THE LABOUR MARKET IMPLICATIONS OF JOB QUALITY

by

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Abstract

This thesis takes the form of three essays about the labour market implications of job quality.

In the first essay, I demonstrate, by analysing a two-type, two-period example, that high introductory wage offers can signal the quality of experience jobs. In this game, one type of firm - the "good" type - offers higher expected quality jobs. If this type is less likely to exit from the industry than the "bad" type, it can increase expenditure on introductory wages without being mimicked, distinguishing it from its inferior. The game has many equilibria with these separating wages. In each, the introductory compensating differentials have the opposite sign to the usual case: higher expected quality jobs pay more, rather than less.

In the second essay, I present Canadian evidence that tests and supports the theory of compensating differentials for a variety of job characteristics. The data used are from the National Survey of Class Structure and Labour Process in Canada (NSCS). These self-report data are preferable to the more conventional occupational-trait data; they provide information on individual jobs rather than averages across broad occupational categories and industries.

In the third essay, I focus on the mismatch between the educational requirements of jobs and the educational attainments of workers. Using NSCS data, I find that the returns to over- and undereducation for males are sensitive to the level of required education. There is evidence of positive returns to overeducation for jobs that require a university bachelor's degree; but, in general, the returns are insignificant. Undereducated workers are penalised in jobs with low educational requirements. For females, I find that the returns to over- and undereducation are insignificant for all levels of required education.

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Chapter 1

Introduction

This thesis takes the form of three related essays about the labour market implications of job quality.

The first essay, Chapter 2, is a theoretical piece about signalling job quality. Economists have long recognised that the theory of compensating differentials does not sufficiently explain the observed distribution of wages across job quality. The theory predicts that lower quality jobs pay higher wages than more desirable jobs. However, casual observation suggests that workers in more desirable jobs are often paid more, rather than—as the theory predicts—less.

Following the terminology coined by Nelson [71] in the context of product quality, I draw a distinction between "search" and "experience" jobs. Many unskilled jobs are of the former type: quality is immediately apparent. In contrast, the quality of skilled jobs is often difficult to verify by inspection, and workers learn through experience. For a firm offering this type of job, conveying quality is difficult; a straightforward claim is unverifiable and can be costlessly copied by firms with lower quality jobs. It is, however, in the interests of both a firm supplying high quality jobs, and workers searching for such jobs, that information about quality is revealed.

In this chapter, I demonstrate by analysing a two-type, two-period example, that high introductory wage offers can signal the quality of experience jobs. In this game, one type of firm, hereafter referred to as the "good" type, offers higher expected quality jobs. Assuming this type is less likely to exit from the industry than the "bad" type, it can increase expenditure on introductory wages without being mimicked, distinguishing it from its inferior. The game has many equilibria with these separating wages. In each, the introductory compensating differentials have the opposite sign to the usual case: higher expected quality jobs pay more, rather than less. There are also equilibria in which the two types offer the same (or pooling) introductory wage. In these equilibria, the introductory wage offer is independent of job quality.

The intuition captured by the model is very straightforward. Wage offers affect inexperienced workers' beliefs about job quality. Realising this, the firm resists cutting the wage to the market clearing level.

In the second essay, Chapter 3, I present Canadian evidence that tests and supports the theory of compensating differentials for a variety of job characteristics. Previous Canadian studies, such as those by Meng [64 and 65], Martinello and Meng [62], and Cousineau et al [22] have found support for the theory for risk of injury or death. But no previous research has found Canadian evidence of compensating wage payments for non-hazardous job characteristics.

The data used in this chapter come from the National Survey of Class Structure and Labour Process in Canada (NSCS). These unique data, which are cross-sectional and relate to 1981 incomes, provide detailed self-report information about the respondents' job quality and personal characteristics. Meng's [64] study of compensating differentials also used this data set. However, to measure job quality, Meng used occupational-trait data developed by Statistics Canada and Employment and Immigration Canada, rather than the self-report information contained in the Survey. Unfortunately, these occupational-trait data provide information on averages across broad occupational categories and industries, introducing error into the job quality variables. Using self-report data—which avoids this particular problem—I find stronger support for the theory of compensating differentials than did Meng [64].

