measurable specific variables such as the size or weight of the product (Rosen, 1974). The quality of an occupation is similar. The only significant difference between consumer goods and occupations is that safety and risk do not have a market price. The imputed price of an occupation is estimated by specifying it to be a function of job quality. The 'hedonic technique' as applied to the labour market examines occupational characteristics and their valuations.

If all occupations pay the same wage rate, those occupations that are more 'pleasant' will attract more workers. This implies that the jobs with better qualities will have increased supply, which drives down the occupational wage rate. Jobs with more hazards attached to them will have to pay higher wages to attract sufficient workers.

Job characteristics play an important role in determining the equilibrium wage rate. Within a job quality vector there are many variables that affect worker's welfare. However, each of the individual job characteristics will influence incomes differently. We assume that workers prefer to control their working hours. In such cases those who are able to control their hours, ceteris paribus, should receive a lower wage rate than individuals with less flexible schedule. Another characteristic, like

repetitive work, should also affect income in the same manner assuming, workers dislike repetitive work. Those individuals who do not have a repetitive work schedule should receive, ceteris paribus, lower wages than those who constantly have to repeat their assigned tasks. However, the relative importance of each job characteristic should be different given different individual job quality preferences for each worker.

Workers care about the financial benefits from their work and the quality of their job. This implies that measures of occupational quality should be included in their utility functions.⁵ The greater the quality and desirability of the job the greater the utility. Suppose a worker is offered a job at \$10.00 an hour in which 2 percent of the workers in that occupation are injured every year. The employee will achieve a certain level of utility from that job. If the risk of injury increased to 3 percent per year there would be a fall in worker 1's level of utility. In order to maintain the same level of utility the job would have to pay a higher wage.

Therefore, we include quality measures in an individual's conditional indirect utility function so that:⁵

$$(1) U_1 = u[Y_1^j, Q^j, A_1, Z_1^*]$$

where U_1 represents the maximum utility of individual 1, Y_1^j is the income individual 1 receives in occupation j , Q^j is the quality of job j , A_1 is a vector of personal characteristics (mostly human capital variables) and Z_1 represents the idiosyncratic elements in 1's tastes that are not measurable. Job quality is a function of numerous occupational characteristics.

Holding all other things constant there is a tradeoff between income

and job characteristics. The tradeoff is depicted in Figure 1, where $\bar{U}_1$ shows a constant level of utility for 1. Assume that the job characteristic we are examining is the probability of dying due to an occupational accident or disease. $\bar{U}_k$ displays the level of utility for individual k. Given the

slopes of the utility curves 1 is more risk averse than k $\left[\frac{\partial y_1^j}{\partial PD^j} \right]_{U_1} = \bar{U}_1 >$

$\left[\frac{\partial y_k^j}{\partial PD^j} \right]_{U_k} = \bar{U}_k$, where PD is the probability of death as a result of

choosing occupation j. Both indifference curves $\bar{U}_1^*$ and $\bar{U}_k^*$ are preferred to U_1 and U_k .

Risk aversion implies that indifference curves will be concave. In this case risk aversion is the aversion to the expectation of death. The term does not apply to variance aversion. The latter deals with the variability of outcomes.

From the perspective of the firm, different job characteristics have important effects on net profit. To make a job safer the firm must incur costs, which lowers profits. Worker 1 generates a net profit of π_1 for the firm. Therefore, we can write:

$$(2) \pi_1 = \pi(Y_1^j, Q^j, A_1, X_1)$$

where X_1 is 1's idiosyncratic skill not reflected in A_1 .

Under the present assumption of perfect competition there are no economic profits. Maximizing (2) subject to the zero profit constraint

leads to the isoprofit lines in Figure 2. Assume there are two firms who do not necessarily have to be in the same industry. The isoprofit curve for

Figure 1

84

Wage
Rate

2

MICRO
ELECTRONICS
CORPORATION

firm $Z(\pi^Z)$ is steeper than the one for $V(\pi^V)$. This indicates that it is more costly for Z to reduce risk than it is for V. Both isoprofit curves are concave ($\frac{\partial^2 Y}{\partial PD^2} \Big|_{\pi} = 0 < 0$), reflecting diminishing marginal returns to safety expenditures.

Firm V can make higher wage offers than firm Z for lower levels of risk. Since firm V can reduce risk more cheaply below point S than firm Z it can pay higher wages and still remain in business. At higher levels of risk, however, firm Z can afford to pay higher wages to its employees. Firm Z saves a great deal of money by operating at a risk level beyond point S. It is willing to pay higher wages at higher levels of risk than is firm V. The latter, meanwhile, does not save nearly as much money if it operates above point S since the reduction in risk for this firm is inexpensive.

The goal for employees is to achieve the highest level of utility. If they have two job offers with the same wage rate they will choose the job with the least risk. Employers, meanwhile, cannot make large wage concessions to their employees because they would be driven out of business by their low cost competitors. On the other hand, employers will not attract workers if the wages they offer are not competitive with other firms' offers.

The supply function for a specific worker can be written as:

$$(3) \theta_1^j = \theta(\theta_1, A_1, Q_j, Z_1)$$

where $\theta_1^j = 0$ if the worker does not select job occupation j and $\theta_1^j = 1$ if he does select occupation j . θ_1 is a vector of wages that i will for different

Figure 2

35

occupation $\{Y_1^1, Y_1^2, \dots, Y_1^j, \dots\}$.

Like the individual, the firm also makes choices about who works in a given occupation. This relation can be expressed as:

$$(4) \alpha_1^j = \alpha(\theta_1, Q^j, A_1, X_1)$$

where $\alpha_1^j = 0$ if the firm does not hire i and $\alpha_1^j = 1$ if the firm hires individual j . In equilibrium employees and employers sort themselves such that:

$$(5) \alpha_1^j = \alpha_1^j.$$

Solving the structural equations above leads to a reduced form hedonic equation?

$$(6) Y_1^j = Y(Q^j, A_1, Z_1, X_1)$$

Figure 2 also includes the indifference curves for individual i and k . The dashed line in Figure 2 (OA) is the wage-risk frontier. In wage-risk space we draw the indifference curve map for both workers and the isoprofit map for both firms. An equilibrium matching of the curves is a pair of points in wage-risk space with the following two properties. First, no firm and its worker can trade wages for risk to the benefit of both. That is, each point must be a point of tangency between the isoprofit curve and the indifference curve. Second, no firm or worker can substitute their respective partners and make a mutually superior arrangement. In other words, equilibrium isoprofit lines cannot intersect equilibrium indifference curves.

A wage-risk frontier is simply the locus of such equilibrium matching points. The two properties mentioned above do not, even with large numbers of firms and workers, pin down an unique equilibrium wage-risk frontier. All they do is determine a map of possible equilibrium frontiers which meet the matching requirements. What does pin down a particular frontier is the supply and demand for labour. With too high a wage-risk frontier, there will be more workers than jobs, and with too low a frontier there will be more jobs than workers.

The above discussion has important implications for the empirical results listed below. The argument presented in this section implies that, workers in riskier jobs should, *ceteris paribus*, receive greater financial compensation than workers in less hazardous occupations.

(ii) Testing for Compensating Wage Differentials Using Labour Market Data

a. Wage Equations and Data Problems

Since the mid-1970s there have been numerous studies on the topic of compensating wage differentials. Most papers have dealt with the relationship between job characteristics and incomes. However, union membership (Duncan and Stafford, 1980; Hirsch and Berger, 1984), labour mobility (Viscusi, 1979; Bartel, 1982), the male-female wage gap (Filer, 1983) and fringe benefits (Dorsey, 1983) also have been studied using the framework of compensating differentials.

This review concentrates on those papers that relate job characteristics and individual incomes. It examines more closely those studies that include worker fatalities in their analysis.

Two general types of data problems exist in most studies on this topic (Smith, 1979).⁶ The present paper is no exception to these difficulties. The most common technique used to measure compensating wage differentials is to merge several data bases. Typically the first data base is a micro file containing information on individual incomes and personal background variables like education, experience, location and so forth. This data source contains information on the individual's occupation or some type of job classification code.

The occupational codes are used to merge personal characteristic data with other files that describe individual job content. As an example, Lucas (1977) used the Dictionary of Occupational Titles to link the Survey of Economic Opportunity files with another tape that described the job content of 13,778 occupations.

The advantages of such an approach are the size of the sample and objectivity. If attached to the proper survey the sample sizes can run into the thousands. As well, by avoiding personal questionnaires on the worker's own view of his or her job content we do not have to deal with problems of response rates or possible response bias.

The disadvantage of this approach is that occupational codes do not necessarily describe job characteristics. Two individuals having the same job code, no matter how detailed the classification system, may perform very different tasks and be exposed to different risks at their places of employment.

Another approach, which suffers from a different type of data problem, is to ask individual workers about their jobs. This is the technique used

90

by Duncan (1976) and Hammermesh (1977). While such data are unique to each individual, the problem of reliability outlined above is particularly acute. It is also very difficult to compare one set of job content characteristics with another. How dangerous is dangerous? When using fatality rates or other objective criteria this question is not difficult to answer. However, when using personal responses one cannot be sure of the answer since each worker will evaluate their job differently.⁷

Subjectivity raises another important issue. Most economists would agree that hazardous jobs should pay some form of wage premium. However, occupations that require strength or stamina are much harder to deal with. An individual may prefer a job that requires lifting or a great deal of physical exertion even though other people might classify this as a negative job trait. Given heterogeneous tastes it is difficult to determine what are agreeable or disagreeable non-fatal job characteristics. For these reasons, the inclusion of variables measuring the risk of injury or death in regression equations is probably the best test of the theory of compensating differentials. In all likelihood, most workers would demand some form of wage premium for hazardous jobs.

b. The Value of Life and Risk Premiums

Wage premiums for hazardous jobs have often been related to the value of life. If the earnings regressions include fatality rates, we can impute the willingness-to-pay for increased safety. This willingness-to-pay has often been called the value of life.

When we estimate the value of life in this manner we are not placing a monetary value on the life of any specific individual. What we are

estimating is how much people on average are prepared to pay (in terms of lower incomes) to gain a small reduction in their risk of death, what we call "the value of life" is simply a convenient way to report such an estimate.

Suppose for instance that we discover that jobs with a one percent risk of death pay \$10,000 more than otherwise identical jobs that have no risk of death. Assuming a free choice between the two jobs, we then know that some people (those choosing the safe job) require more than \$10,000 compensation to make them willing to accept a one percent risk of death, while others (those choosing the risky job) would be willing to pay less than \$10,000 to eliminate their one percent risk of death. In saying that the value of reducing the risk of death from one percent to zero is \$10,000 we are then examining the upper and lower bound of heterogeneous agents' compensating and equivalent variations. The closer together are those two jobs in terms of the risk of death in each, the more accurate will be our approximation, for those workers choosing those two jobs will become more homogeneous, and the income effect (which gives rise to the difference between compensating and equivalent variations) will become smaller and smaller. In the limit, with an infinite choice between otherwise identical jobs offering a continuum of risks of death, we can estimate exactly the (identical) compensating and equivalent variations of a marginal reduction in the risk of death for a worker choosing each level of risk.

What we call the value of life is simply a convenient representation of this value of a marginal reduction in the risk of death. The value of life is calculated by taking the value of a small reduction in the probability of

death and dividing it by that small reduction in probability. We thus get a measure in more convenient units, that of money per life saved. The reason that the value of life, thus defined, is not the same thing as the value of preventing the otherwise certain death of a specific individual is very simply that the reduction in the risk of death is not marginal but decidedly large in such a case, and so the approximation of equality between the compensating and equivalent variations, of heterogenous individuals furthermore, becomes hopelessly invalid. The amount any individual would willingly pay to prevent certain death would differ significantly from the amount he would accept as compensation for incurring certain death, and different individuals will also pay and accept very different amounts.

The upshot of this discussion is that estimates of the value of life constructed in this way can, at best, only reasonably be applied in policy evaluation when the policies in question cause only small changes in the risk of death, so that the difference between compensating and equivalent variations is negligible. With policies causing larger changes in the risk of death, the compensating variation will be considerably larger than that implied by our value of life estimate. Furthermore, policies causing large changes in the risk of death for a subset of the population will obviously have a bigger impact on the distribution of welfare, and require us to take distributional as well as efficiency considerations into account.

To illustrate these points further assume that the fatality rate for a given occupation is included in a human capital earnings function. Further, assume that this variable (call it PDEATH) measures the deaths per 1,000 workers per annum. Let Z be the estimated coefficient on PDEATH in the

human capital earnings function. Thus \$Z per year must be paid to a worker to accept a job with an extra 1/1,000 chance of death per year.

A group of 1,000 workers would have to receive \$1,000Z to accept a one unit increase in the probability of death. In this case 1,000 workers in total would expect an increase of one statistical death. By statistical it is meant that we are talking about a randomly chosen person with no a priori knowledge of who it might be. The extra life lost would have a compensating variation equal to \$1,000Z.

When comparing a job that has 1/1,000 risk of death, to another job that has 0.0 risk of death, \$Z measures the compensation you have to pay one worker to accept the riskier job. Therefore, in terms of the regression analysis the implicit value of life is \$1,000 ($\partial Y / \partial PDEATH$), where Y is annual income and ($\partial Y / \partial PDEATH$) is equal to Z. Written in semi-log form the above estimate is \$1,000 x Y($\partial \ln Y / \partial PDEATH$), and the results are evaluated at the mean of Y.⁸

Smith (1979), Brown (1980), Blomquist (1981), Marin and Psacharopoulos (1982), Dillingham (1985) and Digby and Riddell (1986) present various summaries of the empirical work done in this field by economists. For a sociological perspective see Hunter and Manley (forthcoming). Smith (1979) and Brown (1980) present summaries of works dealing with both job hazards as well as the results for general occupational characteristics. Marin and Psacharopoulos (1982), Blomquist (1981) and Dillingham (1985) only present value of life estimates. The latter two studies are particularly useful for my purposes because they discount previous estimates, put them in 1979 US

dollars and present them in tabular form. This makes any results presented in this paper easily comparable to existing American and British findings.

In order to make comparisons with my results easier, studies containing information only on the value of life are presented in Table 1. Studies that include other job characteristics for which compensating differentials are likely are listed in Table 2.

The empirical results in Table 1 indicate that Adam Smith was correct in arguing that there are compensating wage differentials. When the probability of dying due to an occupational accident is included as an independent variable the coefficient on that variable is statistically significant.

However, one of the most striking features about the table is the diversity of the estimates. Although all the figures are in 1979 US dollars the imputed value of life ranges from approximately \$400,000 to almost \$6 million. The variance in willingness-to-pay estimates for safety has reduced their usefulness for policy purposes. It is difficult for economists to use these estimates to recommend whether or not particular life saving programs should be enacted. When conducting a cost-benefit study for improved road safety, for instance, do we use \$400,000 or \$6 million as the benefit of saving one additional statistical life?

Dillingham (1985), and to some degree Marin and Psacharopoulos (1982), have tried to reconcile the differing results. Dillingham (1985) has shown that value of life estimates are very sensitive to the definition of risk, the occupations being analyzed and the exclusion (inclusion) of industry and occupational dummy variables in the regressions.

TABLE 1

Empirical Studies Incorporating Fatalities
(1979 US dollars)

<u>Study</u>	<u>Value of Life Estimate</u>	<u>Risk Data</u>
Thaler and Rosen (1975)	\$430,000*	Excess annual deaths per 1000,000 workers in 37 riskiest occupations
Smith (1976)	\$2,400,000*	Number of fatalities by per 1 million man-hours by industry
Viscusi (1978)	\$2,500,000*	Number of fatalities per 100 million man-hours by industry
Brown (1980)	\$930,000**	Excess annual deaths per 1,000 workers in riskiest occupations
Olson (1981)	\$2,934,000- \$5,934,000*	Fatal injury rate per 10,000 workers
Marin and Psacharopoulos (1982)	\$1,948,000*	Excess annual deaths per 1,000 workers in Great Britain
Arnould and Nichols (1983)	\$441,540- \$572,220*	Excess annual deaths per 1000,000 workers
Dillingham (1985)	\$1,375,070 -\$3,844,447*	Five different risk measures

* The estimated coefficients are statistically significant.

** Some of the estimated coefficients are statistically significant, while others are not. The significant estimates are present here.

Source: Dillingham (1985) Blomquist (1981) and Marin and Psacharopoulos (1982).

Dillingham (1985) and Smith (1979) point out that the highest value of life estimates are generally reported when industry fatality rates are used. Clearly the fatality coefficient contains many other influences besides risk when such aggregate data are being used. Industry data only supplies the average level of risk each worker faces in that industry. The data do not contain information on the risks faced in specific jobs. A potentially serious bias is introduced into the analysis when this type of data is used.

The use of industry data creates an errors-in-variable problem. This would bias the estimated coefficient downwards, indicating a low value of life estimate. However, the estimated coefficient may also be biased in an upward direction. This is because Dillingham (1985) has shown that industry studies do not always use the same definition for risk used by occupational studies.

Some of the industry studies use data collected from the Bureau of Labor Statistics. The data measure fatal injuries per average level of employment, rather than fatalities per full-time employment or total hours worked in the industry. In general average employment will be larger than full-time employment measures. Industry estimates based on average employment will underestimate actual risk in an industry. The coefficient for the fatality term in the earnings regression will be inflated for average employment compared to any full-time risk measures.

Smith (1979), meanwhile, argues that industry wage premium estimates are higher than occupational estimates because of the possibility of spillover effects. Workers in general in a given industry may receive

additional benefits due to the hazards faced by some workers in that industry. Employees in the mining section, for instance, generally may receive a wage premium because of the additional risks face by the workers in the mines. This would most likely be re-enforced by the presence of an industrial union that negotiates for all unionized workers in the industry.

It would be more correct to base value of life estimates on occupational codes. Risks faced by underground miners, for instance, will be better described by their own occupational fatality rates than by the industry fatality rate. The latter will include a large number of people who face very few on-the-job risks.

Dillingham (1985) also discovered that the inclusion of industry and occupation dummy variables reduced the value of life. In his own work the implicit value for statistical life was \$2.6 - \$3 million when there were no industry and occupation controls. These figures dropped to \$1.4 - \$1.8 million when the dummies were included in the regressions. Evidently, the absence of the variables creates a specification error since certain key variables are omitted from the regression equations.

Finally, Dillingham (1985) observed that the 'low' estimates seen in Table 1 (Thaler and Rosen, Brown, and Arnould and Nichols) all used actuarial data. This data measures the total excess deaths in a given occupation. By excess we mean the total number of deaths less the expected number of deaths given age distributions in the occupations.

Actuarial data are inappropriate when dealing with the value of life since this definition of risk does not necessarily measure occupational risk. Estimates should be based on work related fatalities. A serious

errors-in-variable problem arises if individuals found in a certain occupation display common personal traits. If, for instance, loggers (a dangerous occupation) smoke more than the general population their death rates will be higher than average. However, with actuarial data we do not know if the loggers died of cancer or work related accidents. The errors-in-variables problem biases downwards the estimated impact of fatalities on earnings and leads to a lower-estimated value of life.

Taking all these considerations into account has led Dillingham (1985) to reject both the very high and very low value of life estimates. He concludes that the "best guess" estimate in 1979 US dollars is between \$1 - \$2 million. His own figures put the value of life between \$1.4 and \$1.8 million.

c. Other Job Characteristics

Table 2 presents a summary of various studies that have dealt with non-fatal job characteristics. Included in the table are the expected and actual signs for each individual coefficient and whether or not they were statistically significant in the regression estimates.

Given heterogenous tastes it is doubtful that many of the undesirable job characteristics listed in Table 2 are indeed 'undesirable' to the marginal worker. A specific job characteristic may increase the utility of one worker while decreasing the utility of another.

A common argument used when the results are insignificant is to say that a number of important variables are omitted from the regression equations (Brown, 1980). In particular, if there are variables that are correlated with income and the other explanatory variables the job

TABLE 2

Estimated Differentials for Selected Job Characteristics

<u>Author</u>	<u>Job Characteristic</u>	<u>Expected Impact on Earnings</u>	<u>Actual Impact on Earnings</u>	<u>Statistical Significance</u>
Duncan (1976) Table 1	Control overtime	-	-	a
	Emotional Stability			
	Free to increase hours	-	-	a
	Free to reduce hours	-	-	a
	Income stability	-	-	a
Hammermesh (1977) Table 2	Noise	+	+	NS
	Extreme heat	+	+	NS
	Hazardous materials	+	-	NS
	Misc. hazard	+	+	NS
	Dirt	+	-	NS
	Hazardous equipment	+	+	NS
Lucas (1977)	Repetitive work	+	+	S
	Physical strength	+	+	S
	Bad conditions	+	+	S
	Supervise people	+	+	S
Viscusi (1978)	Fast pace	+	+	S
	No freedom	+	-	NS
	Job insecurity	+	-	S
Duncan and Stafford (1980) Table 2	Work with machines	+	+	S
	Work effort	+	+	S
	Not free to take time off	+	+	S
Brown (1980) Table II (col. 5)	Bad conditions	+	-	S
	Work under stress	+	+	NS
	Physical strength	+	-	NS
	Repetitive work	+	-	S

Cont'd

TABLE 2 (cont'd)

<u>Author</u>	<u>Job Characteristic</u>	<u>Expected Impact on Earnings</u>	<u>Actual Impact on Earnings</u>	<u>Statist Signifi</u>
Duncan and Holmlund (1983)	Inflexible hours	+	+	N
	Punch clock	+	+	N
	Difficult to run personal errands	-	-	S
	Heavy lifting	+	+	N
	Physically demanding	+	-	N
	Daily sweating	+	-	N
	Noise	+	+	S
	Smoke	+	+	S
	Shake	+	+	N
	Poison substances	+	+	N
	Mentally demanding	+	+	N
	Hectic	+	+	N

a. Based on canonical correlation. There were no significance tests.