After controlling for personal characteristics, I find evidence of compensating differentials for working with data, working with hands, bureaucratic procedures, and responsibility over other workers. I also find evidence of differentials for the control of hours and pace. Although these characteristics are generally held to be desirable, I find that they are associated with higher, rather than lower, wages. That is, the coefficients have the "wrong" signs. I find no evidence of differentials for working with people, working with machines and the freedom to design work. In short, my results support the theory of compensating differentials across a wider range of characteristics than previous Canadian studies.

The third essay, Chapter 4, takes a slightly different perspective on job quality. I focus on the mismatch between the educational requirements of jobs and the educational attainments of workers. In his seminal work, "The Great Training Robbery", Ivar Berg [14] argued that overeducated workers may be less productive than their less skilled counterparts because they become bored with their jobs and lose motivation. Despite the widespread concern over educational mismatch, there have been few studies of its impact on earnings; data sets rarely contain information on both the educational attainments of workers and the requirements of jobs. A small number of studies have used either US or Dutch data; but there have been no previous Canadian studies. Duncan and Hoffman [28], Rumberger [84], Hersch [43] and Sicherman [87] have estimated earnings (or wage) equations including both the years of required schooling for the job, and the years of over- or undereducation. These researchers have found strong evidence that the earnings of overeducated workers are greater than those of otherwise identical workers who are neither overeducated nor undereducated; and, that the earnings of undereducated workers are lower. Assuming earnings reflect marginal productivity, their results refute Berg's [14] hypothesis.

I use NSCS data to estimate the returns to educational mismatch in Canada. I find that the returns to over- and undereducation are sensitive to the level of required education. There is evidence of positive returns to overeducation for jobs that require a university bachelor's degree; but, in general, the returns are insignificant. Unlike previous studies, I find little evidence of lower pay for undereducated workers; though they are penalised in jobs with low education requirements. I also estimate separate equations for male and female workers. Although I find that the results for the male sub-sample are similar to the full sample, I find that the returns to over- and undereducation for females are insignificant for all levels of required education. Since, in general, overeducated workers have identical earnings to their less skilled counterparts with the required level of schooling, the data do not support Berg's [14] claim. But, in the sense that overeducated workers do not receive the full returns to their attained education, they are "robbed".

In the final chapter, I draw some conclusions from the thesis.

Chapter 2

Signalling Job Quality

2.1 Introduction

Economists have long recognised that the theory of compensating differentials (or equalising differences, as it is also known) does not fully explain the observed distribution of wages across job quality. The theory, originally due to Adam Smith [89] and formalised by Rosen [81], predicts that better jobs pay lower wages. Yet, casual observation suggests that often workers in high quality jobs are paid more, rather than—as the theory predicts—less.

For example, in the early 1980s, ICI made particularly enticing offers to freshly trained UK chemical engineers. Ex post, it is apparent that the firm had high safety standards, offered good prospects for promotion and training, and infrequently laid-off workers. Yet the pay offers exceeded those of its immediate competitors.[1]

On the face of it, ICI gained little from offering high wages; except a reputation as a high paying employer. And the message, "We devote a vast sum to our wage bill" appears—at first glance—to be useless. In this chapter, I propose that this message can inform newly qualified, inexperienced labour about job quality.[2]

Following the terminology coined by Nelson [71] in the context of product quality, I draw a distinction between "search" and "experience" jobs. Many unskilled jobs are of the former type: the quality is immediately apparent. In contrast, the quality of skilled jobs—whether it be repetition, stress, or risk

[1] In 1982, the basic weekly wage of the lowest-skilled ICI worker was over 15at Glaxo, its best-known domestic competitor (Smith [90]).

[2] Efficiency wage theories, associated with the work by Salop [85], Shapiro and Stiglitz [86] and Weiss [108] can also account for non-market clearing wages. My explanation is complementary.

of fatality—is often difficult to verify by inspection, and workers learn through experience. For a firm offering this type of job, conveying quality is troublesome; a straightforward claim is unverifiable and can be costlessly copied by inferiors. It is, however, in the interests of both a firm supplying high quality jobs, and workers searching for such jobs, that information about quality is revealed.