NS. Not statistically significant.

S. Statistically significant.

characteristic coefficients are biased. The difficulty with this argument is that the omitted variable problem is almost always present in social science research. After some time this defense starts to become very hollow. It is true that certain personal idiosyncratic characteristics are very difficult to measure and that they do affect the estimates. However, it is pointless to argue that the results do not fit the theory for this reason.

Hammermesh (1977) used data that questioned workers about their own personal views about their occupations. All six job characteristic variables were statistically insignificant. Viscusi (1978) used three job characteristic variables in his analysis. One of the coefficients was insignificant, one was significant but the actual impact on earnings was opposite to what the theory predicts, and the last variable (fast working pace) was significant and the coefficient had the predicted sign. Lucas (1977) and Duncan and Stafford (1980) obtained very different results than the ones mentioned above. In the former case four job characteristics were included in the analysis: repetitive work, use of physical strength, bad working conditions and supervising people. They were all significant and the coefficients had the predicted sign. Duncan and Stafford (1980) used three job characteristic variables in their analysis; working with machines, an index of work effort, and inability to take time off work. These variables also had an impact on earnings that is consistent with the theory of equalizing differences.

One possible way to improve the estimates for non-fatal job characteristics is to use panel data. Brown (1980) and Duncan and Holmlund

(1983) both use longitudinal data in their work. The former uses an American survey, while the latter examines Swedish workers. Some of the panel data results are also shown in Table 2.

Brown's (1980) estimates are almost always insignificant and often the coefficients take on the wrong sign. Duncan and Holmlund (1983) are more successful in terms of being consistent with the theory. Out of a total of 12 working condition variables nine coefficients have the correct sign. However, only four of the variables were significant at the five percent level.

One final study is worth noting. Kumar and Coates (1982) examined compensating differentials using Canadian data. They find evidence to indicate the validity of the theory. Their proxy for risk (the interquartile range of earnings) takes on the correct sign and is usually significant at the one percent level.

However, the Kumar and Coates (1982) study suffers from a very serious flaw. They do not use micro data. Kumar and Coates (1982) examine earnings differences in 372 four-digit occupational categories. Since micro data were not available they used class data published by Statistics Canada. Clearly the marginal worker is lost in such an exercise. The theory of compensating differentials is based on individual tastes and preferences. This requires the knowledge of a worker's own work setting as well as personal background information. Only micro data contains this type information. It is therefore impossible to conclude that Kumar and Coates (1982) verify or refute the theory.

(iii) Other Approaches to Valuing Risk

Generally there are two approaches in addition to labour market risk estimates found in the economics literature.⁹ Implicit values can be obtained from consumption estimates, including housing and travel choices (Blomquist, 1979; Ghosh, Lees and Seal, 1975). Another approach is to use questionnaire data and ask individuals how much they would pay for improved safety (Acton, 1973; Jones-Lee, 1976).

The use of consumption or activity data attempts to go beyond studies that deal with health and safety at work. Blomquist (1979) estimates the value of life from the use of seat belts in automobiles. He uses probit analysis for seat belt use to derive his estimates. The probit equation is used to find the implicit value of life for the average driver that does not wear a seat belt. Blomquist's estimates indicate that the average value of life is between \$290,000 US to \$1,037,000 US, with his own preferred estimate to be \$466,000.

Ghosh, Lees and Seal (1975) examine the relation between speed, accidents and gasoline consumption on British highways. The average speed for a typical driver is determined by balancing the costs of fuel consumption and the increased probability of traffic accidents with the benefits of time saved on the highway. The value of life was estimated to be £95,000 in 1973 British pounds.

Both studies present estimates that are generally lower than those found in Table 1. Blomquist (1982) points out that an implicit assumption used in all consumption data experiments is that individuals know the changes in risk of death when they change their consumption habits. It is

possible that individuals know the general risks associated with employment, but are less aware of the risk of increasing their speed on the highway by 4 or 5 kilometres per hour. Estimates from consumption data are also highly sensitive to the imputed value of time used and the assumptions about the disutility of certain actions, such as putting on a seat belt (Blomquist, 1981).

Acron (1973) and Jones-Lee (1976) developed sophisticated questions in order to derive their value of life estimates. The former questioned people concerning the reduction in risk of death due to a heart attack.

Jones-Lee's experiment asked individuals how much they would pay for decreased risk of being killed in an airplane crash. In 1979 US dollars Acron's value of saving a life was \$50,000, while Jones-Lee's was \$8.9 million.

In addition to the large variation in these results, questionnaire data suffer from several other problems. The biggest drawback to this approach is the truthfulness of the responses. Some of the surveyed population may not have provided their true thoughts on the subject. Even if they did not intentionally misrepresent their answers, the surveyed individuals may respond differently in an actual situation than in an experiment. Such potential response biases are a well-known problem in survey research.

III. EARNINGS FUNCTIONS

(1) Data

The data used in this study come from four different sources. The individuals' characteristics data come from the National Survey of Class

Structure and the Labour Process in Canada (see Table 3). It is a cross-sectional micro data tape that relates to 1981 incomes.¹⁰ The Class Structure tape is very useful because attached to each record is the individual worker's seven digit 1971 Canadian Classification and Dictionary of Occupations (CCDO) code. The CCDO code, similar to the U.S. Dictionary of Occupational Titles, describes the job content of each occupation. The levels are major groups (two digit), minor groups (three digit), unit groups (four digit) and individual occupations (seven digit).

This study uses the four digit CCDO as the basis for analysis. At this level of disaggregation 488 occupations are dealt with. The seven digit level contains information on some 6,500 occupations. The former is used here for several reasons. First, existing fatality rates are only reported at the four digit level. Second, use of the CCDO at the four digit level is more intuitively appealing than it is at the seven digit level. The distinction between related occupations starts to become very blurred when dealing with the 6,500 disaggregated codes.

Worker-trait data developed by Statistics Canada¹¹ were then attached to each four digit CCDO on the Class Structure tape. The Statistics Canada file contains information on the job quality of each CCDO (see Table 3). As an example, each of the 488 occupations are characterized by the general educational development (6 levels) and the specific vocational preparation (9 levels) needed to do the job. These variables, and the others listed in Table 3, describe the content and quality of each job.

The fatality rates come from two different sources. Labour Canada kindly supplied me with 1981 unpublished data for all of Canada except

TABLE 3
Variables

Individual Characteristics

ln EARN	Natural log of earned income, 1981
ln HRS	Natural log of weekly hours worked
EDUC	Years of formal schooling
AGE	Age
AGESQ	Age squared
UNION*	Union member
YRRND*	Work yearround
APP*	Completed apprenticeship program
MAR*	Married (spouse present)
TEN	Present job tenure
NUNEM	Number of periods of unemployment
BIL*	Bilingual (English and French)
<u>Location*</u>	
ATL	Atlantic (Reference group)
QUE	Quebec
ONT	Ontario
PRA	Prairies
BC	British Columbia
CITY	Live in a city greater than 100,000

Industry Characteristics*

SERV	Business or Personal Services (Reference Group)
CONMI	Construction and Mining
MAN	Manufacturing
COMM	Communications or Utilities
TRADE	Wholesale or Retail Trade
GOVPRO	Government or Professional Service

TABLE 3 cont'd.

Occupational Characteristics*

PROF	Professional or Management
SEMI	Semi-Professional and Middle Management
SUPER	Supervisor and Foremen
SKILL	Skilled Worker
UNSKIL	Semi-Skilled and Unskilled Worker (Reference Group)

Worker-Trait Data

STRESS*	Work under stressful and risky situations
STREN	Index of work effort and strength (scale of 1 to 5)
REPEAT*	Short repetitive work cycles
MACH*	Work with machines
CONTROL*	Can control working hours
GED	General educational development (6 levels)
SVP	Specific vocational development (9 levels)
DEATH	Fatality rate per 1,000 workers
AGEDEATH	Age x Death
UNDEATH	Union x Death
MARDEATH	Mar x Death

* Dummy variable = 1 if criteria satisfied.

Quebec. The latter province's fatality rates were provided by the Quebec Workmen's Compensation Board. The total of fatality data were then individually attached to each record on the Class Structure Tape.¹²

The fatality data for both the Quebec and the rest of Canada estimates define a worker fatality as a worker dying as a result of an occupational accident or disease (Canada, 1984).¹³ The advantage of defining occupational fatalities in this manner is that it avoids the problem discussed above concerning the use of actuarial data. Fatalities in the present context relate specifically to the occupation. The inclusion of diseases with accidents does create some difficulties though. Logically it should make no difference to the workers whether they risk death from an accident or a disease. However, defining a fatal occupational disease is much harder than defining a fatal accident. Toxicologists often cannot say for certain whether some occupations are associated with specific diseases. In many cases we simply do not know the link between exposure to certain chemicals and the risk of acquiring a fatal disease.

Other problems with occupational illnesses are the long latency period of many diseases and the interaction between exposure and personal habits, like smoking or drinking. The former is not as serious a problem in this study as one might expect. Occupational illness data are collected for those who were still working at the time of death as well as for those who were retired or absent from work.¹⁴ However, it is not possible in this study to control for the interaction between occupational risks and personal habits.

(ii) Sample Selection and Variables

Labour market estimates of compensating wage differentials and the value of life have used diverse samples. Thaler and Rosen (1975), Brown (1980) and Olson (1981) only examined workers in risky occupations. The first two studies only dealt with males, while the latter included both sexes. R. Smith (1976) looked at white males in manufacturing, while Viscusi (1978) dealt with blue-collar non-agricultural workers. Marin and Psacharopoulos (1982) studied male workers in a diverse set of occupations, as well as distinguishing between manual workers and non-manual workers. Finally, Dillingham (1985) concentrated on blue-collar and service workers.

Although the sample selection criteria are fairly diverse a general pattern in the literature has emerged. Most studies distinguish between blue-collar and service workers on one hand and white-collar workers on the other. With the low fatality rates associated with white-collar occupations (see Table 5) it is unlikely that a great deal of information can be derived from this group. Following convention, three samples will be examined in this study; all workers, blue-collar and service workers and white-collar workers.

Human capital models often deal with men and women separately. Most of the studies listed above only examine the earnings of males. Although women are also subject to work related hazards, their numerous exits and entries into the market make it difficult to specify a plausible earnings function for them. Multiple work periods also imply that women may have less information about work related hazards than men. Shorter work histories may also encourage women to be less interested in health and safety. This is

particularly important when workers are trading off current income for a reduction in the probability of acquiring a long-term occupational disease. Following this logic I concentrate on the earnings of male workers. For comparison purposes, however, I also include some estimates for women.

The sample chosen includes only those workers between 21 and 64 with positive 1981 earnings and positive hours worked in a week. All records who did not have a codeable four digit CCDO and who gave non-responses to the personal characteristic variables listed in Table 3 were also deleted.

The variables listed in Table 3 are included in the hedonic equations that are estimated. The personal characteristic variables are common to most human capital models. The notable exception is work year round (YRRND). Unfortunately, the data base does not include the total number of weeks worked in 1981. Instead it only provides a dummy variable for whether or not the individual worked all year in 1981. The data base does, however, provide the number of usual hours worked in a week (in HRS), present job tenure (TEN) and the number of periods of unemployment (NUNEM) to partially compensate for this problem.

The worker-trait data consist of nine variables, of which seven come under the general heading of compensating differentials. The specific vocational preparation (SVP) variable and the general educational development variable (GED) describe the level of training needed to do a certain job. They help to describe an occupation but they are not generally viewed as being a compensating differential.

These two variables are included in the analysis because they are useful in describing job content. A respondent's age, my proxy for

experience, is not necessarily a good indicator of individual skill. The specific vocational preparation variable helps correct for this problem because it measures the precise length of time needed to learn how to do a specific job. The actual level of education may also be weakly correlated with the educational requirement needed to do a specific job. Freeman (1976) has shown that although individuals have become more educated over time the general educational level needed for most occupations has not changed dramatically over the last several decades.

The differences between the expected and actual impacts on earnings for the job description coefficients seen in Table 2 are quite significant. Given these discrepancies it is best to list the expected effect on earnings for the worker-trait data used in this study before any estimates are given. They are seen in Table 4.

The interactions between fatality rates and unionization, age and marriage are worth noting. Exclusion of these variables assumes that there is one market for risk, independent of all personal characteristics and individual productivities. However, in all likelihood health and safety is not a simple homogeneous product. The interaction between various groups and risk is warranted because of the heterogeneity of the product health and safety as well as the differences in individual workers. Without the interaction between workers and job hazards we implicitly make the highly unrealistic assumption that there is only one risk value in the market.

The union interaction term could have either a positive or negative coefficient. A positive coefficient would imply that unionized workers receive greater compensation for risk than do non-union workers. Using

TABLE 4

<u>Variable</u>	<u>Expected Impact on Earnings</u>
Work under stressful and risky situations (STRESS)	+
Index of work effort and strength (STREN)	+
Short repetitive work cycles (REPEAT)	+
Work with machines (MACH)	+
Can control working hours (CONTROL)	-
General educational development (GED)	+
Specific vocational preparation (SVP)	+
Fatality rate (DEATH)	+
Interaction of age and fatality rate (AGEDEATH)	?
Interaction of married and fatality rate (MARDEATH)	?
Interaction of unionism and fatality rate (UNDEATH)	?

American data Thaler and Rosen (1975) find a positive interaction between unionization and fatality rates.

Using data from the United Kingdom, Marin and Psacharopoulos (1982) find that the same term has a negative coefficient. They conclude that a negative interaction effect could be a result of two factors. First, collective bargaining often may take place for a wider range of occupations than the ones used in their study. Wage agreements would only consider an average degree of job riskiness. This would tend to weaken the relationship between wages and worker fatalities.

The second possibility is that unions often negotiate directly for occupational health and safety. This implies that risk will play less of a role in the determination of earnings through the collective bargaining process since British unions will not trade off more risk for higher incomes. Marin and Psacharopoulos conclude that compensating differentials are not larger for unionized British workers.

This latter argument needs some clarification. The fatality rates used in this study, as pointed out earlier, are for four digit CCDO. Within each job category one will find unionized and non-unionized workers. However, it is not possible to determine whether or not the fatalities are primarily unionized workers or non-union workers. Multiplying occupational fatality rates by the union membership dummy variable implicitly assumes that worker fatalities are equally distributed across the CCDO. This may not be an accurate picture of the risk individual workers face in their specific jobs.

If the above is the case the union interaction coefficient could be negative. This result can occur for the following reason. Assume that the union dummy variable captures all the systematic differences between the earnings of union and non-union workers that do not relate to risk. The fatality rate used in this study assigns the same level of risk for both union and non-union workers within each CCDO. If unions trade wages for more job safety their true fatality rate is below the one assigned to them in the regression equations. The true fatality rate for non-union workers, meanwhile, is above the one assigned to them in the regression equations. This implies that we would observe union workers receiving lower earnings than non-union workers for the same fatality rate. This will result in a negative coefficient for the interaction term.

Alternatively fatality rates may actually reflect the risk each worker faces but unions negotiate for non-wage benefits. Union and non-union workers could receive approximately the same returns for facing an additional degree of risk. However, union workers accept their risk premium in the form of fringe benefits. Non-union workers, meanwhile, may take their risk premium in the form of higher dollar earnings. Since the dependent variable is annual dollar earnings the empirical results miss part of the compensation that union workers receive for additional risk. This would also result in a negative coefficient for the interaction term. A final plausible argument for a negative union interaction coefficient deals with Freeman's (1980, 1982) evidence on unions and the dispersion of wages. He has shown that unions reduce the variance in wages for their members. Union members in risky jobs may be paid less than non-union workers in

TABLE 6 cont'd

	(1)	(2)	(3)	(4)
CITY	0.0288 (0.69)	0.0257 (0.61)	0.0258 (0.62)	0.0121 (0.32)
CONMI	0.173 (2.19)**	0.1562 (1.97)**	0.1495 (1.88)**	0.2166 (2.71)*
MAN	0.1463 (1.99)**	0.1319 (1.79)***	0.1235 (1.67)***	0.1258 (1.85)***
COMM	0.1575 (1.80)***	0.1222 (1.38)	0.1118 (1.25)	0.0929 (1.13)
TRADE	0.0854 (1.03)	0.0795 (0.96)	0.0752 (0.91)	0.0797 (1.16)
GOVT PRO	0.0251 (0.32)	0.0129 (0.16)	0.0043 (0.05)	0.0147 (0.20)
PROF	0.4250 (5.66)*	0.4314 (5.75)*	0.4276 (5.70)*	0.2745 (2.33)**
SEMI	0.1850 (2.74)*	0.1813 (2.69)*	0.1801 (2.67)*	0.0581 (0.58)
SUPER	0.3027 (3.87)*	0.3105 (3.97)*	0.3096 (3.96)*	0.1708 (1.56)
SKILL	0.1694 (3.20)*	0.1701 (3.22)*	0.1679 (3.17)*	0.1119 (1.66)***
DEATH		0.13172 (2.10)***	0.53352 (1.86)***	0.56422 (2.21)***
UNDEATH			-0.18647 (1.45)	-0.19091 (1.66)
MARDEATH			-0.15556 (0.73)	0.11719 (0.62)
AGEDEATH			-0.00419 (0.68)	-0.00637 (1.16)
STRESS				0.1029 (0.78)
REPEAT				0.1208 (1.04)

The interaction of age and fatality rates also may have either a positive or negative effect on earnings. Older workers may have greater knowledge about job related risks than younger workers. In such a case the interaction term should be positive since older workers are more aware of the risks in the work place. Younger workers may have better reflexes and be faster at completing certain tasks than older workers. This implies that young employees are more suited to quickly dealing with hazards. Young workers' accident rates for a given occupation will be lower than the accident rate for older workers. In such a case the interaction term should also be positive because older workers will value working in safer jobs.

The opposite result can occur if workers "get used to" risks. Older workers may accept certain job characteristics more readily than younger workers. In order to attract new entrants into an occupation it may be necessary to pay some form of risk premium. Given shorter time horizons the older you are may mean the less you are concerned about occupational fatalities. In such cases young workers who have longer time horizons will demand additional compensation. In this case the coefficient will also be negative. Thaler and Rosen (1975) and Arnould and Nichols (1983) both find a negative coefficient for this term.

(iii) Means

The means for the male population are reported in Table 5. The data indicate that blue-collar and service workers earn considerably less than white-collar workers. The former also have fewer years of education and are slightly younger than the white-collar group. Almost 50 percent of blue-collar and service workers are unionized.

TABLE 5

MEANS FOR MALE WORKERS

	Total Sample	Blue Collar and Service	White Collar
Income (\$)	27,837	23,196	34,509
ln (Income)	10.05	9.92	10.24
ln (Hours)	3.77	3.72	3.83
Education	12.7	11.5	14.5
Age	40.9	39.1	41.5
(Age) ²	1740.43	1670.2	1841.2
Union (%)	41.2	49.5	29.3
Yearround (%)	91.4	90.4	93.0
Married (%)	79.8	78.5	81.7
Tenure	10.28	9.3	11.7
Apprenticeship (%)	26.0	30.5	19.2
Unemployed	1.5	2.0	0.7
Bilingual (%)	20.0	20.0	20.1
Atlantic (%)	9.2	10.4	7.1
Quebec (%)	29.6	33.2	24.9
Ontario (%)	31.0	28.2	35.0
Prairies (%)	18.6	14.6	24.3
British Columbia	11.6	13.6	8.7
City	48.2	48.4	47.9
Business and Personal Services (%)	11.4	10.4	12.8
Construction and Mining (%)	20.7	17.7	24.9
Manufacturing (%)	23.9	30.9	13.8
Communications and Utilities (p)	10.6	14.7	4.8
Trade (%)	11.9	13.4	9.9
Government and Professional Service (p)	21.5	12.9	33.8

TABLE 5 cont'd

MEANS FOR MALE WORKERS

	Total Sample	Blue-Collar and Service	White-Collar
Professional (%)	16.9	-	41.0
Semi-Professional (%)	13.0	0.4	31.1
Supervisory	8.1	9.6	6.0
Skilled (%)	23.2	39.0	0.6
Semi-Skilled and Unskilled (%)	38.8	51.0	21.3
Death Rate	0.13	0.18	0.06
Union x Death Rate	0.07	0.11	0.02
Married x Death Rate	0.11	0.15	0.06
Age x Death Rate	5.16	6.77	2.86
Stress and Risk (%)	5.0	6.2	2.9
Repetitive (%)	31.3	48.5	1.3
Strength	2.19	2.56	1.53
Machines (%)	47.6	59.6	26.6
Control Hours (%)	28.1	18.6	44.7
General Educational Development	3.72	3.04	4.90
Specific Vocational Preparation	5.66	4.70	7.33
N	813	479	334

Blue-collar and service workers also experience more unemployment and on average have a year less of present job tenure than white-collar workers. As one would expect the former are found more in construction and mining, manufacturing and communications or utilities, while the latter are found primarily in the government and professional services.

The blue-collar and service population also has an occupational fatality rate that is three times higher than for white-collar workers. Blue-collar and service employees work under more stressful conditions, require more strength to do their jobs, work more with machines, are less able to control their working hours and hold jobs that are significantly more repetitive than their white-collar counterparts. Blue-collar occupations require less education and less specific vocational preparation. In terms of the overall job quality variables white-collar occupations appear to be superior to blue-collar and service occupations.

(iv) Earnings Regressions

a. Overall Estimates¹⁶

The regression estimates for all males, blue-collar and service workers and white-collar workers are found in Tables 6, 7 and 8 respectively. Column (1) of each table includes personal characteristics and the industry and occupational variables. Column (2) of each table gives the earnings estimates when only occupational fatality rates are included. These results are based on the strong assumption that there are no interactions. Column (3) includes the occupational fatality rates and the interaction terms (UNDEATH, MARDEATH, AGEDEATH). Column 4 includes all the variables listed in Table 3.

In Table 6 most of the human capital coefficients are statistically significant. The notable exceptions are number of periods of unemployment (UNUNEM), bilingual (BIL) and most of the region variables. In Tables 7 and 8 some of these variables are significant.

There are some marked differences between the coefficients for the human capital variables for the three samples chosen. The natural log of hours worked is insignificant for the white collar group. Meanwhile the return for an additional year of education is only about 2.7 percent for blue-collar workers, while it is approximately 5.2 percent for white-collar workers. Blue-collar workers also have a flatter life-cycle profile (AGE, AGESQ) and receive substantial benefits from unionization.

b. Non-fatal Job Characteristics

The worker-trait data are found in column (4) in Tables 6, 7 and 8. The coefficients for general educational development and specific vocational preparation are insignificant in all three tables. It should be pointed out, however, that when the regressions were estimated without the industry and occupational dummy variables (not shown here) the coefficient for specific vocational preparation was always significant at the five percent level. The coefficient for general educational level was significant for white-collar workers.

The other non-fatal job characteristics generally yield very poor results. Only the ability to control one's working hours (CONTROL) is significant in Tables 6 and 7. However, the ability to control working hours is usually considered a positive job quality and should therefore have a negative coefficient. In all three tables controlling hours has a

TABLE 6

EARNINGS OF ALL MALE WORKERS

	(1)	(2)	(3)	(4)
ln HRS	0.2459 (3.55)*	0.2.992 (3.60)*	0.2917 (3.50)*	0.3629 (4.41)*
EDUC	0.0395 (5.83)*	0.0411 (6.04)*	0.0414 (6.08)*	0.0362 (5.62)*
AGE	0.0558 (4.00)*	0.0566 (4.06)*	0.0575 (4.11)*	0.0616 (4.70)*
AGESQ	-0.000565 (3.43)*	-0.000572 (3.48)*	-0.000578 (3.51)*	-0.000628 (4.06)*
UNION	0.0552 (1.19)	0.0507 (1.09)	0.0736 (1.58)	0.1106 (2.32)**
YRRND	0.0871 (1.28)	0.0868 (1.39)	0.0945 (1.59)	0.1384 (2.29)**
MAR	0.3136 (6.01)*	0.3072 (5.90)*	0.3217 (5.69)*	0.2992 (5.52)*
TEN	0.0021 (0.81)	0.0023 (0.86)	0.0025 (0.95)	0.0048 (1.89)***
APP	0.0394 (0.86)	0.0397 (0.87)	0.0416 (0.91)	0.0593 (1.39)
NUNEM	-0.0039 (0.54)	-0.0043 (0.04)	-0.0042 (0.58)	-0.0054 (0.78)
BIL	0.0741 (1.30)	0.0763 (1.34)	0.0766 (1.34)	0.0413 (0.76)
QUE	0.0276 (0.35)	0.0251 (0.32)	0.0251 (0.32)	0.0920 (0.40)
ONT	0.0217 (0.29)	0.0252 (0.33)	0.0303 (0.40)	0.0015 (0.02)
PRA	0.0453 (0.62)	0.0491 (0.60)	0.0475 (0.58)	0.0559 (0.71)
BC	0.2002 (2.28)**	0.1809 (2.05)**	0.1686 (1.91)**	0.1756 (2.17)**

TABLE 6 cont'd

	(1)	(2)	(3)	(4)
CITY	0.0288 (0.69)	0.0257 (0.61)	0.0258 (0.62)	0.0121 (0.32)
CONMI	0.173 (2.19)**	0.1562 (1.97)**	0.1495 (1.88)**	0.2166 (2.71)**
MAN	0.1463 (1.99)**	0.1319 (1.79)***	0.1235 (1.67)***	0.1258 (1.85)***
COMM	0.1575 (1.80)***	0.1222 (1.38)	0.1118 (1.25)	0.0929 (1.13)
TRADE	0.0854 (1.03)	0.0795 (0.96)	0.0752 (0.91)	0.0797 (1.16)
GOVT PRO	0.0251 (0.32)	0.0129 (0.16)	0.0043 (0.05)	0.0147 (0.20)
PROF	0.4250 (5.66)*	0.4314 (5.75)*	0.4276 (5.70)*	0.2745 (2.33)**
SEMI	0.1850 (2.74)*	0.1813 (2.69)*	0.1801 (2.67)*	0.0581 (0.58)
SUPER	0.3027 (3.87)*	0.3105 (3.97)*	0.3096 (3.96)*	0.1708 (1.56)
SKILL	0.1694 (3.20)*	0.1701 (3.22)*	0.1679 (3.17)*	0.1119 (1.66)***
DEATH		0.13172 (2.10)***	0.53352 (1.86)***	0.56422 (2.21)***
UNDEATH			-0.18647 (1.45)	-0.19091 (1.66)
MARDEATH			-0.15556 (0.73)	0.11719 (0.62)
AGEDEATH			-0.00419 (0.68)	-0.00637 (1.16)
STRESS				0.1029 (0.78)
REPEAT				0.1208 (1.04)

TABLE 6 cont'd

	(1)	(2)	(3)	(4)
STREN				-0.0572 (1.35)
MACH				0.0056 (0.10)
CONTROL				0.1056 (2.34)**
GED				0.0083 (0.15)
SVP				0.0299 (0.710)
C	6.474	6.43	6.40	5.99
N	813	813	813	813
$\bar{R}^2$	0.28	0.28	0.28	0.36

TABLE 7

EARNINGS OF MALE BLUE-COLLAR AND SERVICE WORKERS

	(1)	(2)	(3)	(4)
ln HRS	0.3622 (3.67)*	0.3596 (3.63)*	0.3527 (3.57)*	0.3362 (3.30)*
EDUC	0.0266 (3.11)*	0.0270 (3.15)*	0.0292 (3.39)*	0.0280 (3.15)*
AGE	0.0416 (2.72)*	0.0416 (2.72)*	0.0427 (2.78)*	0.0447 (2.84)*
AGESQ	-0.000438 (2.37)**	-0.00434 (2.37)**	-0.00045 (2.46)**	-0.00047 (2.51)**
UNION	0.1342 (2.57)*	0.1321 (2.53)*	0.2028 (3.39)*	0.2354 (3.80)*
YRRND	0.1716 (2.15)**	0.1720 (2.15)**	0.1816 (2.28)**	0.1839 (2.28)**
MAR	0.3317 (5.66)*	0.3297 (5.61)*	0.3598 (5.44)*	0.3695 (5.46)*
TEN	0.00237 (0.76)	0.0023 (0.74)	0.0025 (0.80)	0.0033 (1.04)
APP	0.0272 (0.55)	0.0277 (0.56)	0.0369 (0.75)	0.0435 (0.85)
NUNEM	0.00021 (0.03)	0.00015 (0.02)	0.00006 (0.01)	0.0022 (0.30)
BIL	0.1263 (1.94)***	0.1278 (1.95)**	0.1267 (1.96)**	0.1086 (1.62)***
QUE	0.0138 (0.16)	0.0131 (0.15)	0.0099 (0.11)	0.0126 (0.14)
ONT	0.0388 (0.46)	0.0386 (0.46)	0.0191 (0.23)	0.0313 (0.36)

TABLE 7 cont'd

	(1)	(2)	(3)	(4)
PRA	0.1269 (1.35)	0.1277 (1.36)	0.1091 (1.16)	0.1538 (1.59)***
BC	0.2886 (3.00)*	0.2835 (2.94)*	0.2617 (2.71)*	0.2585 (2.62)*
CITY	0.0119 (0.26)	0.0118 (0.25)	0.0139 (0.30)	0.00028 (0.06)
CONMI	0.1546 (1.69)***	0.1452 (1.57)	0.1076 (1.15)	0.1293 (1.27)
MAN.	0.1434 (1.68)***	0.1370 (1.59)	0.1067 (1.23)	0.1353 (1.44)
COMM	0.0914 (0.96)	0.0833 (0.86)	0.0469 (0.48)	0.0413 (0.40)
TRADE	0.1541 (1.64)	0.1519 (1.62)	0.1379 (1.47)	0.1791 (1.82)***
GOVT PRO	0.0386 (0.40)	0.0309 (0.32)	0.0011 (0.01)	-0.0179 (0.17)

TABLE 7 cont'd

	(1)	(2)	(3)	(4)
PROF	-	-	-	-
SEMI	-1.149 (3.27)*	-1.1354 (3.22)*	-1.1503 (3.27)*	-1.2655 (3.44)*
SUPER	0.3065 (3.65)*	0.3126 (3.70)*	0.3158 (3.74)*	0.1866 (1.35)
SKILL	0.1519 (3.10)*	0.1539 (3.14)*	0.1482 (3.02)*	0.0913 (1.25)
DEATH		0.05051 (0.67)	0.48004 (1.71)**	0.51576 (1.84)**
UNDEATH			-0.40122 (2.48)**	-0.37372 (2.24)**
MARDEATH			-0.24589 (1.18)	-0.24523 (1.18)
AGEDEATH			-0.00141 (0.18)	-0.00073 (0.09)
STRESS				0.10365 (0.70)
REPEAT				0.1108 (0.81)
STREN				-0.0628 (1.07)
MACH				0.0278 (0.35)
CONTROL				0.1331 (2.16)**
GED				-0.0693 (0.70)
SVP				0.0677 (1.00)

TABLE 7 cont'd.

	(1)	(2)	(3)	(4)
C	6.549	6.55	6.50	6.47
N	479	479	479	479
$\bar{R}^2$	0.27	0.27	0.27	0.29

TABLE 8

127

EARNINGS OF WHITE-COLLAR WORKERS

	(1)	(2)	(3)	(4)
Ln HRS	0.1720 (1.15)	0.1857 (1.24)	0.2031 (1.34)	0.3905 (2.78)*
EDUC	0.0506 (4.44)*	0.0522 (4.56)*	0.0522 (4.55)*	0.0418 (4.28)*
AGE	0.0786 (2.76)*	0.0784 (2.76)*	0.0797 (2.79)*	0.0766 (3.13)*
AGESQ	-0.000790 (2.43)**	-0.00789 (2.43)**	-0.000802 (2.46)*	-0.000760 (2.69)*
UNION	-0.0699 (0.73)	-0.0699 (0.73)	-0.0843 (0.86)	-0.0808 (0.90)
YRRND	-0.1116 (0.82)	-0.1086 (0.79)	-0.1111 (0.81)	-0.0092 (0.07)
MAR	0.2953 (3.03)*	0.2844 (2.91)*	0.2816 (2.83)*	0.2264 (2.57)**
TEN	0.0013 (0.26)	0.0022 (0.44)	0.0019 (0.36)	0.0066 (1.51)
APP	0.0431 (0.46)	0.0459 (0.49)	0.0521 (0.55)	0.0774 (0.94)
NUNEM	-0.0354 (1.50)	-0.0351 (1.49)	-0.0375 (1.58)	-0.0590 (3.07)*
BIL	0.0384 (0.37)	0.0369 (0.35)	0.0361 (0.35)	-0.0428 (0.47)
QUE	0.0283 (0.18)	0.0260 (0.16)	0.0292 (0.19)	0.0569 (0.45)
ONT	-0.1277 (0.88)	-0.1343 (0.93)	-0.1344 (0.92)	-0.0718 (0.63)
PRA	-0.0364 (0.23)	-0.0436 (0.27)	-0.0421 (0.26)	-0.1427 (1.05)
BC	0.1170 (0.66)	0.0824 (0.46)	0.0798 (0.44)	0.1049 (0.72)
CITY	0.0324 (0.39)	0.0294 (0.35)	0.0264 (0.31)	0.0382 (0.59)

TABLE 8 cont'd

128

	(1)	(2)	(3)	(4)
CONMI	0.3888 (1.98)**	0.3679 (1.93)***	0.3609 (1.89)***	0.5066 (3.29)*
MAN	0.2141 (1.52)	0.2105 (1.50)	0.2062 (1.46)	0.1605 (1.50)
COMM	0.4952 (2.56)**	0.3862 (1.84)***	0.0315 (1.87)***	0.3146 (1.94)**
TRADE	-0.0115 (0.07)	-0.0167 (0.10)	-0.0157 (0.10)	-0.0294 (0.23)
GOVT PRO	0.0580 (0.41)	0.0547 (0.39)	0.0584 (0.41)	0.1498 (1.30)
PROF	0.5676 (3.00)*	0.5533 (2.98)*	0.5519 (2.96)*	0.2715 (0.58)
SEMI	0.3641 (2.00)**	0.3531 (1.94)**	0.3541 (1.94)**	0.0913 (0.20)
SUPER	0.6529 (2.61)*	0.6555 (2.63)*	0.6527 (2.61)*	0.3206 (0.66)
SKILL	1.2025 (2.30)**	1.1822 (2.27)**	1.2107 (2.31)**	1.1476 (1.91)***
DEATH		0.1565 (1.30)	0.0135 (0.24)	-0.0193 (0.29)
UNDEATH			0.2030 (0.67)	0.2332 (1.03)
MARDEATH			-0.0307 (0.05)	0.1893 (0.37)
AGEDEATH			0.0012 (0.09)	-0.00019 (0.18)
STRESS				0.0052 (0.01)
REPEAT				0.1617 (0.18)

TABLE 8 cont'd

129

	(1)	(2)	(3)	(4)
STREN				-0.1494 (1.65)***
MACH				0.0614 (0.59)
CONTROL				0.0393 (0.60)
GED				0.0321 (0.37)
SVP				-0.0281 (0.42)
C	6.382	6.326	6.242	6.111
N	334	334	334	334
$\bar{R}^2$	0.22	0.23	0.22	0.38

TABLE 9

130

EARNINGS OF WOMEN

	Total Sample (1)	Blue-Collar and Service Workers (2)	White-Collar Workers (3)
ln HRS	0.6352 (9.59)*	0.5494 (6.95)*	0.9046 (6.91)**
EDUC	0.0216 (2.06)**	0.0052 (0.38)	0.0457 (2.56)*
AGE	0.0366 (2.14)**	0.0187 (0.95)	0.08548 (2.29)**
AGESQ	-0.000442 (2.10)**	-0.000213 (0.87)	-0.0010 (2.33)**
UNION	0.1788 (2.54)*	0.1719 (2.04)**	0.0331 (0.21)
YRRND	0.2546 (2.81)*	0.2807 (2.45)*	0.2622 (1.55)
MAR	-0.0903 (1.47)***	-0.0617 (0.88)	-0.0191 (0.15)
TEN	0.0158 (3.69)*	0.0183 (3.41)*	0.0086 (1.04)
APP	0.0446 (0.52)	0.0762 (0.77)	-0.1932 (0.99)
NUNEM	-0.0036 (0.27)	-0.00013 (0.09)	-0.0203 (0.35)
BIL	-0.0500 (0.67)	-0.0466 (0.49)	-0.0403 (0.31)
QUE	0.1485 (1.43)**	0.1368 (1.12)**	0.2239 (1.03)
ONT	0.0207 (0.21)	-0.0041 (0.04)	-0.0469 (0.24)
PRA	0.1162 (1.06)**	0.1382 (1.07)**	0.1314 (0.60)
BC	0.0318 (2.26)	0.0311 (0.21)	0.0052 (0.02)

TABLE 9

131

	(1)	(2)	(3)
CITY	0.2517 (4.51)*	0.3191 (4.67)*	0.0706 (0.64)
CONMI	0.3684 (2.10)**	0.3924 (2.66)**	0.3502 (0.55)
MAN	0.0384 (0.38)	0.0788 (0.71)	-0.1130 (0.34)
COMM	0.3281 (2.29)**	0.4087 (2.73)**	-0.0059 (0.10)
TRADE	-0.1859 (2.14)**	-0.2057 (2.12)**	0.2014 (0.80)
GOVTPRO	0.0764 (0.95)	0.1477 (1.61)	-0.2245 (1.17)
PROF	0.1959 (1.32)	-	-0.0991 (0.73)
SEMI	0.2453 (1.76)	0.3605 (0.99)	
SUPER	-0.1364 (0.59)	-0.0028 (0.69)	-0.8707 (2.84)*
SKILL	0.0860 (0.91)	0.0672 (0.64)	
DEATH	-0.0319 (0.72)	0.0305 (0.56)	-0.1259 (0.03)
UNDEATH	-0.6032 (0.85)	0.9567 (1.21)	0.8786 (0.41)
MARDEATH	-0.0468 (0.05)	0.0767 (0.82)	1.1159 (0.41)
AGEDEATH	0.0021 (0.14)	0.0278 (0.51)	0.0005 (0.01)
STRESS	-0.2094 (1.12)	-0.3186 (1.32)	-0.9192 (2.21)**

TABLE 9 cont'd

132

	(1)	(2)	(3)
REPEAT	-0.1144 (1.08)	-0.1325 (1.16)	-4.151 (1.16)
STREN	-0.0868 (0.89)	-0.1350 (1.19)***	0.4925 (2.58)**
MACH	-0.1278 (1.29)	-0.1479 (1.23)	-0.1042 (0.46)
CONTROL	0.1209 (1.86)***	0.0978 (1.26)	0.2373 (1.66)***
GED	0.0622 (0.72)	0.1243 (1.12)	-0.0711 (0.35)
SVP	0.0004 (0.01)	-0.0254 (0.39)	0.1374 (1.24)
C	5.475	6.146	2.143
N	550	375	175
$\bar{R}^2$	0.43	0.39	0.31

positive effect on earnings and for blue-collar and service workers as well as the total sample the effect is statistically significant. An explanation for this result is that the ability to control working hours is correlated with other unmeasured job characteristics. For example, those individuals who can control their hours will most likely be found in supervisory positions.

The only other significant job quality variable is the index of work effort and strength for white-collar workers. Individuals who experience heavy lifting or strenuous work receive less compensation than other workers with more sedentary jobs. This result is just the opposite of what the theory would predict. Although insignificant the coefficient for the work effort variable is also negative in Tables 6 and 7.

c. Occupational Fatalities¹⁷

The fatality rates and interaction variables appear in columns (3) and (4). Only the fatality rate appears in column (2). In some cases the fatality rates yield little information. For white-collar workers none of the four hazard variables (DEATH, UNDEATH, MARDEATH, AGEDEATH) are statistically significant.

Given the low fatality rates seen in Table 5 this result is not surprising for the white-collar group. The insignificant findings may occur because the occasional death in an occupation is not a crucial or significant factor in workers' demands for additional compensation. There may be some threshold level of occupational fatalities in order for workers to become aware of risks they encounter at work. The mean death rate for white-collar workers is only 0.66 per 1,000 workers.

The low variance in the white-collar fatality rates also indicates that most white-collar jobs are equally safe. This implies that the data will not reveal much information since we do not observe significant differences in occupational risk.

In Table 6 all the interaction variables are insignificant, although the interaction between unionization and fatality is almost significant at the ten percent level. The t-statistics for the marriage interaction coefficient term in columns (3) and (4) are very low, indicating that married workers in risky jobs do not receive any more compensation than unmarried workers in similar jobs.¹⁸ The coefficient for age times fatality rate is also negative and insignificant in Table 6. The coefficient for the fatality variable, however, is significant at the five percent level in two of the three regressions. Meanwhile, it is significant at the ten percent level in the third regression.¹⁹

The fatality rate in Table 7 is significant at the ten percent level in two of the estimates for blue-collar and service workers. The only exception is column (2) where the coefficient is insignificant.

In columns (3) and (4) of Table 6 both the fatality rates and the union interaction variables are significant at the five percent level. This indicates that blue-collar and service workers do receive income premiums for working in risky occupations. The negative coefficient for the union interaction variable implies that compensating differentials are smaller for unionized members.

(v) The Earnings of Women

Most studies that deal with compensating wage differentials use only a sample of males, however there are a few exceptions (Olson, 1981; Dillingham, 1985). To test for differences between males and females some of the previous regressions have been re-estimated for women only.