In this chapter, I demonstrate, by analysing a two-type, two-period example, that high introductory wage offers can signal the quality of experience jobs. One type of firm, hereafter referred to as the "good" type, offers higher expected quality jobs. If this type is less likely to exit from the industry than the "bad" type, it can increase expenditure on introductory wages without being mimicked, distinguishing it from its inferior. The game has many equilibria with these separating wages. In each, the introductory compensating differentials have the opposite sign to the usual Smith/Rosen case: higher expected quality jobs pay more, rather than less.

There are also equilibria in which the two types offer the same (or pooling) introductory wage. In these equilibria, the introductory wage offer is independent of job quality.

The intuition captured by the model is very straightforward. Wage offers affect inexperienced workers' beliefs about job quality. Realising this, the firm resists cutting the wage to the market clearing level.

The distinction between search and experience jobs has been made before by (amongst others) Adam Smith [89], Reynolds [79] and Johnson [46]. A series of papers by Viscusi [99, 100, 101, 102 and 103] and Viscusi and Moore [107] has explored the relationship between compensating differentials and worker learning. In the model common to these papers, inexperienced workers are compensated for undesirable jobs; but, because they are more optimistic about job quality, they receive smaller compensating differentials than their more experienced counterparts. However, the result relies on the assumption that workers' beliefs are independent of the wage offers. In this chapter, I show that if this assumption is relaxed, inexperienced workers are generally uncompensated ex ante for undesirable jobs. In a separating equilibrium, it is the type of firm with higher expected quality jobs that pays the differential.

The remainder of this chapter is set out as follows. In the following section, I review the related literature. I analyse the signalling game in Section 2.3. The strategies and payoffs of the firm and the workers are considered in Section 2.4. The (Bayesian) Nash equilibria to the game are characterised in Section 2.5. Signalling games generally have a plethora of equilibria; and this one is no exception. In Section 2.6, I show that (a two-period version of) the Cho-Kreps Intuitive Criterion renders a unique separating equilibrium, where one exists. The implications of the game are discussed in Section 2.7, and some conclusions are drawn in the final section.

2.2 Related Literature

As a rule, researchers in the compensating differentials tradition have assumed that workers know the quality of the jobs available to them. The initial idea, developed by Adam Smith [89], was formalised by Rosen [81]. A job is viewed as a tied transaction: workers simultaneously sell labour and buy job characteristics. The equilibrium wage distribution clears the market so that the worker's and firm's preferences are matched. As a result of this sorting process, there is an equilibrium trade-off between each job characteristic and the wage.

The standard textbook treatment is as follows (see Gunderson and Riddell [38]). Consider a job with a single observable characteristic. Suppose workers dislike this characteristic, but firms find it costly to eradicate. A decrease in the provision of the characteristic can be thought of as an increase in job quality. The equilibrium locus is downward sloping in wage/job quality space. A positive compensating differential is paid to workers who take on lower quality jobs.

This equilibrium wage-job quality schedule can be expressed as:

(1) $w = w(x, z),$

where w, x and z denote the real wage, job quality, and other wage determinants respectively. Typically, this locus is assumed to be concave. The trade-off captures the workers' "willingness-to-pay" for increases in quality.[3]

The idea that workers have difficulty observing job quality prior to employment has a considerable tradition. Adam Smith [89] noted that workers tend to underestimate the risk of injury and death, particulary when young. Oi [74], Diamond [23] and Rea [78] have argued that workers are systematically misinformed about safety levels. Carmichael [19] has shown that if workers take time to learn about the risk of injury (but are fully informed in the steady state) then there is a moral hazard problem: firms may cut costs by offering riskier jobs.

Outside the safety literature, Reynolds [79], Johnson [46], Jovanovic [48 and 49] and Wilde [110] have argued that a variety of job characteristics are unobservable prior to employment. This leads to high mobility or "job shopping" as young workers experiment with different jobs.

The connection between experience jobs and compensating differentials has been made by Viscusi [99, 100, 101, 102 and 103] and Viscusi and Moore [107]. In the two-period, two-type model in these papers, one type of firm offers higher expected quality jobs. It is assumed that the workers have heterogeneous work-leisure preferences. They learn about expected job quality from experience, updating their beliefs using Bayes' rule. The wage in each period is determined by market clearing, so that the marginal worker in each period receives reservation utility. The period 2 marginal worker has had an unfavourable period 1 job experience and, therefore, is less optimistic about job quality than the period 1 marginal worker. Consequently, inexperienced workers demand a smaller compensating differential. However, this result depends on the assumption that workers' beliefs are independent of the introductory wage offers. In this chapter, I show that if this assumption is relaxed, inexperienced workers are generally uncompensated ex ante for undesirable jobs.