For simplicity only those estimates that include fatality rates, the interaction variables, and the non-fatal job characteristics are presented. The results are seen in Table 9. The first column includes the entire sample of women. Column (2) contains the estimates for blue-collar and service workers, and column (3) includes the results for white-collar workers.

In column (1) none of the fatality coefficients are significantly different from zero using the ten percent criterion. The same results are seen in Columns (2) and (3).

Some of the non-fatal job characteristics do contribute to explaining the variation in earnings. For all women, controlling working hours positively contributes to yearly earnings. The impact of the variable is different than what the theory would predict. Three of the job quality coefficients are significant for white-collar workers. Working under stress negatively influences earnings and controlling working hours and physical exertion positively influence earnings. Only the latter variable is consistent with the theory of compensating differentials.

IV. COMPARISONS WITH OTHER ESTIMATES

In order to compare results across studies, wage differential estimates are frequently converted to a value of life format. As indicated above

statistical value of life estimates are principally used for these comparisons.

Several points must be clarified before any estimates are given. First, it is important to choose the proper sample to base the results on. Second, it is necessary to specify the appropriate level of significance for determining whether or not a risk variable should be included in the statistical value of life estimates.

Although all workers potentially face on-the-job risks it would be inappropriate to use the entire population of men and women. Given the arguments presented earlier concerning female labour force participation rates this group should not be used in the analysis. White-collar workers apparently face few serious risks in the labour market. With very low fatality rates white-collar workers are either unaware of the risks they face or they feel that occupational risk is not a serious enough problem to demand compensation. Following the above logic my estimates will be based on the blue-collar and service worker sample.

The variables included in the following value of life estimates are: occupational fatality rate (DEATH), interaction of union and fatality rates (UNDEATH), interaction of age and fatality rate (AGEDEATH), and interaction of marriage and fatality rate (MARDEATH). The latter two variables are included in the calculations even though their respective coefficients are not significant at the ten percent level. These coefficients, despite being insignificant, remain our best point-estimates, and should be included in the analysis. The fact that an effect is not significantly different from zero does not mean it is zero.

The risk variables used in the calculations below are found in columns (2), (3) and (4) of Table 6. In terms of the regression coefficients the implicit value of life is $1000 \times \bar{S\bar{Y}} \times (\partial \ln Y / \partial \text{DEATH}) = 1000 \times \bar{S\bar{Y}} [\beta_0 + \bar{U} \times \beta_U + \overline{MAR} \times \beta_M + \overline{AGE} \times \beta_A]$ where $\bar{S\bar{Y}}$ is the mean level of income and $\bar{U}$ is the fraction of blue-collar and service workers that are unionized, $\overline{MAR}$ is the mean of the marriage variable, and $\overline{AGE}$ is the mean of the age, and the β 's are the respective variables. All the coefficients and means relate to male workers. Using the estimates reported in column (2) the implicit value of life is estimated to be \$3,666,690; while the coefficients in column (3) imply a value of \$4,581,485; while in column (4) the value is \$3,797,192.

If 1,000 men are employed in a job entailing an extra risk of death of 0.001 per year on average, one man of the 1,000 will die. The regressions indicate that each individual on average would be willing to pay approximately \$4,000 to reduce the probability of death by 0.001. Collectively the 1,000 men will be willing to forego \$4.0 million to save the additional randomly chosen individual's life.

Converting my 1981 Canadian dollar estimates to 1979 U.S. dollars yields an implicit value of life of \$2.51 - \$3.13 million.²⁰ Comparing these results to other estimates is somewhat difficult given the high variance in estimates reported in Table 1. As pointed out earlier the definitions of risk and the data sources used in other studies vary substantially. It is preferable to compare my results with those studies that use occupational risk data rather than industry estimates. It is also useful to deal with those studies that do not rely on actuarial data. The

two most suitable estimates are the recent ones presented by Dillingham (1985) and Marin and Psacharopoulos (1982). The former estimates the imputed value of life to be \$1.4 - \$1.8 million, while the latter puts the figure at \$1.95 million for British workers.

The estimates presented here are higher than those reported by Dillingham and Marian and Psacharopoulos. However, the differences are not that significant, especially compared to the other estimates reported in Table 1. Unfortunately there are no other Canadian studies to compare my results with.

The differences between the Canadian labour market and the market in the United States and Great Britain are substantial. Although the United States and Canada are linked with a common border and have similar cultures their labour markets are different. Although this study has emphasized occupational characteristics more than industry differences it is worth noting that industrial injury rates are twice as high in Canada as they are in the United States. Occupations within a given industry in both countries may vary. However, the differences between the two countries is still striking. The worker fatality rate in Canada in 1981 was 8.8 deaths per 100,000 workers, while it was only 4.4 deaths per 100,000 workers in 1981 in the United States (Digby and Riddell, 1986).²¹ Meanwhile, union membership as a percent of the non-agricultural labour force was only 20.7 percent in the United States in 1981. The comparable figure for Canada is 37.4 percent. The unique aspects of the Canadian economy mean that value of life comparisons with other countries should not be taken too far.

V. CONCLUSIONS

The goal of making the work environment completely safe from risk of injury or death would be so costly that society would be unwilling to pay for it. Given these real constraints on reducing risk the government is forced to make decisions on "acceptable" levels of risk.

Reducing existing risks is expensive in terms of the resources needed to finance such efforts. Improving health and safety in the work place will be beneficial to society in general. However, it is impossible to conclude that a specific program is beneficial unless we can calculate the benefits and costs of the program. It is crucial to balance the costs and benefits of potential life saving activities?

Some may consider such cost-benefit calculations on the part of economists as immoral or unethical. There are some serious flaws and misconceptions in this type of argument. Choices are being made every day by government regulators, unions, employers, and individual workers. The act of not examining risks within a cost-benefit structure is also a choice. If, the choice is made in an ad hoc manner, those groups with more political and economic power are likely to gain at the expense of less powerful groups.

Governments must decide how to allocate limited resources to competing programs. For example, should regulations be enacted to improve ventilation systems in mines, or should additional safety features be placed on automobiles? Only by detailing the benefits and costs of such a choice can society best be served.

It is worth repeating that this type of analysis deals with small variations in the degree of occupational risk. Society's attitude toward saving an identified life is very different than reducing risks in the work place. The risk framework used here cannot be used to determine how much to spend on rescuing trapped underground miners or finding lost individuals in the woods.

The non-fatal job characteristics used in this study apparently do not influence earnings to any significant extent. These results are similar to many of the studies discussed above.

This study has shown that some workers do receive risk premiums for hazardous jobs. The estimates suggest that male workers are willing to pay approximately \$4.0 million for an expected reduction of one death per 1,000 workers. While this estimate is an average across industries and workers, policy makers and regulators can now calculate rough estimates of the gross benefits of risk reducing programs. These benefits can be compared to the estimated costs of such programs or rule changes to see if they are worthy of implementation.

FOOTNOTES

- ¹Adam Smith (1976), p. 112.
- ²As Smith points out it is the most detestable of all jobs, the public executioner, that is better paid than any common trade.
- ³Mishan (1976) presents a more complete theoretical discussion on the willingness to pay for saving an additional life.
- ⁴Huron (1980) and Kumar and Coates (1982) do attempt to give Canadian estimates for compensating wage differentials. However, neither study includes worker fatality rates in the analysis.
- ⁵The simple model presented here follows Lucas' (1977) work closely.
- ⁶The approach used throughout this paper is based on labour market survey data. For alternative approaches see Section II (iii).
- ⁷One way to avoid some of the problems outlined above is to use panel data. See Brown (1980) and Duncan and Holmlund (1983).
- ⁸Linnerooth (1979) points out that the value of life estimates derived from labour market data underestimates the 'true' figures. This is because labour market estimates do not control for non-market activities. It is well known that household production and consumption should also be considered part of one's well-being or income. The latter are excluded since they cannot be measured with market data.
- ⁹Actually there is another method that values life saving programs that is not mentioned in the text. This is the foregone earnings approach. This technique estimates the lifetime earnings of those people who die in either work related accidents or by some other means (auto accidents, airplane crashes, etc.). This approach is rejected here, it is not related to utility maximization.
- ¹⁰The survey was designed by researchers in the Department of Sociology and Anthropology at Carleton University. It was funded by a research grant from the Social Science and Humanities Research Council of Canada. The survey itself was fielded by Canadian Facts, a private research firm (Canadian Facts, 1985).
- ¹¹I would like to thank Professor Alfred Hunter of the Department of Sociology at McMaster for providing me with a copy of this tape.

- 12 The data from Labour Canada and the Quebec Workman's Compensation Board listed the total number of deaths in each occupation in 1981. To obtain the fatality rates the number of deaths were divided by the total number of people who worked at least 50 weeks a year in each occupation. Unfortunately, there are no 1981 estimates for the latter. I had to use 1980 employment figures (Canada, 1981). Given data restrictions this problem is unavoidable.
- 13 Unfortunately at this time non-fatal occupational accidents at a disaggregated level are not available for public use. Statistics Canada will soon be releasing this information at the four digit CCDO level.
- 14 Errors can still result from incorrectly specifying the cause of death. There is little guarantee that the reported deaths due to occupational illnesses are an accurate measure of actual deaths.
- 15 If there is only one income earner in a multi-unit household they are likely to demand greater wage premiums than individual unit households.
- 16 The following regressions equations follow Thaler and Rosen (1975) closely.
- 17 Other specifications were tried using fatality rates. Following Olson (1981) I included death squared as an explanatory variable. The use of death squared helps to determine if the wage-risk frontier is linear or not. If the coefficient is positive the frontier increases at an increasing rate, and if it is negative the coefficient increases at a decreasing rate. Although the coefficient for death squared was negative it was insignificant for blue-collar and service workers. The coefficient for DEATH was also insignificant when death squared was included in the regressions. One possible explanation for this result was the high degree of multi-collinearity between the two variables. The variance in the fatality rates for blue-collar and service workers is 0.55 with the mean being 0.39.
- 18 A more useful approach would have been to use the number of children times fatality rates as an independent variable. Unfortunately the data do not permit such an exercise.
- 19 This result is surprisingly similar to Thaler and Rosen's. They find that the fatality coefficient is insignificant when none of the interaction variables are included.
- 20 The 1981 estimates were first converted to 1979 Canadian dollars. The consumer price index in 1981 was 100 (the base year) and the 1979 index was 80.7. These figures were then converted into U.S. dollars. In 1979 the exchange rate was \$1 Canadian = \$0.85 U.S.. The conversion rates come from The Bank of Canada Review (Canada, 1986).

- ²¹ The high injury and fatality rates in Canada are only in part the result of the fact that the Canadian economy is heavily resource based. Digby and Riddell (1986) point out that fatality rates in mining, forestry and fishing, construction and manufacturing are all higher in Canada than they are in the United States.

- Acton, J. (1973) Evaluating Public Programs to Save Lives: The Case of Heart Attacks, Santa Monica: Rand Corporation.
- Arnold, R. and L. Nichols (1983) 'Wage-risk premiums and workers' compensation: a refinement of estimates of compensating wage differentials', Journal of Political Economy, 91, 332-340.
- Bartel, A. (1982) 'Wages, non-wage job characteristics, and labor mobility', Industrial and Labor Relations Review, 35, 578-589.
- Blomquist, G. (1979) 'Value of life saving: implications of consumption activity', Journal of Political Economy, 87, 540-558.
- Blomquist, G. (1981) 'The value of human life: an empirical perspective', Economic Inquiry, 19, 156-164.
- Blomquist, G. (1982) 'Estimating the value of life and safety: recent developments', in M. Jones-Lee (ed.) The Value of Life and Safety, Amsterdam, North-Holland.
- Brown, C. (1980) 'Equalizing differences in the labor market', Quarterly Journal of Economics, 94, 90-118.
- Canada, The Bank of Canada (1986). The Bank of Canada Review, May, Ottawa: Bank of Canada.
- Canada, Labour Canada (1984) Employment Injuries and Occupational Illnesses Ottawa: Ministry of Supply and Services.
- Canada, Statistics Canada (1981) Work Since January, 1980 - Occupation by Labour Force and Work Activity, Ottawa: Ministry of Supply and Services.
- Canadian Facts (1985) National Survey on Class Structure and Income Determination, Ottawa.
- Digby, C. and W.C. Riddell (1986) 'Occupational health and safety in Canada', in W.C. Riddell (ed.) Canadian Labour Relations, Toronto: University of Toronto Press.
- Dillingham, A. (1985) 'The influence of risk variable definition on value-of-life estimates', Economic Inquiry, 25, 277-294.
- Dorsey, S. (1983) 'Employment hazards, and fringe benefits: further tests of compensating differentials', in J. D. Worrall (ed.) Safety and the Workforce: Incentives and Disincentives in Workers' Compensation, Ithaca: New York State School of Industrial Relations.
- Duncan, G. (1976) 'Earnings functions and non-pecuniary benefits' Journal of Human Resources, 11, 462-483.

- Duncan, G. and B. Holmlund (1983) 'Was Adam-Smith right after all: another rest of the theory of compensating wage differentials', Journal of Labor Economics, 1, 366-379.
- Duncan, G. and P. Stafford (1980) 'Do union members receive compensating wage differentials', American Economic Review, 70, 335-371.
- Filer, R. (1983) 'Male-female wage differences: the importance of compensating differences', Industrial and Labor Relations Review, 36, 426-437.
- Flanagan, R., R. Smith and R. Ehrenberg (1984) Labor Economics and Labor Relations, Glenview: Scott.
- Freeman, R. (1976) The Overeducated American, New York: Academic Press.
- Freeman, R. (1980) 'Unionism and the dispersion of wages', Industrial and Labor Relations Review, 34, 3-23.
- Freeman, R. (1982) 'Union wage practices and wage dispersion within establishments' Industrial and Labor Relations Review, 36, 3-21.
- Freeman, R. and J. Medoff (1984) What do Unions Do?, New York, Basic Books.
- Ghosh, D., D. Lees and W. Seal (1975) 'Optional motorway speed and some valuations of time and life', Manchester School of Economic and Social Studies, 43, 134-143.
- Hammermesh, D. (1977) 'Economic aspects of job satisfaction' in O. Ashenfelter and W. Oates (ed.) Essays in Labor Market and Population Analysis, New York: John Wiley.
- Hinton, M. (1980) 'The value of a "limb": evidence from the Canadian labour market', Toronto: University of Toronto, Department of Political Economy (mimeo).
- Hirsch, B. and M. Berger (1984) 'Union membership determination and industry characteristics' Southern Economic Journal, 50, 665-679.
- Hunter, A. and M. Manley (forthcoming) 'Using the CCDO worker-trait data in the study of occupations', Canadian Review of Sociology and Anthropology.
- Jones-Lee, M. (1976) The Value of Life: An Economic Analysis, Chicago: University of Chicago Press.
- Linnerooth, J. (1979) 'The value of human life: a review of the models' Economic Inquiry, 17, 52-74.
- Lucas, R.E.B. (1977) 'Hedonic wage equations and psychic wage equations' American Economic Review, 67, 549-558.

- Kumar, P. and M. Coates (1982) 'Occupational earnings, compensating differentials and human capital: an empirical study', Canadian Journal of Economics, 15, 442-457.
- Marin, A. and G. Psacharopoulos (1982) 'The reward for risk in the labor market: evidence from the United Kingdom and a reconciliation with other studies' Journal of Political Economy, 90, 827-853.
- Mishan, E. (1971) 'Cost-Benefit Analysis', New York: Praeger.
- Olson, C. (1981) 'An analysis of wage differentials received by workers on dangerous jobs', Journal of Human Resources, 16, 167-185.
- Rosen, S. (1974) 'Hedonic prices and implicit markets', Journal of Political Economy, 82, 34-55.
- Smith, A. (1976) The Wealth of Nations, Chicago: University of Chicago Press.
- Smith, R. (1976) The Occupational Safety and Health Act: Its Goals and Achievements, Washington: American Enterprise Institute.
- Smith, R. (1979) 'Compensating wage differentials and public policy: a review', Industrial and Labor Relations Review, 32, 339-352.
- Thaler, R. and S. Rosen (1975) 'The value of life: evidence from the labor market' in N. Terleckyz (ed.) Household Production and Consumption, New York: Columbia University Press.
- Usher, D. (1985) 'The value of life for decision making in the public sector', in E. Paul, F. Miller and J. Paul (ed.) Ethics and Economics, Oxford, Oxford University Press.
- Viscusi, W.K. (1978) 'Labor market valuations of life and limb: empirical evidence and policy implications', Public Policy, 26, 359-386.
- Viscusi, W.K. (1979) 'Job hazards and worker quit rates an analysis of adaptive worker behaviour', International Economic Review, 20, 29-58.

CHAPTER FOUR

INTERRUPTED WORK CAREERS,
THE DEPRECIATION OF HUMAN
CAPITAL AND THE EARNINGS OF
MARRIED WOMEN

I. INTRODUCTION

The gap between the earnings of men and women in Canada has declined over the previous decade, but still remains substantial. According to Statistics Canada (1982, p. 64), the annual earnings of women in 1982 were 53 percent of the annual earnings of men. Table 1 shows the average hourly earnings of men and women by educational attainment in Canada in 1970 and 1980.¹ These data also confirm the existence of a substantial gap in wages.

Corcoran and Courant (1985) distinguish among three major approaches to attempt to explain this earnings gap -- human capital theory, the pure discrimination hypothesis, and the crowding (sex segregation) hypothesis. This paper concentrates primarily on the first of these approaches -- human capital theory.²

The principal objective of this study is to explain the earnings of married women in Canada. According to the human capital approach, one of the main causes of differences in earnings both between the sexes and between people of the same sex is differences in the amount of human capital acquired both through on-the-job and formal training. What most studies within the human capital approach ignore however, is the possibility that human capital may depreciate when not in use. A worker's skills may deteriorate or become obsolete when the working career is interrupted. Since many women interrupt their careers for spells of considerable length, depreciation of human capital may be important, both in explaining differences in earnings between different women, and between women and men.

In order to incorporate the effect of depreciation of human capital on

TABLE 1Average Hourly Earnings of Women and Men, by
Educational Attainment

	Women		Men		Women's Wages as a proportion of Men's	
	1970 (\$)	1980 (\$)	1970 (\$)	1980 (\$)	1970 (%)	1980 (%)
Secondary School or less	2.15	6.57	3.27	9.33	66	70
Non-university diploma or certificate or some university without a degree	2.75	7.67	3.92	10.50	70	74
Bachelors degree	3.89	10.28	5.29	13.72	74	75
Post-graduate degree	5.01	12.50	7.47	15.81	67	79
Weighted Average	2.49	7.60	3.74	10.58	67	72

Source: Boulet and Lavalie (1984, p. 12)

earnings, we need detailed information on the working histories of women. If depreciation is important, the usual proxies for experience (Mincer's Identity or age) or even actual work experience itself, in the sense of total number of years worked, may be inadequate as a measure of current human capital. If human capital does depreciate, and to a significant extent, what matters is not merely how much experience has been acquired, but when that experience was acquired. Both duration and timing are important, especially for a group of workers, such as women, who enter and leave the labour market frequently.

The data used in this study do provide this crucial information on the dates of entries and exits into the labour market by married working women. The 'segmented' human capital model used as a framework for the analysis is derived from the model used by Mincer and Polachek (1974) and Polachek (1975) in their studies of the earnings of U.S. women. The model explicitly incorporates the interruptions in the working careers of women.

The first question this paper seeks to answer is whether, and to what extent, women's earnings are adversely affected by spells out of the labour market (commonly labelled "home time").

The second question this paper seeks to answer is how women invest in human capital over various phases of the life-cycle. With interrupted work careers do women invest in training programs and acquire on-the-job skills before they exit from the market or after they return to the labour market?

The third question this paper seeks to address is to what extent the earnings gap between men and women can be explained by human capital theory, once we have incorporated the effects of human capital depreciation due to

spells out of the labour market. Existing studies of this question, especially those from Canada, are inadequate because they have failed to incorporate the major differences between men's and women's work histories (Robb, 1978; Gunderson, 1979).

A major problem with empirical work of this type is selectivity bias. Heckman (1974, 1979) and Gronau (1974) highlight the problem of using a select sample of the population. If the sample of working women is random, then the parameter estimates listed below are unbiased. However, a woman will decide to work if her potential productivity in the labour force exceeds her potential productivity outside the labour force. Given this situation the sample of working women analyzed is clearly not a random one. In order to see whether selectivity bias is a problem, and how it affects the results, some of the equations are re-estimated controlling for this potential bias.

In addition to selectivity bias, several other criticisms have been directed against Mincer and Polachek. In particular, Corcoran (1979) and Corcoran and Duncan (1979) are highly critical of Mincer and Polachek's restricted age range (30-44). Two age groups are used in this study, 25 to 44, and 18 to 64. Sandell and Shapiro (1978), meanwhile, are critical of Mincer and Polachek's specification of their human capital model as well as their use of uncorrected data. This study uses a data set and methodology which avoid many of the above problems.

Section II develops the theoretical framework used throughout most of the text, presents a series of hypotheses derived from this framework, and reviews some of the relevant literature. Section III presents and

discusses the empirical results for the determinants of women's earnings. Section IV compares regression estimates for men and women in order to examine the extent to which the approach developed in section II can explain the earnings gap between men and women. Section V presents a summary and conclusions.

II. THEORY, HYPOTHESES AND EXISTING LITERATURE

1) Earnings Functions

Net investments in human capital produce increased earnings over the life-cycle. When gross investment is zero, net investment is negative, and earnings fall because of the depreciation of skills. Those women who interrupt their work careers will likely have their incomes reduced by this depreciation. Therefore it is necessary to examine the effect of home time on women's incomes.³

Let C_{t-1} be the dollar amount of net investment in human capital in time $t-1$. Gross investment may be defined as C_{t-1}^* ; where the latter includes the depreciation rate for the stock of human capital, δ_{t-1} . Next let r be the average rate of return on human capital investment. Finally, let E_t be the gross earnings in t before investment expenditures are subtracted. Assume that the cost of investment increases as one acquires greater amounts of human capital. The relation between investment in human capital and the change in earnings is given by:

$$E_t = E_{t-1} + rC_{t-1} \quad (1)$$

or

$$E_t = E_{t-1} + rC_{t-1}^* - \delta_{t-1}E_{t-1} \quad (2)$$

Let $k_t = C_t/E_t$, and $k_t^* = C_t^*/E_t$ be respectively the ratios of net and gross

investment expenditures to earnings. We can re-write (1) and (2) as

$$E_t = E_{t-1} (1 + rk_{t-1}) \quad (3)$$

and:

$$E_t = E_{t-1} (1 + rk_{t-1}^* - \delta_{t-1}) \quad (4)$$

From (3) and (4) we can easily see that $rk_{t-1} = rk_{t-1}^* - \delta_{t-1}$. The logarithmic approximations of (3) and (4) over a multi-period time span, starting in period 0, are

$$\ln E_t = \ln E_0 + r \sum_{i=0}^{t-1} k_i \quad (5)$$

$$\ln E_t = \ln E_0 + \sum_{i=0}^{t-1} (rk_i^* - \delta_i) \quad (6)$$

Assume that women exit from the labour market twice in their working careers and return to work in the labour market after each interruption. Further, assume that the rate of depreciation (δ) and the average ratio of gross investment expenditures to earnings (k^*) are constant within spells of market work and home time. As shown below, data considerations dictate this theoretical structure. If we observe women working in time t equation (6) can be rewritten as

$$\begin{aligned} \ln E_t = & \ln E_0 + (rs - \delta_s) + (rk_1^* - \delta_1)e_1 \\ & + (rk_{h_1}^* - \delta_{h_1})h_1 + (rk_2^* - \delta_2)e_2 \\ & + (rk_{h_2}^* - \delta_{h_2})h_2 + (rk_3^* - \delta_3)e_3 \end{aligned} \quad (7)$$

where

s = duration of schooling

e_1 = duration of first full-time job after school

h_1 = duration of first home time interval

e_2 = duration of second interval of job market experience

h_2 = duration of second home time interval

e_3 = duration of present job experience

Notice several important features about specifying an earnings function such as (7). First, the above allows for the depreciation of human capital during home time, if women do not use this time to upgrade their skills. Table 2 details the work histories of the women examined in this study. For the married woman aged 25 to 44 (with children) who is presently working, average total experience is 10.1 years, while home time after starting the first full-time job is 6.7 years. For the same group, aged 18 to 64, average work experience is 12.5 years and home time is 9.0 years. These results indicate that women who are currently working spend on average about forty percent of their time out of the labour market.⁴

(11) Hypotheses

Mincer and Polachek have set out a series of hypotheses concerning the life-cycle patterns of working women. The most important are:

1. Investments in human capital generate financial rewards only while women are working. Therefore, shorter expected work careers reduce the incentives for women to invest in job-related skills. This applies to both schooling and on-the-job investments.

Table 2 shows that labour force experience for all women from 18 to 64 with children is 58 percent of their total potential experience. For women with no children in the same age group the comparable figure is 80 percent. Since labour market attachment for married women with children is lower than

TABLE 2

Work Histories of Married Women
Spouse Present

Size	First Job	Second Job	Present Job	Total	Total*	Years Out Of Market	Years of School	Nos. of Child- ren	Sample Size
	e_1	e_2	e_3	$\sum e$	EXP	h	S	N_c	N
<u>Aged 25 to 44</u>									
With children	4.7	1.7	3.7	10.1	10.1	6.7	11.6	2.8	540
No children	4.8	1.2	2.8	8.8	8.8	1.6	13.0	-	56
Total	4.7	1.7	3.7	10.1	10.1	6.3	11.7	2.5	596
<u>Aged 18 to 64</u>									
With children	5.0	2.1	5.4	12.5	12.5	9.0	11.5	2.8	896
No children	5.4	1.8	4.3	11.5	11.5	2.9	12.4	-	97
Total	5.1	2.1	5.3	12.5	12.5	8.4	11.6	2.5	993

*Number of years of experience reported by respondents in the survey.

Source: Canadian National Mobility Survey

for other women, or for men, the former are likely to invest less intensively in skill training. The longer the expected participation in the work force by women the larger will be their investments in skill training. Those women who expect to work continuously during their adult lives will have earnings profiles similar to men's.

2. Mincer and Polachek (1974, p. 586) argue that investments in on-the-job training are likely to be double-peaked for women with children. Peaks of high investment will occur prior to maternity, and after the children are grown, with the latter being the most important. Any investments between these periods are likely to be minimal. In terms of work histories, Table 2 shows that the intermittent work period (e_2) is significantly shorter than the other work periods.

3. A final implication of this type of model deals with the wage gap between men and women. Human capital theory argues that one of the primary reasons women have lower incomes is that they work fewer years than men. Women also invest less intensively in skilled occupations requiring participation in training programs or apprenticeships because of family commitments. This means that home time (h) should have a significant effect on future earnings.⁵

Given discontinuous work patterns, many women will have a relatively flat earnings profile over the life-cycle. Since they choose not to invest in skills that depreciate due to non-use, women will not acquire the same skills as men. This occurs because of a rational choice made by women, not because of discrimination or some form of sexual stereotyping.

The preceding paragraphs summarize the neo-classical explanation for relatively lower incomes of women. In the human capital model the wage gap between men and women is explained by the depreciation of skills due to extended home time, the differing job investment patterns of the sexes, and the fact that discontinuous work causes workers to miss increases in earnings simply because of their absence from work. England (1982) defines the latter as "foregone appreciation". If human capital does depreciate substantially with non-use, the human capital theory is useful in explaining earnings differences.

The simplified neo-classical argument presented above is complicated by the fact that one has to distinguish between short run and long run depreciation rates (Mincer and Ofek, 1982; Corcoran, 1979; Corcoran and Duncan, 1979; Corcoran, Duncan and Ponza, 1983a, 1983b). Short run depreciation rates (of up to 1 year) may be substantial for women as they re-enter the labour force. There is, however, no guarantee that this pattern will exist over a longer period of time. Women's earnings patterns may 'rebound' over the longer term to catch up with their old earnings profile. Moreover, women will probably not be able to recoup the entire loss of their earnings while they were out of the market because they will lose many seniority benefits and opportunities for job advancements. However, even with the foregone appreciation in income it is possible for the actual long term depreciation rate to be quite small.

These hypotheses and their implications for the male/female wage gap are examined in detail in this paper. The results show that in general the hypotheses cannot be substantiated with any degree of certainty. There are

instances where Mincer and Polachek's hypotheses hold, but they are generally not consistent with the findings of this paper.

(iii) Previous Literature on the Earnings of Women

The major contribution of Mincer and Polachek (1974) was to extend the human capital model to include the depreciation of skills. They recognized that an individual's stock of human capital could depreciate with non-use. Given the discontinuity of women's work experience, multiple exits and entries should be very important in determining their earnings.

The Mincer and Polachek model is similar to equation (7) above. They defined the variable e_1 to be work experience prior to first child. They also define e_3 as current job tenure and e_2 as 'residual' or intermittent work experience between first child and current job. Home time (h) is split between home time prior to first child (h_1) and all other home time (h_2).

Mincer and Polachek also include a number of other explanatory variables in their model, such as education, hours worked, weeks worked, and locational dummy variables. They present various earnings functions for women aged 30 to 44. The regression equations were run for women with and without children, as well as by educational attainment, marital status and differing levels of work experience.

Mincer and Polachek found a negative coefficient for home time indicating a net depreciation in skills due to non-use. Although individual depreciation rates differ for the various groups the overall rate was 1.2 percent for white women with children. This implies that for every year out of the labour market current earnings fall by 1.2 percent. The coefficient was statistically significant at the five percent level.

Mincer and Polachek also found that depreciation rates increase with years of schooling completed. Women with higher levels of education lose proportionately more income because of non-use than women with lower levels of schooling. These results are consistent with the first and third hypotheses listed above.

Earnings of women with children were also found to be double-peaked. The coefficient for intermittent experience (e_2) was generally insignificant. The coefficients for e_1 and e_3 , were generally statistically significant, with the latter being larger than the former.

Their estimates imply that intermittent experience does not significantly contribute to earnings. Current job tenure is also more important than first job in determining earnings. These results are consistent with the second hypothesis listed above.

Sandell and Shapiro (1978) presented one of the first major criticisms of Mincer and Polachek's work. After correcting problems with the data used by Mincer and Polachek, Sandell and Shapiro found that wages declined by only 0.4 percent per year of nonparticipation. The coefficient for home time was also statistically insignificant.

Corcoran (1979) replicated the Mincer-Polachek model using cross-sectional data from the Panel Study on Income Dynamics. She used two age groups of women in her analysis, 30 to 44 years and 18 to 64 years. For the 30 to 44 group the depreciation rate due to nonparticipation was 1.4 percent. This finding was similar to Mincer and Polachek's estimate of 1.2 percent for the same age group.

When the sample was expanded to include women 18 to 64 years old, the results changed dramatically. For women with at least one child the depreciation rate fell to 0.6 percent. For all white women who had at least one child the figure was only 0.5 percent.

Corcoran and Duncan (1979) found that the depreciation rate for white women was approximately 0.6 percent. Their findings also indicate that the wage advantages enjoyed by white males cannot be explained by labour force attachment. When controlling for work history they conclude that 58 percent of the wage gap between white men and white women cannot be explained by their earnings regressions. The unexplained figure is 71 percent when comparing the differences between white men and black women.

Corcoran (1979) concluded that the differing results were due to the restricted sample used by Mincer and Polachek. Women between 30 and 44 years of age are more likely than women in general to re-enter the labour market after various spells of nonparticipation (having children). It is likely that this group will exhibit higher depreciation rates than women in general because they have not had the opportunity to restore or repair part of their human capital. Corcoran concluded that Mincer and Polachek estimated short run depreciation rates rather than long run rates.

Polachek (1979, 1981) extended the original Mincer-Polachek model to include sex segregation by occupation. He argued that the cost of nonparticipation varies with different types of jobs. A rational decision for a woman who plans to exit and enter the market frequently will be to choose an occupation that does not penalize home time significantly. For women who plan to work most of their adult lives these constraints will not

apply. A person with a longer labour market time horizon will choose an occupation that has a steeper earnings profile. The cost of nonparticipation for this person will be much higher than for the worker who expects to work only part of her adult life.

Polachek's approach defines the relationship between depreciation and earnings more clearly and also provides an explanation for occupational segregation. Since women exit and enter the market more frequently than men they will self select themselves into "female" occupations. Women are more likely to move into occupations that have low depreciation rates, require little on-the-job training and consequently pay low wages. Women receive low wages because they will not bother to invest intensely in work related skills. Since they have little or no job-specific human capital the depreciation of their skills will be minimal.

Mincer and Ofek (1982) have revised the initial Mincer and Polachek (1974, 1978) model to account for the 'repair' of human capital. Given that it is less costly to restore existing human capital than to build new skills Mincer and Ofek distinguish between the short and long run consequences of non-participation. They find that the long run rate is between 0.6 percent and 1.1 percent using National Longitudinal Survey panel data.⁶

Corcoran, Duncan and Ponza (1983a, 1983b) recently examined the effect of non-participation on earnings using the Panel Study on Income Dynamics with panel data from 1967 to 1979. They concluded that the long run rate of depreciation is approximately 0.5 percent. The short run rate after re-entry into the market was 3 percent.

(iv) Canadian Contributions to the Literature

There has been no attempt in Canada to examine the depreciation of

women's skills due to nonparticipation in the labour market. The reason for this gap in the literature is lack of data. This study is the first to determine lost income due to multiple exits from the labour market. The results presented here will help to determine how robust existing American studies are.

The findings of this paper are relevant for measuring the male/female wage gap. Previous Canadian estimates by Gunderson (1979) and Robb (1978) use age as a proxy for experience for women in their wage gap studies. Clearly this is not appropriate given the intermittent work histories of women. The data used in this study provide a more accurate picture of how actual labour market experience affects earnings.

III. EMPIRICAL RESULTS

(1) Data and Sample

The data base used in this study is the Canadian National Mobility Survey (1973), commonly known as "CARMAC". It is a cross-sectional micro data set that contains information on over 44,000 individuals eighteen years of age and over who were not full-time students in March 1973.⁷

The value of the survey lies in the fact that each respondent was asked to give a detailed account of her work history. Information is provided on:

- (a) the year that the first full-time job began after the completion of school
- (b) the actual number of years worked for pay or profit⁸
- (c) the year the respondent first withdrew from the labour market (if they withdrew at all)
- (d) whether or not the respondents returned to work if they

originally exited from the market

(e) the year the respondents last re-entered the labour market on a full-time basis

(f) the year the last child was born

This information was used to construct the work history intervals shown in Table 2. A few specific points should be clarified. First, e_1 is years of work experience prior to any major interruption in one's working career. A major interruption is defined as an exit from the labour market for at least one year. The variable e_3 is defined as years of current work experience (the number of continuous years worked up to and including 1972). The variable e_2 is 'residual' work experience. It is total experience less e_1 and e_3 , or that experience obtained in the work force between the first work interval and the last one ($e_2 > 0$).

The variable h is defined as total home time (1972 less year started work less total work experience). For women who work continuously h will equal zero, e_3 will equal total experience and e_1 and e_2 are equal to zero.

Due to data restrictions, these work intervals are not the same as Mincer and Polachek's. However, they remain useful for exploring this issue. Women are likely to have at least several work intervals. The first interval (e_1) would take place after completing school but before any major interruption. An interruption might imply child care, extended unemployment or other non-market uses of time. During child rearing, women may return to work for short periods (e_2). If they do not work outside the home during this time e_2 would be zero. Current job tenure (e_3) should be treated

differently than intermittent work as it represents a stronger commitment to the labour force.

The major difference between the work and home time definitions presented here and those developed by Mincer and Polachek deal with the timing of exits from the labour market. Their data permit them to distinguish between home time prior to the birth of the respondents first child (h_1) and all other home time (h_2).

Mincer and Polachek obtained their results from the National Longitudinal Survey of Mature Women. The CARMAC survey only asks women to supply information on the total number of years out of the labour force (h). The data does allow for the distinctions between various work segments, but it does not provide any information on when the respondent's first child was born. Instead, women were asked to supply information on the year of birth of their last child.⁹

(11) Sample Specification¹⁰

To analyze for the discrepancies between Corcoran's (1979) and Mincer and Polachek's findings two age profiles are used in this study. The samples consist of women, aged 25-44 and 18-64, who are presently in the labour force, who worked in 1972, earned positive incomes and are married (spouse present).¹¹ Since home time should play a key role in determining the earnings of women with children much of the empirical work listed below deals with this group.

By examining two age groups we can better see if there are differences between the long run and short run depreciation rates. If Corcoran's argument is correct, the depreciation rates for the 18 to 64 group should be

much lower than the rates for the 25 to 44 group. The extended age sample should put more weight on the long run effect of nonparticipation. The 25 to 44 age group will capture more of the short run depreciation effects.

(iii) Earnings Regressions

The definitions for the variables used in this study, other than the experience (e_i) and home time variables described above are found in Table 3. The first phase of this analysis does not control for sample selectivity bias as specified in Heckman's work.

The results dealing with experience defined as first, second and third work intervals are found in Tables 4 to 11. Tables 4 and 5 are for the 25 to 44 sample, and Tables 6 and 7 are for those women who are 18 to 64 years old. Tables 8 through 11 present the regression estimates for women with different levels of education.

a. Women 25 to 44 Years Old

Table 4 presents the earnings function for women, aged 25 to 44, whose spouse is present and who have had at least one child. The regression in column (1) includes total experience and experience squared. Column (2) includes all the work intervals as well as home time in the equation. These results are presented in a linear format to allow better visualization of the life-cycle investment profile. Column (3) includes those variables found in column (2) as well as home time squared, and first and third work intervals squared.¹³ Table 5 is identical to Table 4, except the earnings functions of all prime age women (with or without children) are presented.

Given that the data are cross-sectional and it is the earnings of women being analyzed, the overall fits are quite good. The adjusted R^2 's in all

TABLE 3

Variables

LNEARN	Natural log of income from employment, 1972.
S	Number of years in school ¹
EXP	Number of years worked
EXP ²	Number of years worked squared
LNWKS	Natural log of weeks worked, 1972
EDG	Experience x degree
EAPR	Experience x apprenticeship or training program completed
NPUN	Number of periods of 3 months or more unemployed
BREAK*	Did not work for a period of at least one year after first full-time job
Nc	Number of children
PTIME*	Employed part-time
ATL*	Atlantic provinces (reference group)
QUE*	Quebec
ONT*	Ontario
PRA*	Prairie provinces
BC*	British Columbia
LCITY*	Large city (pop. > 100,000 - reference group)
OCITY*	Other city (pop. 5,000-100,000)
TOWN*	Small urban centre (pop. 1,000-5,000)
RURAL*	Rural area
LANG1*	English
LANG2*	French or other (reference group)
LANG3*	French and English
FOR*	Born outside Canada

*Indicates dummy variable = 1 if condition satisfied

the equations are quite high. The sample sizes are also reasonably large.

The most striking features about Tables 4 and 5 are the depreciation rates and experience variables. The rate of depreciation of human capital in both tables is statistically significant, although only at the ten percent level in Table 4. These results indicate that for an additional year of home time women's earnings fall by about 0.9 percent. The findings in Tables 4 and 5 are consistent with Mincer and Polachek's (1974) third hypothesis. How home time affects the wage gap between the sexes will be discussed below in detail. When included in non-linear form, home time is statistically insignificant.

The life-cycle investment patterns, however, do not appear to be consistent with the second hypothesis stated above. The coefficient for the first work interval is insignificant in Tables 4 and 5, indicating that pre-interruption experience does not contribute to present earnings. The coefficient for current work experience is significant at the one percent level. From column (2) an additional year of current job experience increases earnings by approximately 3 percent in both samples.

These results may occur for several reasons. First, the Mincer-Polachek theory may simply be incorrect. Although work histories are apparently double-peaked (Table 2), the empirical results indicate that there is little evidence of any significant pre-interruption experience affecting the earnings of women for this age group. A second possibility is that since the work intervals are defined differently than those specified by Mincer and Polachek, the effects on earnings of these periods will also be different.

TABLE 4

Earnings of Women (25-44) Spouse Present with Children

	(1)	(2)	(3)
S	0.0716* (7.15)	0.0669* (6.75)	0.0674* (6.81)
EXP	0.0137* (9.52)	-	-
EXP ²	0.0000993 (0.13)	-	-
e ₁	-	-0.00120 (0.17)	0.00282 (0.15)
e ₂	-	0.00102 (0.10)	0.00311 (0.30)
e ₃	-	0.0294* (4.47)	0.0687* (3.99)
e ₁ ²	-	-	-0.000258 (0.19)
e ₃ ²	-	-	-0.00322** (2.47)
h	-	-0.00859 (1.76)	-0.0137 (1.08)
h ²	-	-	0.000273 (0.39)
NPUN	0.00127 (0.38)	-	-
EAPR	0.00827 (1.37)	0.00423 (0.72)	0.00429 (0.73)
EDG	0.0170 (1.53)	0.019 (1.55)	0.0179 (1.44)
LNWKS	0.689* (16.74)	0.663* (16.53)	0.649* (15.93)
BREAK	-0.350 (0.68)	-	-

TABLE 4 (continued)

Earnings of Women (25-44) Spouse Present with Children

	(1)	(2)	(3)
INC	-0.0407* (2.64)	-0.021 (1.19)	-0.0198 (1.16)
PTIME	-0.406* (7.71)	-0.397* (7.75)	-0.390* (7.63)
LANG1	-0.307** (2.36)	-0.282** (2.24)	-0.262** (2.07)
LANG3	-0.227 (1.87)	-0.174 (1.47)	-0.149 (1.25)
FOR	0.036 (0.57)	0.041 (0.66)	0.041 (0.66)
OCITY	0.0414 (0.64)	0.0476 (0.75)	0.0331 (0.52)
TOWN	0.0655 (0.93)	0.0624 (0.93)	0.0497 (0.74)
RURAL	0.0336 (0.56)	0.0349 (0.59)	0.0237 (0.40)
QUE	-0.0161 (0.15)	0.0180 (0.17)	0.0226 (0.74)
ONT	0.260* (3.73)	0.253* (3.71)	0.234* (3.41)
PRA	0.104 (1.53)	0.0953 (1.42)	0.0961 (1.43)
BC	0.116 (1.37)	0.105 (1.26)	0.106 (1.26)
C	5.322	5.141	5.120
N	517	540	540
R ²	0.52	0.52	0.53
F	28.65	30.65	27.08

* Statistically significant at the 1% level, **statistically significant at the 5% level (t-statistics in brackets)

TABLE 5

Earnings of Women (25-44) Spouse Present

	(1)	(2)	(3)
S	0.0727* (7.57)	0.0673* (7.08)	0.0677* (7.17)
EXP	0.00824 (0.43)	-	-
EXP ²	0.000372 (0.52)	-	-
e ₁	-	-0.00227 (0.35)	-0.0163 (0.92)
e ₂	-	0.00533 (0.53)	0.00767 (0.76)
e ₃	-	0.0313* (5.01)	0.0700* (4.25)
e ₁ ²	-	-	0.00108 (0.89)
e ₃ ²	-	-	-0.00314** (2.53)
h	-	-0.00932** (1.96)	-0.0146 (1.20)
h ²	-	-	0.00321 (0.48)
NPUN	0.000438 (0.13)	-	-
EAPR	0.00547 (0.95)	0.00271 (0.49)	0.00262 (0.47)
EDG	0.0193 (1.65)	0.0221 (1.91)	0.0214 (1.86)
LNWKS	0.695* (17.94)	0.665* (17.62)	0.654** (17.10)

TABLE 5 (continued)

Earnings of Women (25-44) Spouse Present			
BREAK	(1) -0.386 (0.75)	(2) -	(3) -
Nc	-0.0316** (2.33)	-0.01417 (0.92)	-0.0135 (0.88)
PTIME	-0.4004* (7.93)	-0.387* (7.90)	-0.381* (7.79)
LANG1	-0.342* (2.75)	-0.319* (2.63)	-0.296** (2.45)
LANG3	-0.251** (2.17)	-0.193 (1.70)	-0.168 (1.49)
FOR	0.0287 (0.49)	0.0382 (0.66)	0.0394 (0.69)
OCITY	0.0188 (0.30)	0.0277 (0.46)	0.0114 (0.19)
TOWN	-0.00597 (0.09)	-0.00369 (0.06)	-0.0162 (0.025)
RURAL	0.0101 (0.18)	0.00866 (0.15)	-0.00138 (0.02)
QUE	-0.0316 (0.31)	0.00228 (0.02)	0.00907 (0.09)
ONT	0.271* (4.03)	0.264* (4.03)	0.244* (3.71)
PRA	0.110 (1.69)	0.0966 (1.51)	0.0965 (1.51)
BC	0.150 (1.89)	0.137 (1.76)	0.131 (1.69)
C	5.371	5.151	5.154
N	573	596	596
R ²	0.52	0.53	0.54
F	32.41	35.01	31.00

A third possible reason is slightly more complex. Although work experience influences most women's earnings in the above manner, this does not have to be the case for sub-samples of groups being analyzed. That is, the predictions of the hypothesis may be better suited to women who are more educated. The fact that the hypothesis is not consistent with all the empirical findings presented here does not necessarily make them invalid. Further empirical work is necessary to investigate this possibility.

Mincer and Polachek's (1974) first hypothesis stated that women who expect to be out of the labour market an extended period of time will not invest intensely in skilled occupations. The implications of this hypothesis will be discussed below when the earnings of women between 18 and 64 years old are examined.

b. Women 18 to 64 Years Old.

Tables 6 and 7 provide the estimates for married women aged 18 to 64. The labour force withdrawals variable (h) in Table 6 indicates that the total cost of home time is only about 0.5 per cent. The findings reported in Table 7 are similar. These results indicate that the marginal effect of home time is about half as great as that reported in Tables 4 and 5.

The relative effects of the experience variables also change from the results reported in Tables 4 and 5: The coefficient for intermittent experience actually exceeds the one for the first work interval in the linear estimations (column (2)) in both tables. The result is particularly evident in Table 7 where there is a striking 0.9 percent increase in current income for one additional year of pre-interruption experience. For an additional year of intermittent experience current incomes rise by 1.4

TABLE 6

Earnings of Women (18-64) Spouse Present With Children

	(1)	(2)	(3)
S	0.0773* (9.87)	0.0744* (9.61)	0.0743* (9.69)
EXP	0.315* (3.76)	-	-
EXP ²	-0.000436 (1.75)	-	-
e ₁	-	0.0105** (2.33)	0.00927 (0.88)
e ₂	-	0.0112** (2.02)	0.0109** (1.97)
e ₃	-	0.0209* (6.82)	0.0495* (7.18)
e ₁ ²	-	-	0.0000232 (0.04)
e ₃ ²	-	-	-0.00132* (4.63)
h	-	-0.00463 (1.85)	-0.00645 (0.97)
h ²	-	-	0.0000401 (0.16)
NPUN	0.00178 (0.75)	-	-
EAPR	-0.00523 (1.34)	-0.00572 (1.47)	-0.00659 (1.70)
EDG	0.0123 (1.79)	0.0133 (1.92)	0.0128 (1.87)
LNWKS	0.656* (20.05)	0.661* (20.62)	0.634* (19.60)

TABLE 6 (continued)

Earnings of Women (18-64) Spouse Present With Children

BREAK	(1) 0.0892 (0.50)	(2) -	(3) -
Nc	-0.0275** (2.32)	-0.0122 (0.98)	-0.0134 (1.08)
PTIME	-0.415* (10.15)	-0.419* (10.52)	-0.400* (10.08)
LANG1	-0.175 (1.60)	-0.154 (1.46)	-0.116 (1.10)
LANG3	-0.121 (1.17)	-0.084 (0.84)	-0.0566 (0.57)
FOR	0.0374 (0.78)	0.0174 (0.37)	0.0311 (0.66)
OCITY	0.000656 (0.13)	0.0105 (0.22)	0.000311 (0.01)
TOWN	0.0072 (1.28)	0.0581 (1.10)	0.0543 (1.04)
RURAL	-0.0411 (0.89)	-0.0399 (0.88)	-0.0466 (1.04)
QUE	0.0853 (0.96)	0.0818 (0.96)	0.110 (1.29)
ONT	0.160* (3.00)	0.167* (3.20)	0.152* (2.94)
PRA	0.0751 (1.41)	0.0861 (1.65)	0.0692 (1.34)
BC	0.0628 (0.98)	0.0719 (1.14)	0.0749 (1.20)
C	4.724	4.921	4.941
N	855	896	896
$\bar{R}^2$	0.52	0.52	0.53
F	46.83	48.75	44.23

TABLE 7

Earnings of Women (18-64) Spouse Present

	(1)	(2)	(3)
S	0.0765* (10.32)	0.0727* (9.90)	0.0726* (9.97)
EXP	0.0345* (4.38)*	-	-
EXP ²	-0.00047 (1.89)	-	-
e ₁	-	0.00897** (2.18)	0.00237 (0.28)
e ₂	-	0.0141* (2.63)	0.0135** (2.52)
e ₃	-	0.0208* (7.11)	0.0497* (7.41)
e ₁ ²	-	-	0.000286 (0.73)
e ₃ ²	-	-	-0.00134* (4.79)
h	-	-0.00498** (2.04)	-0.00536 (0.84)
h ²	-	-	-0.0000169 (0.07)
NPUN	0.000317 (0.14)	-	-
EAPR	-0.00442 (1.18)	-0.00279 (0.88)	-0.00403 (1.10)
EDG	0.0139** (2.22)	0.0162** (2.64)	0.0157* (2.59)
LNWKS	0.659* (21.35)	0.665* (21.85)	0.637* (20.79)
BREAK	0.232 (1.45)	-	-
Nc	-0.0192 (1.85)	-0.00570 (0.51)	-0.00707 (0.63)

TABLE 7 (continued)

Earnings for Women (18-64) Spouse Present

	(1)	(2)	(3)
PTIME	-0.404* (10.35)	-0.404* (10.60)	-0.387* (10.21)
LANG1	-0.149 (1.45)	-0.125 (1.25)	-0.0868 (0.87)
LANG3	-0.129 (1.34)	-0.0944 (1.00)	-0.0671 (0.71)
FOR	0.0292 (0.64)	0.00480 (0.11)	0.0172 (0.39)
OCITY	-0.0229 (0.48)	-0.0144 (0.30)	-0.0240 (0.51)
TOWN	0.00571 (0.11)	-0.00232 (0.05)	-0.00539 (0.11)
RURAL	-0.0661 (1.50)	-0.0697 (1.61)	-0.0736 (1.71)
QUE	0.0923 (1.13)	0.0836 (1.06)	0.117 (1.49)
ONT	0.161* (3.13)	0.158* (3.16)	0.147* (2.96)
PRA	0.0825 (1.61)	0.0839 (1.67)	0.0697 (1.40)
BC	0.920 (1.51)	0.0876 (1.47)	0.0918 (1.55)
C	4.537	4.904	4.932
N	947	993	993
R ²	0.52	0.52	0.53
F	51.44	53.68	48.69

percent. Like Corcoran (1979), I find that the depreciation rate for the larger sample (18-64) is significantly smaller than for the 25 to 44 year age group.

The first of Mincer-Polachek's hypotheses cited above states that the shorter the expected duration of future work experience, the fewer incentives there are to increase the stock of human capital. Corcoran (1979) and Corcoran and Duncan (1979) do not find this result. The Panel Study on Income Dynamics questioned women concerning their future family investment plans. Respondents were asked whether they plan to stop working in the near future for non-training reasons, and were asked if they had plans for more children fairly soon. The two variables were designed to capture women's time horizons. For white women both variables were statistically insignificant in determining their wages.

Sandell and Shapiro (1980) also tested the possibility that women who expect to exit from the market in the future will have flatter experience-earnings profiles than women who expect to work continuously. Using National Longitudinal Survey data on young women they found that most of the key parameter estimates were in the expected direction, but, none were significant at the five percent level. The wage growth patterns were not statistically different for women who did not plan on exiting from the market by age 35 compared with women who did intend to leave the labour market.

The results presented by Corcoran and Duncan (1979) and Sandell and Shapiro (1980) are based on ex ante information. Women were specifically asked whether or not they plan on leaving the labour market in the near

future for an extended period of time. The results presented by Mincer and Polachek (1974, 1978) and those reported here are based on ex post data. In order to test the hypothesis that women will not invest intensely in job-related skills the shorter the duration of future work ex ante data should be used, if the information is available. Actual work intervals are not the same as expected work intervals.¹⁴ This implies that Mincer and Polachek (1974, 1978) and my own efforts cannot properly test their first hypothesis. We do not have any information on what women expect to do in the future. The former were in error when they stated that they could test this hypothesis.

Given the marginal differences between Tables 4 and 5 as well as the differences between Tables 6 and 7, the distinctions between married spouse present, and married spouse present with children are dropped. The results from the tables indicate that there is virtually no difference between the two groups. The remaining tables deal primarily with women who have had at least one child. This facilitates a comparison with the work of Corcoran (1979), Corcoran and Duncan (1979) and Corcoran, Duncan and Ponza (1983a, 1983b) which also deal with women who have had at least one child.

c. Role of Education

Tables 8 to 10 present the earnings functions by education level for the 18 to 64 group. Table 8 presents the results for married women with children who have 8 years or less of formal education. Table 9 presents the results for women with 9 to 12 years of education. Finally, Table 10 presents the results for those with 13 or more years of education.

The marginal effect of an additional year of education is much greater for more educated women. However, the investment patterns, and the effects of home time are still not consistent with the Mincer-Polachek model. For women with little or no education none of the experience variables are significant. For the 9 to 12 years group all three work intervals contribute to earnings [column (2)]. For an additional year of current experience earnings increase by two percent. The coefficient for e_3 is larger for than the other two segments. However, the marginal effect for the first interval is 1.6 percent and for the second interval it is 1.5 percent.

The estimates for the most educated group are somewhat surprising. The partial effect of a year of total experience in Table 10 [column (1)] is insignificant. Only the third work interval in columns (2) and (3) is significant. The return to current job experience is 2.7 percent for the sample. This is somewhat larger than the 2.0 percent return seen in Table 9. Some of the differences between the two samples may be due to the smaller sample size found in Table 10.

Higher educational attainment implies a greater labour market potential. The loss in future earnings from not working should be greater for women with higher educational levels. However, home time does not affect women with 9 to 12 years of schooling any differently than it does for women with less education. The earnings of women with 13 or more years of education are also not significantly effected by an additional year of home time.

TABLE 8

Earnings of Women (18-64) Spouse Present
With Children With < 8 Years of Education

	(1)	(2)	(3)
S	0.0906 (1.85)	0.0858 (1.79)	0.0788 (1.60)
EXP	0.0307 (0.87)	-	-
EXP ²	-0.00101 (0.98)	-	-
e ₁	-	-0.0138 (0.87)	-0.0232 (0.52)
e ₂	-	0.0152 (0.61)	0.0126 (0.49)
e ₃	-	0.00393 (0.29)	0.0450 (1.08)
e ₁ ²	-	-	0.000342 (0.13)
e ₃ ²	-	-	-0.00223 (1.05)
h	-	-0.00302 (0.38)	0.0108 (0.49)
h ²	-	-	-0.000471 (0.67)
NPUN	0.00609 (0.69)	-	-
EAPR	-0.00005 (0.38)	-0.0049 (0.32)	-0.0068 (0.43)
EDG	-	-	-
LNWKS	0.563 (4.03)*	0.603 (4.17)*	0.546 (3.97)*
BREAK	0.352 (0.76)	-	-

7).¹⁶ Segment HL appears to describe the unadjusted results presented here more accurately than segment HK.

(iv) Sample Selection Bias

The data used in this paper include only working women. Labour force status is unlikely to be randomly determined and this could bias the results reported here. If the independent variables in the income equations influence a woman's market wage relative to her reservation wage, income functions estimated on all working women may yield biased parameter estimates (Gronau, 1974; Heckman, 1974).

Heckman (1979) describes the sample selection bias of a problem which arises because data are missing. The problem is formulated below:

$$Y_{1i} = X_{1i}\beta_1 + U_{1i} \quad (8)$$

$$Y_{2i} = X_{2i}\beta_2 + U_{2i} \quad (9)$$

where Y_{1i} = yearly income

Y_{2i} = market income less reservation income.

X_{1i} = independent predictors of Y_{1i}

X_{2i} = independent predictors of Y_{2i}

Equation (8) represents the behavioural equation estimated in this paper. The sample selection rule that determines whether a woman joins the labour market is given by equation (9). Data are available on Y_{1i} only if $Y_{2i} > 0$, otherwise there is no observation on Y_{1i} . Equation (9) can be formulated to capture the relation between market and the reservation income (Y_{2i}). It is

TABLE 9

Earnings of Women (18-64) Spouse Present
With Children With 9-12 Years of Education

	(1)	(2)	(3)
S	0.0382 (1.59)	0.0390 (1.65)	0.0358 (1.54)
EXP	0.0421* (3.79)	-	-
EXP ²	-0.000662** (2.06)	-	-
e ₁	-	0.0163* (2.76)	0.0152 (1.12)
e ₂	-	0.0148** (2.08)	0.0135 (1.91)
e ₃	-	0.0208* (5.09)	0.0571* (6.57)
e ₁ ²	-	-	-0.0000639 (0.09)
e ₃ ²	-	-	-0.00158* (4.75)
h	-	-0.00539 (1.57)	-0.00172 (0.12)
h ²	-	-	-0.000230 (0.62)
NPUN	0.00098 (0.31)	-	-
EAPR	-0.0037 (0.73)	-0.0044 (0.88)	-0.0055 (1.09)
EDG	-	-	-
LNWKS	0.592 (13.10)*	0.606 (13.60)*	0.566 (12.75)*
BREAK	0.0868 (0.41)	-	-

Table 9 (continued)

Earnings of Women (18-64) Spouse Present
With Children With 9-12 Years of Education

	(1)	(2)	(3)
Nc	-0.0401 (2.50)**	-0.0232 (1.39)	-0.0267 (1.61)
PTIME	-0.3670 (6.58)*	-0.3669 (6.72)*	-0.3454 (6.44)*
LANG1	0.0706 (0.44)	0.0568 (0.36)	0.1317 (0.85)
LANG3	-0.0046 (0.03)	0.00091 (0.01)	0.0413 (0.28)
FOR	0.0311 (0.45)	-0.0089 (0.13)	0.0246 (0.37)
OCITY	0.0187 (0.28)	0.0219 (0.33)	0.0099 (0.16)
TOWN	0.0792 (1.01)	0.0353 (0.47)	0.0335 (0.45)
RURAL	-0.0647 (1.02)	-0.0715 (1.15)	-0.0760 (1.25)
QUE	0.1886 (1.46)	0.1641 (1.32)	0.2218 (1.80)
ONT	0.1451 (2.02)**	0.1574 (2.23)**	0.1416 (2.05)**
PRA	0.0474 (0.66)	0.0681 (0.96)	0.0411 (0.59)
BC	0.0457 (0.55)	0.0593 (0.72)	0.0648 (0.81)
C	5.07	5.28	5.31
N	484	511	511
$\bar{R}^2$	0.43	0.43	0.45
F	20.46	20.83	19.90

TABLE 10

Earnings of Women (18-64) Spouse Present
With Children With 13+ Years of Education

	(1)	(2)	(3)
S	0.0968* (4.52)	0.0965* (4.55)	0.0978* (4.59)
EXP	0.0123 (0.89)	-	-
EXP ²	0.000207 (0.49)	-	-
e ₁	-	0.00852 (1.05)	0.00778 (0.43)
e ₂	-	0.00634 (0.68)	0.00741 (0.78)
e ₃	-	0.0265* (5.53)	0.0327** (2.45)
e ₁ ²	-	-	0.0000787 (0.08)
e ₃ ²	-	-	-0.000279 (0.44)
h	-	-0.00523 (1.27)	-0.0183 (1.73)
h ²	-	-	0.000532 (1.33)
NPON	0.0039 (1.00)	-	-
EAPR	-0.0068 (1.07)	-0.0061 (0.94)	-0.0069 (1.05)
EDC	0.0033 (0.48)	0.00254 (0.37)	0.0024 (0.34)
LNWKS	0.8248 (17.00)*	0.8174 (17.23)*	0.8178 (16.82)*
BREAK	-0.0869 (1.59)	-	-

Table 10 (continued)

Earnings of Women (18-64) Spouse Present
With Children 13+ Years of Education

	(1)	(2)	(3)
Nc	-0.0282 (1.36)	-0.0106 (0.48)	-0.0032 (0.14)
PTIME	-0.4573 (7.32)*	-0.4639 (7.64)*	-0.04583 (7.38)*
LANG1	-0.5773 (2.41)**	-0.5403 (2.26)**	-0.5198 (2.15)**
LANG3	-0.3866 (1.66)	-0.3414 (1.49)	-0.3259 (1.40)
FOR	-0.1368 (1.95)	-0.1213 (1.71)	0.1187 (1.67)
OCITY	0.0194 (0.25)	0.0239 (0.30)	0.0191 (0.24)
TOWN	0.0654 (0.82)	0.0725 (0.92)	0.0771 (0.97)
RURAL	0.0155 (0.22)	0.0026 (0.04)	0.0099 (0.14)
QUE	-0.1305 (0.88)	-0.1037 (0.71)	-0.0843 (0.57)
ONT	0.1393 (1.64)	0.1079 (1.32)	0.1083 (1.31)
PRA	0.0780 (0.95)	0.0819 (1.04)	0.0815 (1.03)
BC	0.0837 (0.81)	0.0926 (0.91)	0.0944 (0.92)
Nc	-0.0282 (1.36)	-0.0106 (0.48)	-0.00321 (0.14)
C	4.51	4.51	4.48
N	273	280	280
$\bar{R}^2$	0.67	0.67	0.67
F	30.46	29.83	25.93

In order to compare the differences between the long run effects and the short run effects of the non-use of human capital, the results reported in Table 10 were re-estimated for the restricted age group.

Table 11 shows the results for women aged 25 to 44 with 13 or more years of education. Although insignificant in linear format home time is statistically significant at the five percent level in column (3). For one year out of the labour market incomes fall by slightly more than 5 percent. However, when moving to the larger sample in Table 10, incomes fall by only 1.8 percent. In the latter case the t-statistic is only significant at the ten percent level. Sample selection appears to help determine the estimates. Depreciation rates are consistently higher when examining the 25 to 44 group compared to the 18 to 65 group.

d. Number of Children

The number of children (N_c) generally has a negative effect on women's earnings. However, the level of significance of the variable changes dramatically in the different equations. When the number of children is included in the regressions with total experience and experience squared the variable is usually highly significant. In Tables 4 through 7 (column (1)) the number of children variable is significant at the five and one percent levels in three out of four regressions.

The results in columns (2) and (3) in Tables 4 to 7, as well as many of the other regressions, suggest that the number of children variable is insignificant when home time and experience are more accurately defined.

The results presented here are similar to Hill's (1979) finding that the number of children is a good proxy variable for differential work history

TABLE 11

Earnings of Women (25-44) Spouse Present
With Children With 13+ Years of Education

	(1)	(2)	(3)
S	0.0945* (3.63)	0.0976* (3.82)	0.106* (4.13)
EXP	0.0172 (0.57)	-	-
EXP ²	0.000144 (0.11)	-	-
e ₁	-	0.00296 (0.23)	0.0295 (0.86)
e ₂	-	0.00551 (0.30)	0.00139 (0.08)
e ₃	-	0.0356* (3.24)	0.0757* (3.00)
e ₁ ²	-	-	-0.00171 (0.72)
e ₃ ²	-	-	-0.00333 (1.67)
h	-	-0.0121 (1.53)	-0.0504** (2.25)
h ²	-	-	0.00249 (1.76)
NPUN	0.0089 (1.52)	-	-
EAPR	0.0047 (0.43)	0.0032 (0.29)	0.0019 (0.18)
EDG	0.0043 (0.44)	0.0035 (0.29)	0.0023 (0.19)
LNWKS	0.8409 (14.14)*	0.8407 (14.26)*	0.8291 (13.39)*
BREAK	-0.0679 (1.43)	-	-

Table 11 (continued)

Earnings of Women (25-44) Spouse Present
With Children with 13+ Years of Education

	(1)	(2)	(3)
Nc	-0.0508 (1.94)	-0.0125 (0.42)	-0.00937 (0.31)
PTIME	-0.4032 (5.04)*	-0.4209 (5.32)*	-0.3844 (4.77)*
LANG1	-0.5152 (1.87)	-0.4290 (1.54)	-0.4048 (1.46)
LANG3	-0.3448 (1.34)	-0.2303 (0.86)	-0.2286 (0.86)
FOR	-0.0642 (0.72)	-0.0286 (0.32)	-0.0319 (0.35)
OCITY	0.0719 (0.68)	0.0928 (0.88)	0.0939 (0.89)
TOWN	0.0737 (0.73)	0.1017 (1.02)	0.0828 (0.84)
RURAL	0.0164 (0.18)	0.0166 (0.13)	0.0230 (0.26)
QUE	-0.1263 (0.78)	-0.0556 (0.34)	-0.0482 (0.30)
ONT	0.1483 (1.44)	0.1294 (1.28)	0.1227 (1.22)
PRA	0.0643 (0.64)	0.0699 (0.72)	0.1114 (1.12)
BC	0.0707 (0.52)	0.0699 (0.51)	0.0922 (0.68)
C	4.40	4.30	4.11
N	174	179	179
$\bar{R}^2$	0.67	0.67	0.68
F	19.39	19.12	17.14

only when there are crude controls for experience. When more accurate controls are used the variable is less significant.

e. Credential Effects

The credential effects (EDC, EAPR) are included interactively with experience. This is because women's participation rates are significantly lower than men's. If men work most of their adult lives, there is no need to combine experience with a signalling effect. However, in the case of women the return to a degree or training program is often dependent upon how many years they work in the market. If, for instance, a woman receives a degree but does not utilize it in subsequent labour market experience, the return will be negligible.

The effects of the two credential variables are somewhat ambiguous. The degree effect is usually positive and often statistically significant. The influence of obtaining a training certificate, however, is negligible.

When examining these credential effects for different sub-sets of the population the results change very little. For women who work most of their adult lives, or those who are more educated, the degree variable is still highly significant but the effect of a training program is not.

f. A Graphical Interpretation of the Results.

The overall picture that emerges is that in the long run depreciation rates for women as a whole are quite low, roughly 0.5 percent. Although the short run rates are substantial in some cases, usually twice as large as the long run rates, it appears that women are able to make up for most skill losses upon re-entry into the market.

The life cycle patterns are depicted in Figure 1.¹⁵ B represents the age a typical woman starts working on a full-time basis. The line AC represents the earnings profile of a woman who works continuously until retirement (Z). For simplicity, we will assume that there is only one period of interruption (EF) for women.

Women who interrupt their working careers will return to work with the same income if there is no depreciation of human capital skills. The distance b represents the loss in potential income that occurs because of the break in experience (missed job opportunities and promotions).

If there are short run depreciation effects, women return to work with income G. Mincer and Polachek originally assumed that the earnings functions for all women was GJ by generalizing the depreciation rates for women, aged 30 to 44 to all women. In other words they assumed the short run depreciation rate (a) to be equivalent to the long run depreciation rate.

Alternatively, women may experience certain 'rebound' effects. Upon re-entry they may have a steeper earnings profile than previously enjoyed (Mincer and Ofek, 1982; Corcoran, Duncan and Ponza, 1983a, 1983b). Such a situation would be depicted by the line GH. During this segment women may be able to find jobs paying wages that reflect their non-depreciated human capital.

Figure 1 generally fits the results reported in this paper. The short term depreciation effects (a) are approximately 0.9 percent (Tables 4 and 5) The long run effects (c) are estimated to be about 0.5 percent (Tables 6 and

The Life-Cycle Earnings of Women

7).¹⁶ Segment HL appears to describe the unadjusted results presented here more accurately than segment HK.

(iv) Sample Selection Bias

The data used in this paper include only working women. Labour force status is unlikely to be randomly determined and this could bias the results reported here. If the independent variables in the income equations influence a woman's market wage relative to her reservation wage, income functions estimated on all working women may yield biased parameter estimates (Gronau, 1974; Heckman, 1974).

Heckman (1979) describes the sample selection bias of a problem which arises because data are missing. The problem is formulated below:

$$Y_{1i} = X_{1i}'\beta_1 + U_{1i} \quad (8)$$

$$Y_{2i} = X_{2i}'\beta_2 + U_{2i} \quad (9)$$

where Y_{1i} = yearly income

Y_{2i} = market income less reservation income.

X_{1i} = independent predictors of Y_{1i}

X_{2i} = independent predictors of Y_{2i}

Equation (8) represents the behavioural equation estimated in this paper. The sample selection rule that determines whether a woman joins the labour market is given by equation (9). Data are available on Y_{1i} only if $Y_{2i} > 0$, otherwise there is no observation on Y_{1i} . Equation (9) can be formulated to capture the relation between market and the reservation income (Y_{2i}). It is

$$E(Y_{11} | X_{11}, Y_{21} > 0) = X_{11}\beta_1 + E(U_{11} | U_{21} > -X_{21}\beta_2) \quad (10)$$

The ordinary least squares estimate of (8) omits the final term in (10) as an independent variable. The bias produced by sample selection is therefore a problem of an omitted variable.

The final term of (10) can be written:

$$E(U_{11} | U_{21} > -X_{21}\beta_2) = \sigma_{12} / (\sigma_{22})^{1/2} \lambda_1 \quad (11)$$

where σ_{12} = covariance (U_{11}, U_{21})

σ_{22} = variance (U_{21})

$\lambda_1 = \frac{\phi(Z_1)}{1 - \Phi(Z_1)}$

$Z_1 = -X_{21}\beta_2 / (\sigma_{22})^{1/2}$

ϕ = density function for standard normal variable

Φ = distribution function for standard normal variable

The conditional regression function can be written as:

$$E(Y_{11} | X_{11}, Y_{21} > 0) = X_{11}\beta_1 + \sigma_{12} / (\sigma_{22})^{1/2} \lambda_1 \quad (12)$$

In general, λ_1 is not directly observable. However, it can be estimated by first estimating the probability that $Y_{21} > 0$, (i.e., $\beta_2 / (\sigma_{22})^{1/2}$), using probit analysis for the complete sample of women. From the estimate of $\beta_2 / (\sigma_{22})^{1/2}$ it is possible to calculate Z_1 and hence λ_1 . The variable λ_1 is then entered into equation (11) for the selected subsample of women.

A woman's decision to work was estimated to be a function of her years out of the labour force, level of schooling, number of children, years since her last child was born and whether or not she obtained a degree or

completed an apprenticeship program. From the probit analysis I obtained the estimates for the coefficients for the independent variables and the variance for the error term.¹⁷

Tables 12 and 13 present the results when controlling for selectivity bias for women 18 to 64 years old. Table 12 is for all women who have had at least one child. Column (1) contains the estimates when total experience and its square are used as independent variables. Column (2) contains the linear estimates for first, second and third work intervals. Column (3) includes the non-linear work interval estimates. These results should be compared to Table 6 above. Table 13 includes the linear and non-linear estimates for women whose spouse is present. These latter results should be compared to Table 7.

In Table 12 the coefficient for λ is significant at the one percent level in column (1) and significant at the ten percent level in columns (2) and (3). In general, the coefficients, R^2 , and the F-statistic are not dramatically altered when adjusting for self-selection. The coefficients for years of education, experience, home time, and the natural log of weeks worked are slightly lower in Table 12 than previously reported.

The results seen in Table 13 are similar to those reported in Table 12. In Table 13 the coefficient for λ in column (1) is significant at the one percent level, while it is significant at the ten percent and five percent levels in columns (2) and (3) respectively. The coefficients for the human capital variables in Table 13 are also slightly lower than those found in Table 9.

TABLE 12

Earnings of Women (18-64) Spouse Present
With Children Controlling For Selectivity Bias

	(1)	(2)	(3)
S	0.0698* (8.34)	0.0716* (8.72)	0.0715 (8.78)*
EXP	0.0274* (3.19)	-	-
EXP ²	-0.000528** (2.11)	-	-
e ₁	-	0.0099 (2.13)**	-0.0117 (1.10)
e ₂	-	0.0062 (1.00)	0.0059 (0.95)
e ₃	-	0.0157* (3.65)	0.0443* (5.86)
e ₁ ²	-	-	-0.000183 (0.31)
e ₃ ²	-	-	-0.0013 (4.61)*
h	-	-0.0024 (0.78)	-0.0055 (0.79)
h ²	-	-	0.000089 (0.36)
NPUN	0.0021 (0.87)	-	-
EAPR	-0.0095** (2.32)	-0.0079 (1.90)	-0.0086** (2.11)

TABLE 12 (Continued)

Earnings of Women (18-64) Spouse Present
With Children Controlling For Selectivity Bias

	(1)	(2)	(3)
EDG	0.0118 (1.71)	0.0122 (1.78)	0.0118 (1.72)
LNWKS	0.6369* (19.08)	0.6496* (19.75)	0.6217* (18.73)
BREAK	0.1542 (0.77)	-	-
Nc	-0.0276** (2.32)	-0.0151 (1.17)	-0.161 (1.24)
PTIME	-0.4199* (10.16)	-0.4282* (10.58)	-0.4082* (10.14)
LANG1	-0.1869 (1.66)	-0.1642 (1.49)	-0.1204 (1.10)
LANG3	-0.1312 (1.23)	-0.0925 (0.89)	-0.0602 (0.58)
FOR	0.0294 (0.59)	0.0063 (0.13)	0.0177 (0.36)
OCITY	-0.0021 (0.04)	0.0074 (0.15)	-0.0014 (0.03)
TOWN	0.0699 (1.28)	0.0577 (1.08)	0.0561 (1.06)
RURAL	-0.0321 (0.68)	-0.0301 (0.65)	-0.351 (0.77)
QUE	0.1081 (1.19)	0.0938 (1.06)	0.1254 (1.43)
ONT	0.1739* (3.21)	0.1733* (3.25)	0.1573* (2.98)
PRA	0.0816 (1.52)	0.0882 (1.65)	0.0710 (1.35)
BC	0.0749 (1.16)	0.0768 (1.20)	0.0809 (1.28)

TABLE 12 (Continued)

Earnings of Women (18-64) Spouse Present
With Children Controlling For Selectivity Bias

	(1)	(2)	(3)
λ	-0.2782* (3.56)	-0.1602 (1.68)	-0.1622 (1.72)
C	2.713	1.784	1.801
N	855	896	896
$\bar{R}^2$	0.52	0.51	0.53
F	43.82	44.52	40.70

TABLE 13

Earnings of Women (18-64) Spouse Present
Controlling For Selectivity Bias

	(1)	(2)	(3)
S	0.0673 (8.54)*	0.0696 (8.97)*	0.0690 (8.97)*
EXP	0.0303 (3.79)*	-	-
EXP ²	-0.000596 (2.58)**	-	-
e ₁	-	0.00861 (2.10)**	0.00172 (0.20)
e ₂	-	0.0103 (1.81)	0.00958 (1.69)
e ₃	-	0.0167 (4.62)*	0.0458 (6.53)*
e ₁ ²	-	-	-0.00031 (0.62)
e ₃ ²	-	-	-0.00136 (4.84)*
h	-	-0.000206 (0.67)	-0.00349 (0.52)
h ²	-	-	0.000038 (0.15)
NRUN	0.0012 (0.51)		

TABLE 13 (Continued)

Earnings of Women: (18-64) Spouse Present
Controlling for Selectivity Bias

	(1)	(2)	(3)
EAPR	-0.0095 (2.42)**	-0.0049 (1.29)	-0.00639 (1.66)
EDG	0.0131 (2.11)**	0.0156 (2.55)**	0.0153 (2.51)**
LNWKS	0.643 (20.57)*	0.655 (21.06)*	0.627 (20.00)*
BREAK	0.306 (1.75)	-	-
Nc	-0.0152 (1.46)	-0.0079 (0.69)	-0.0091 (0.79)
PTIME	-0.399 (10.14)*	-0.408 (10.55)*	-0.390 (10.12)*
LANG1	-0.0158 (1.50)	-0.131 (1.27)	-0.0861 (0.83)
LANG3	-0.119 (1.21)	-0.0938 (0.97)	-0.060 (0.62)
FOR	0.0241 (0.52)	-0.00412 (0.10)	0.00569 (0.13)
OCITY	-0.0241 (0.50)	-0.0181 (0.37)	-0.0264 (0.55)
TOWN	0.0041 (0.08)	-0.0181 (0.37)	0.0053 (0.11)
RURAL	-0.0548 (1.23)	-0.0598 (1.36)	-0.0615 (1.41)
QUE	0.1056 (1.28)	0.0887 (1.10)	0.1274 (1.58)
ONT	0.1757 (3.39)*	0.1605 (3.15)*	0.1487 (2.95)*
PRA	0.0903 (1.75)	0.0834 (1.63)	0.0691 (1.36)

TABLE 13 (Continued)

Earnings of Women (18-64) Spouse Present
Controlling for Selectivity Bias

	(1)	(2)	(3)
BC	0.1014 (1.66)	0.0874 (1.45)	0.0918 (1.54)
λ	-0.331 (4.39)*	-0.176 (1.91)	-0.191 (2.08)**
C	3.12	1.90	2.03
N	947	993	993
$\bar{R}^2$	0.52	0.51	0.52
F	48.87	49.24	45.04

The hypothesis that women working in the labour market are not representative of all women cannot be rejected. Given that the coefficient for λ is significant at least at the ten percent level, the results presented earlier are most likely biased.

The most important differences between Table 6 and 7 and Tables 12 and 13 relate to the experience and home time variables. The long run depreciation rate was estimated to be approximately 0.5 percent in Tables 6 and 7. When adjusting for selectivity bias the coefficients for home time and home time squared are both insignificant with very low t-statistics.

These results indicate that there is no significant long run depreciation of human capital. Although women will most likely forego promotion opportunities when they are absent from work they are nevertheless not penalized in terms of the loss of skills over the long run. The adjusted results indicate that the life-cycle earnings of women are slightly different than the stylized patterns described earlier in reference to Figure 1.18

The effect of experience on earnings also changes when selectivity bias is controlled for. In Table 12 the first and third work intervals are significant at the five percent level and the one percent level respectively. Meanwhile, intermittent experience is statistically insignificant. For an additional year of pre-interruption experience current earnings rise by approximately 1.0 percent and for an additional year of current job tenure earnings rise by 1.6 percent. The effect of experience on earnings is now more consistent with Mincer and Polachek's earlier work.

In Table 13 the effect of experience on earnings is less clear. An additional year of intermittent experience now increases earnings by 1.0 percent. The coefficient is significant at the ten percent level.

In columns (2) and (3) in Tables 12 and 13 the coefficient for λ is significant at the ten percent level in three equations and significant at the five percent level in one equation. It should be pointed out that it is difficult to interpret these results given that the coefficient is usually significant in the ten percent range. If we were to use the five percent criteria for acceptability we would have to conclude that there is not a problem of selection bias in most cases. Although using five percent as a cutoff point is as arbitrary as using ten percent, the chance for error is still reduced when using the former over the latter.

The correction for selectivity bias alters the results for those variables that capture the effect of women's absence from work. Rather than increasing the significance of home time, correcting for selection bias actually reduces its importance. It is apparently safe to conclude that any potential self-selection bias which may be present in my earlier estimates does not underestimate the effect of not being present in the labour market.

This paper has concentrated on the long run effects of the absence from work and the effects of interrupted working careers on current earnings. However, previously it was shown that there are significant differences between women 18 to 65 years old and women who are between 25 and 44 years. Given these differing results the regressions for the 25 to 44 group were re-estimated controlling for selectivity bias.

The results are presented in Table 14. Columns (1) and (2) are for married women with at least one child and columns (3) and (4) are for all married women. The estimates for total experience and experience squared are reported in Table 14.

The results are somewhat surprising given the estimates reported in Tables 12 and 13. Similar to the uncorrected results for the 25 to 44 age group seen in Tables 4 and 5, and the first and second work intervals do not significantly contribute to current income. In Tables 4 and 5 the coefficient for home time was significant at the ten percent level and the rate of depreciation was estimated at 0.9 percent. In the latest results home time is highly significant and the depreciation rate is approximately 1.1 percent. However, the coefficient is statistically insignificant throughout Table 14. This indicates that the short run depreciation rates presented in Tables 4 and 5 are unbiased. Therefore, the effect of an additional year of home time for this age group is more accurately described in my earlier results.

IV. MALE - FEMALE DIFFERENCES IN EARNINGS

Part of the earnings gap between men and women can be attributed to differences in their work histories. With child care and family responsibilities, women spend less time in the labour market than men, invest less heavily in job-specific human capital and have shorter investment horizons.

Blinder (1973) and Oaxaca (1973) decomposed the earnings gap between white men and white women, white men and black men, and white men and black women into two components. The first component is the impact of endowment

TABLE 14

Earnings of Women (25-44) Spouse Present
Controlling for Selectivity Bias

	(1)	(2)	(3)	(4)
S	0.0649 (6.24)*	0.0652 (6.29)*	0.0659 (6.65)*	0.0662 (6.70)*
e_1	-0.0014 (0.19)	0.0103 (0.53)	-0.0023 (0.35)	-0.0116 (0.64)
e_2	-0.0038 (0.34)	-0.0023 (0.21)	0.00172 (0.16)	0.0038 (0.35)
e_3	0.0238 (2.93)*	0.0652 (3.64)*	0.0270 (3.62)*	0.0675 (3.94)*
e_1^2	-	-0.00084 (0.63)	-	0.00072 (0.58)
e_3^2	-	-0.00346 (2.62)*	-	-0.0033 (2.64)*
h	-0.0109 (2.15)**	-0.0193 (1.46)	-0.0112 (2.28)**	-0.0191 (1.51)
h^2	-	0.00043 (0.61)	-	0.00047 (0.68)
EAPR	0.0035 (0.58)	0.0034 (0.56)	0.0023 (0.41)	0.0022 (0.39)
EDG	0.0168 (1.35)	0.0153 (1.24)	0.0195 (1.68)	0.0187 (1.62)
LNWKS	0.6484 (15.59)*	0.6303 (14.89)*	0.6534 (16.80)*	0.6404 (16.24)*
Nc	-0.0141 (0.80)	-0.0129 (0.75)	-0.0079 (0.50)	-0.0068 (0.43)
PTIME	-0.4208 (8.13)*	-0.4139 (8.01)*	-0.4084 (8.25)*	-0.4011 (8.12)*
LANG1	-0.3201 (2.43)**	-0.289 (2.19)**	-0.3549 (2.83)*	-0.3221 (2.56)**
LANG3	-0.2019 (1.66)	-0.1709 (1.40)	-0.2189 (1.88)	-0.1872 (1.61)

TABLE 14 (Continued)

Earnings of Women (25-44) Spouse Present
Controlling for Selectivity Bias

	(1)	(2)	(3)	(4)
FOR	0.0245 (0.38)	0.0237 (0.37)	0.0236 (0.40)	0.0235 (0.40)
CITY	0.0385 (0.60)	0.0251 (0.39)	0.0193 (0.31)	0.0047 (0.08)
TOWN	0.0638 (0.95)	0.0535 (0.80)	-0.0039 (0.06)	-0.0151 (0.24)
RURAL	0.0467 (0.78)	0.0388 (0.65)	0.0177 (0.31)	0.0100 (0.18)
QUE	0.0123 (0.12)	0.0236 (0.22)	-0.0077 (0.08)	0.0038 (0.04)
ONT	0.2707 (3.89)*	0.2488 (3.56)*	0.2788 (4.19)*	0.2559 (3.83)*
PRA	0.1004 (1.47)	0.1024 (1.50)	0.1021 (1.57)	0.1024 (1.58)
BC	0.1121 (1.33)	0.1132 (1.35)	0.1444 (1.84)	0.1389 (1.77)
λ	-0.0515 (0.78)	-0.0636 (0.96)	-0.0428 (0.63)	-0.0529 (0.78)
C	4.70	5.17	4.35	4.75
N	540	540	596	596
$\bar{R}^2$	0.53	0.53	0.54	0.54

differences on earnings. Given superior endowments such as training, education, and experience, white men should earn more than white women or blacks. However, not all of the wage advantage of white males enjoy is explained by superior skills. The unexplained portion in this model is attributed to discrimination in the labour market.

Using Mincer's identity (age minus education minus six) for experience, Robb (1978) for Ontario, and Gunderson (1979), for Canada, estimated that approximately 37 percent of the earnings advantage men enjoy over women was due to superior endowments. The remaining portion, 63 percent, was due to wage discrimination. These results were not dissimilar to U.S. findings.

Rosenzweig and Morgan (1976) and others have pointed out some serious flaws in the Blinder-Oaxaca approach to estimating women's earnings. In particular, the use of age or Mincer's identity is a poor proxy for actual work experience for women. These are inappropriate measures of experience since people of the same age who have spent different years in school will also have different levels of labour market experience.

CARMAC avoids this fundamental problem because the survey contains direct measures of total work experience, current job experience and labour force withdrawals for both men and women. It also contains other information not used in previous Canadian studies, such as the number of children born, and the acquisition of a degree or training certificate.

The average earnings for males and females respectively are:

$$\overline{\ln y}_m = \sum b_m \bar{X}_m \quad (13)$$

$$\overline{\ln y}_f = \sum b_f \bar{X}_f \quad (14)$$

where y is earnings, b is a vector of regression coefficients, and X is a vector of explanatory variables. If women are paid according to the male pay structure b_m , and retain their endowments ($\bar{X}_f$) their hypothetical earnings without discrimination are:

$$\ln y_f^* = \sum b_m \bar{X}_f \quad (15)$$

The difference between women's hypothetical earnings without discrimination and the actual earnings of males reflect differences in income-generating skills:

$$\overline{\ln y_m} - \ln y_f^* = \sum b_m \bar{X}_m - \sum b_m \bar{X}_f = \sum b_m (\bar{X}_m - \bar{X}_f) \quad (16)$$

The difference due to discrimination is:

$$\ln y_f^* - \overline{\ln y_f} = \sum b_m \bar{X}_f - \sum b_f \bar{X}_f = \sum (b_m - b_f) \bar{X}_f \quad (17)$$

The combination of endowment and discrimination differences accounts for the overall differences in earnings.

$$\overline{\ln y_m} - \overline{\ln y_f} = \sum b_m (\bar{X}_m - \bar{X}_f) + \sum (b_m - b_f) \bar{X}_f \quad (18)$$

Table 15 presents the earnings estimates for men and women. The sample consists of both married and unmarried men and women between 18 and 65, with positive income who worked more than 13 weeks in 1972. The means for each of the variables are also included in the table.

As expected, men have spent more time at work than women. Men are also more likely than women to be working full-time, and have worked more weeks in 1972. However, there is little evidence to indicate that women have lower rates of return for experience than do men. Returns to current job

TABLE 15

Earnings and Means of Men and Women

	<u>MEN</u>		<u>WOMEN</u>	
	b_m	$\bar{x}_m$	b_f	$\bar{x}_f$
Education	0.0406* (20.92)	11.09	0.0707* (10.68)	11.62
First work interval	0.0000617 (0.12)	0.42	0.00262 (0.34)	5.10
Intermittent experience	0.00696 (1.08)	0.11	0.0107** (0.34)	2.12
Current experience	0.0298* (18.04)	19.69	0.0496* (8.29)	5.61
(First work interval) ²	0.000130 (0.71)	6.86	0.000108 (0.30)	44.52
(Current experience) ²	-0.000619* (18.46)	536.83	-0.00136* (5.56)	69.80
Home time	0.0159 (1.32)	0.13	-0.00425 (0.74)	8.55
(Home time) ²	0.000219 (0.30)	0.98	-0.0000657 (0.31)	133.94
Children	0.0142* (4.60)	2.49	-0.00547 (0.55)	2.53
Exper. X Apprenticeship	0.00297* (5.86)	5.65	-0.000977 (0.30)	1.30
Exper. X Degree	0.0126* (10.37)	1.31	0.0175* (3.60)	0.63
Log (Weeks Worked)	0.619* (34.24)	3.82	0.651* (23.07)	3.61
English	0.164* (5.98)	0.73	-0.0866 (0.94)	0.82
Bilingual	0.177* (7.32)	0.19	-0.0829 (0.94)	0.14
Part-time	-0.273* (10.70)	0.05	-0.375* (10.88)	0.23

TABLE 15 (continued)

Earnings and Means of Men and Women

	<u>MEN</u>		<u>WOMEN</u>	
	b_m	$\bar{X}_m$	b_f	$\bar{X}_f$
Married	0.140* (5.54)	0.95	-0.0159 (0.39)	0.85
Quebec	0.135* (5.80)	0.19	0.143** (1.99)	0.11
Ontario	0.192* (11.42)	0.28	0.152* (3.41)	0.30
Prairies	0.00679 (0.40)	0.22	0.0672 (1.50)	0.25
British Columbia	0.231* (11.68)	0.13	0.123** (2.34)	0.14
Other City	-0.0132 (0.82)	0.16	-0.0180 (0.43)	0.19
Town	-0.109* (6.61)	0.15	-0.0381 (0.84)	0.15
Rural	-0.263* (18.73)	0.31	-0.0692 (1.77)	0.24
Foreign-born	-0.00158 (0.11)	0.18	0.00825 (0.21)	0.17
C	5.510		4.916	
N	8078		1173	
F	231.08		58.11	
$\bar{R}^2$	0.47		0.54	

tenure are significantly higher for women. Women also receive much higher returns for a given year of education.

Table 16 reports the percentages of the wage gap between men and women that are explained by differences in work history. Following (18) if women had male payoffs to work history components we could explain 36.5 percent of the total income gap.¹⁹ This implies that approximately one-third of the wage gap is due to different work history patterns. An additional 21 percent of the earnings gap is explained through the other explanatory variables listed in Table 15. In total, approximately 57 percent of the earnings gap is explained by endowments, and 43 percent is unexplained.

There are several things to note from these results. First the explained portion of the earnings difference is larger than estimated by Gunderson and Robb. Evidently, using actual work history variables does help to explain more of the earnings difference than using either Mincer's identity or age.

Second, even taking past work intervals explicitly into account, a significant portion of the earnings gap cannot be explained. These results are similar to Corcoran's (1979) claim that only 36 percent of the earnings gap between white men and white women is explained by their respective work histories. It is also consistent with Corcoran and Cournot's (1985) observation that even in the most detailed studies only about one-third of the earnings gap is due to work related variables.

TABLE 16
 Percentages of the Income Gap Between
 Men and Women Accounted for
 by Work History Segments

Work History Segment	Percent
Years of work from starting first full-time job to first break, plus first work interval squared	0.59
Intermittent work experience	-1.80
Current work experience, and current experience squared	16.72
Years not working since first full-time job, and home time squared	<u>20.95</u>
TOTAL	36.46

V. CONCLUSION

Mincer and Polachek (1974) presented arguments to explain why women have lower earnings than men, and why women acquire specific types of human capital. Central to their analysis was the observation that women often display discontinuous labour market work histories. Women exit and enter the market frequently and this is hypothesized to lower their current and life time earnings.

This paper concentrates on examining the Mincer-Polachek model in detail and on testing it using Canadian data. This was done by addressing the following questions. (a) Do women invest in on-the-job training less intensely during different periods of the life-cycle? (b) Does the absence from market activities adversely affect the earnings of women? (c) Given different types of human capital, are women's earnings affected differently when they are absent from market activities? (d) Do multiple exits and entries contribute to explaining the wage gap between men and women? (e) Does the restriction of the data to a select group of women that is not a random sample of the population alter the results in any way?

This paper has shown that women do invest in on-the-job training differently during different periods of the life-cycle. Throughout all the regressions listed above present job tenure is a key determinant of current market income. The results for the first two work intervals are less clear. When controlling for selectivity bias pre-interrupted work experience increases current incomes by about 1.0 percent. Intermittent experience is significant for women 18 to 64 years old in the uncorrected regressions. However, when including the inverse mills ratios the level of significance for this term drops.

A central result of this paper finds that the long run depreciation of human capital is minimal. The short-run depreciation rates were estimated at 0.9 percent. This is based on a sample of women 25 to 44. For the wider sample of women aged 18 to 64 the rate of depreciation fell to 0.5 percent. When controlling for selectivity bias the rate of depreciation for women 18 to 65 years was insignificant.

The same general pattern existed for women with different levels of education. For women with less than 9 years of formal education and for women with nine to twelve years of education home time does not effect earnings. For women with thirteen or more years of schooling (Table 11) home time is insignificant in the linear estimates and only significant at the ten percent level in the non-linear estimates.

Only about one-third of the wage gap between men and women can be explained when controlling for work history using the non-linear estimates. This figure drops to 25 percent when the squared terms for first work interval, home time and current job tenure are excluded from the analysis.

Sample selection appears to influence the results presented here. In the estimates controlling for work history and home time for the 18 to 65 group the coefficient for λ is significant at the ten percent level in three regressions and significant at the five percent level in one regression. If we accept results based on a ten percent level of significance the hypothesis that there is selectivity bias must be accepted. The most notable difference from the estimates without a bias correction is the fact that the coefficient for home time is now statistically insignificant. The effects of previous work experience are also double peaked for women with

children who are between 18 and 64. The same pattern, however, does not hold for all women between 18 and 64. Using detailed work history data I have demonstrated that human capital theory does not provide consistent answers to most of the questions listed above. Two questions are especially important in this regard. First, a theory must explain the continuing income disparities between men and women. Second, it must indicate why women choose specific occupations over others. /

Human capital theory presents an eloquent theoretical model to answer these crucial questions. However, a number of detailed empirical studies have consistently shown that a significant portion of the wage gap cannot be explained by human capital theory. Treiman and Hartman (1981) in an extensive review of the literature cite a dozen studies that have approached the male-female wage gap from a human capital perspective. Their survey shows that between 0-44 percent of the earnings gap is explained by human capital theory. This study finds that human capital theory can explain up to 57 percent of the wage gap. Although the variance in the estimates is quite high there is no question that the explained portion of the wage gap is low. There are fewer studies on occupational choice than there are on earnings differences and it is beyond the scope of this paper to analyze occupational segregation. However, within the literature the same results generally emerge. Human capital theory is unable to explain why women choose the jobs that they do. (England, 1982; Corcoran, Duncan and Ponza, 1983b).

New approaches in this area are warranted. Human capital approaches must be integrated with other models. Two new areas of research appear to yield promising results. One approach deals with examining specific work characteristics for men and women. This implies including job descriptions in the analysis, such as authority of the worker's position (Hill and Morgan, 1979), compensating differentials (Filer, 1983), and control over financial resources (Ferber and Spaeth, 1984).

The second approach concentrates on the pre-market influences that affect occupational choices and general socialization (Corcoran and Cournant, 1985). Traditionally, economists have not dealt with pre-market influences on labour market outcomes. Most of the research done in this area has been conducted by sociologists and psychologists. More work in this area may lead to a better understanding of why patterns of inequality are consistent over time.

Footnotes

1. This result should not hide the fact many women also worked in occupations at the low end of the pay scale. Given the massive increase in labour force participation rates among women over the past two decades, we are seeing a large influx of women at both ends of the income scale. Older entrants, for lack of human capital skills, are more heavily concentrated at the lower end. It is the younger, often highly trained women, who are moving into the male dominated fields.
2. It would be far too simplistic to argue that one model has the answer to the wage gap question. Undoubtedly all three play a key role in the labour process. It will also be seen in Section IV that the human capital model, by itself, is inadequate to explain the earnings gap between men and women.
3. The basic model presented here is a shortened version of Mincer and Polachek's, (1974) work.
4. The definitions for home time do diverge from Mincer and Polachek's in one important way. They were able to analyze total time out of the labour force after completing school. I only have enough information to start tracking women after they started their first full-time job. Therefore I am missing data between school completion and the start of employment.
5. The relative importance of home time is somewhat confusing in the original Mincer Polachek model. Home time should be more significant for women who work continuously or who are highly educated than for other women. Polachek (1981) clarifies this by distinguishing the occupational choice differences amongst women. I will discuss this in more detail in the text below.
6. Given the later work by Polachek (1978, 1979, 1981) he evidently still adheres to the basic model developed by Mincer and Polachek.
7. Use requires me to acknowledge the investigators responsible - M. Boyd, H.A. McRoberts and J. Porter of Carleton University; F. Jones and P.C. Pineo of McMaster University and J. Goyder, University of Waterloo -- as well as the Canada Council and Statistics Canada.
8. A year of work is defined as having worked on a full-time basis (i.e., 35 hours a week or more) for at least seven months in a given calendar year.
9. A series of work intervals can be constructed from the data centered around the year a woman's last child was born. The variables could be designed in such a way that e_1 = first work interval up to the birth of

the last child e_3 = current job tenure after the birth of her child e_2 = residual experience, h_1 = home time prior to the birth of the last child and h_2 all other home time. This methodology is not used in this paper. The problem with defining experience in this manner is that it really only makes sense for women who do not plan on having children any more. If, for instance, we observe a woman working in the labour market between the births of her first child and her second child the experience and home time variables listed above become very hard to interpret. Her present experience is actually part of her intermittent working career, however, the regression equations would interpret this form of work at current experience (e_3). Home time after the birth of the last child makes little sense. We do not know if the last child born was actually the first, second or third child born. If we are to model experience around the family what is needed is year of birth of the first child.

10. In the work of Sandell and Shapiro (1978) the sum of the experience variables ($e_1 + e_2 + e_3$) did not coincide with the number of years actually worked reported in the National Longitudinal Survey. Table 2 and 4 shows the differences between the total number of years worked (EXP) reported by each respondent in the CARMAC sample and the sum of women's segmented experience ($\sum e$). As can be seen there is no difference between the total experience figure reported in CARMAC and the sum of the work intervals. The data problems experienced in Sandell and Shapiro's work are not present here.
11. Unfortunately there are simply not enough single women in the survey to deal with effectively. For example, there are only 57 acceptable records for never married women, aged 25-44.
12. The sample sizes found in Table 5, and the subsequent Tables, are not the same for all three columns. Column (1) in Table 5 contains a sample of 517 women and columns (2) and (3) contain a sample of 540 women. The differing sizes result from some women not responding to all the questions that they were asked. For instance, the NPUN variable and the BREAK variable are included in column (1), but not in columns (2) and (3). They are included in column (1) because their theoretical importance in explaining earnings. They are excluded in columns (2) and (3) because of their obvious relationship with home time. Failure to answer questions relating to the number of periods of unemployment and whether or not they experienced a break in their working careers meant some women were excluded from the first sample.
13. Following previous studies (Mincer and Polachek; 1974, 1978; Sandell and Shapiro, 1978; Corcoran, 1979) I place more emphasis on the linear estimates than on e^2 and h^2 .

14. Both the data used by Mincer and Polachek and myself use *ex poste* results. Lack of other information sources makes this problem inevitable. The biggest drawback to using such data is the relationship between intermittent experience (e_2) to expected short durations of employment. It is best not to conclude that both variables are measuring the same thing.
15. Figure I is similar to the one presented by Mincer and Ofleck (1982) and Corcoran, Duncan and Ponza (1983a, 1983b).
16. Using panel data Corcoran, Duncan and Ponza (1983a) find that the 'rebound' effect is substantial and the segment GHK more accurately describes their results.
17. Unfortunately CARMAC does not contain any information on either total family income or spouse's income. This would have been a very useful variable in the probit estimates.
18. Previously, it was mentioned that in Figure 1 the typical earnings profile after re-entering the labour market was GHL. Controlling for self-selection implies that the typical profile is now GHK.
19. Using the linear estimates (no e_1^2 , e_3^2 and h^2) it was found that 25 percent of the income gap was explained by the work history variables.

References

- Bergmann, B. (1974) 'Occupational segregation, wages and profits when employers discriminate by race or sex', Eastern Economic Journal, 1, 103-110.
- Blinder, A. (1976) 'On dogmatism in human capital theory', Journal of Human Resources, 11, 8-22.
- Blinder, A. (1973) 'Wage discrimination: reduced form and structural estimates', Journal of Human Resources, 8, 436-455.
- Boulet, J. and L. Lavallee (1984) The Changing Economic Status of Women, Ottawa: Supply and Services.
- Corcoran, M. (1979) 'Work experience, labour force withdrawals, and women's earnings: empirical results using the 1976 panel study of income dynamics', in C. Lloyd, E. Andrews, C. Gilroy ed. Women in the Labour Market, New York: Columbia University Press.
- Corcoran, M. and P. Courant (1985) 'The role of socialization in labor market outcomes' American Economic Review Papers and Proceedings, 75, 275, 278.
- Corcoran, M. and G. Duncan (1979) 'Work history, labor force attachment, and earnings differences between race and sex', Journal of Human Resources, 14, 3-20.
- Corcoran, M., Duncan, G. and M. Ponza (1983a) 'A longitudinal analysis of white women's wages', Journal of Human Resources, 18, 497-520.
- Corcoran, M., Duncan, G. and M. Ponza (1983b) 'Work experience and wage growth of women workers', in G. Duncan and J. Morgan eds. Five Thousand American Families - Patterns of Economic Progress, Vol. X, Ann. Arbor: Institute for Social Research.
- England, P. (1982) 'The failure of human capital theory to explain occupational sex segregation', Journal of Human Resources, 17, 358-370.
- Ferber, M. and J. Spaeth (1984) 'Work Characteristics and the Male-Female Earnings Gap', American Economic Review, 74, 260-264.
- Filer, R. (1983) 'Male-Female Wage Differences: The Importance of Compensating Wage Differentials' Industrial and Labor Relations Review, 38, 426-437.
- Gronau, R. (1974) 'Wage Comparisons -- a selectivity bias', Journal of Political Economy, 82, 1119-1143.
- Gunderson, M. (1979) 'Decomposition of male-female earnings differential: Canada', Canadian Journal of Economics, 12, 479-484.

- Heckman, J. (1979) 'Sample selection bias as a specification error', Econometrica, 47, 153-161.
- Heckman, J. (1974) 'Shadow prices, market wages and labour supply', Econometrica, 42, 679-694.
- Hill, M.V. (1979) 'The wage effects of marital status and children', Journal of Human Resources, 14, 579-594.
- Hill, M. and J. Morgan (1979) 'Dimensions of Occupations' in G. Duncan, J. Morgan (ed.) Five Thousand American Families, Ann Arbor, Institute for Social Research.
- Jones, E. and J. Long (1979) 'Part-week work and human capital investment by married women', Journal of Human Resources, 14, 563-578.
- Malkiel, B. and J. Malkiel (1973) 'Male-female pay differentials in professional employment', American Economic Review, 63, 693-705.
- Mincer, J. (1974) Schooling, Experience and Earnings, New York: NBER.
- Mincer, J. and H. Ofek (1982) 'Interrupted work careers: depreciation and restoration of human capital', Journal of Human Resources, 17, 3-24.
- Mincer J. and S. Polachek (1974) 'Family investments in human capital: Earnings of women', Journal of Political Economy, 82, 576-5108.
- Mincer, J. and S. Polachek (1978) 'Women's earnings reexamined', Journal of Human Resources, 13, 118-134.
- Oaxaca, R. (1973) 'Male-female wage differentials in urban labor markets', International Economic Review 14.
- Polachek, S. (1981) 'Occupational self-selection: A human capital approach to sex differences in occupational structure', Review of Economics and Statistics, 63, 350-359.
- Polachek, S. (1981) 'Occupational self-selection: A human capital approach to sex differences in occupational structure', Review of Economics and Statistics, 63, 350-359.
- Polachek, S. (1979) 'Occupational segregation among women: theory, evidence, and prognosis' in G. Lloyd, E. Andrews and C. Gilroy (ed.) Women in the Labor Market, New York: Columbia University Press.
- Polachek, S. (1975a) 'Potential biases in measuring male-female discrimination', Journal of Human Resources, 10, 205-229.
- Polachek, S. (1978) 'Sex differences in college major' Industrial and Labor Relations Review, 31, 498-508.

Polachek, S. (1975b) 'Work Experience and the difference between male and female wages', PhD. dissertation, Columbia University.

Robb, R. (1978) 'Earnings differentials between males and females in Ontario', Canadian Journal of Economics, 11, 350-359.

Rosenzweig, M. and J. Morgan (1976) 'Wage discrimination: a comment', Journal of Human Resources, 11, 3-7.

Sandell, S. and D. Shapiro (1978) 'The theory of human capital and the earnings of women', Journal of Human Resources, 13, 103-117.

Sandell, S. and D. Shapiro (1980) 'Work expectations, human capital accumulation, and the wages of young women', Journal of Human Resources, 15, 335-353.

Statistics Canada (1985) Women in Canada, Ottawa: Supply and Services.

Treiman, D. and H. Hartmann (1981) Women, Work and Wages: Equal Pay for Jobs of Equal Value, Washington: National Academy Press.

END

20/06/88

FIN