A number of other researchers have argued that prices signal firm-side private information. Milgrom and Roberts [67], Bagwell [9], and Allen and Faulhaber [4] have examined models in which product quality is signalled through the

[3] Estimates of the compensating differential can be obtained from the regression coefficient in the hedonic wage equation (1).

introductory price. Frank [32], Beaudry [10, 11 and 12], Giammarino and Nosal [36], Arvan and Esfahani [8] and Kuhn [56] have shown that a variety of firm characteristics (such as the marginal product, the quality of management, and firm-specific human capital) can be signalled through the wage. However, none of these researchers have analysed the use of the wage to signal job quality or the impact of this on compensating differentials. In the following sections this analysis is carried out.

2.3 The Game

The game between the single firm and the workers is structured as follows.

The firm can be one of two types: good or bad. Firm type, indexed by q, is good $\{q = G\}$ with probability z, and bad $\{q = B\}$ with probability $(1 - z)$. The firm incurs a fixed cost of production in each period. I shall subsequently restrict how this cost, denoted C_q, varies with type. The cost is never observed by the workers; they cannot learn type directly, but must infer it from the firm's behaviour.

In both periods, the good type provides higher expected quality jobs. Let x denote the job quality in period 1. For the good type, this is high $\{x = H\}$ with probability p, and low $\{x = L\}$ with probability $(1-p)$. The bad type provides only low quality jobs. Period 2 job quality is determined in an identical manner.

Given its type, the firm must choose a period 1 wage offer. It must also decide whether to stay in the market in the subsequent period; and if it does decide to stay, it must choose a period 2 wage offer. At the beginning of the second period, the firm learns the value that can be achieved by relocating its capital to the best alternative. This outside option, denoted r, is equal to 0 with probability a, and some positive value, R, with probability $(1 - a)$. I assume that the realisation of this outside option is unobserved by the workers.

The perfectly competitive output market price is normalised to one. Production occurs according to a strictly concave production function, $y_t = f(n_t)$, where y_t and n_t represent output and the quantity of labour demanded in period t respectively. The amount of labour the firm would like to employ at wage

w is determined by its inverse labour demand schedule, $n = g(w)$.[4] With no loss of generality, I assume that the firm is never constrained by the size of the workforce. The discount factor is set to one.

The workforce is comprised of N identical, atomistic, risk-neutral workers. The (representative) worker has additively separable preferences over time, and in each period is endowed with an indivisible unit of labour. If the worker does not sell the unit of labour, it obtains the reservation utility level, which (again, with no loss of generality) I set to zero. If it sells the unit of labour at wage w, it obtains utility w if job quality is high; and $w - L$ if job quality is low. Here L measures the disutility from a low quality job.

Firm type is never directly observed by the worker, and job quality is only observed at the end of each period. The worker's initial beliefs are that job quality is high with probability zp, and low with probability $(1 - zp)$. These beliefs are revised upon observing the period 1 wage offer according to Bayes' rule. Let b_1 denote the worker's posterior probability that job quality is low. The belief function $\beta_1 : \Re_+ \rightarrow [0,1]$ maps the wage offer into a period 1 posterior probability. In the second period, if the firm does not exit, this probability is revised based on the realisation of period 1 job quality, and the subsequent wage offer. If the firm exits, no decision is required by the worker. The belief function in period 2 can be defined as $\beta_2 : [L, H] \times \Re_+^2 \rightarrow [0,1]$. Let b_2 denote a value of β_2 for a particular history.

In summary, the sequence of events is described by the time line shown in Figure 1. At the start of the game, the firm's type is determined. This is private information to the firm. The worker has prior belief $(1 - zp)$ that job quality in period 1 will be low. The firm offers a one period contract specifying the first period wage. The worker forms a posterior belief that the period 1 job quality will be low, b_1, and either accepts or rejects the offer. If it accepts, production occurs, and job quality in period 1 is realised.

At the beginning of period 2, the value of the firm's outside option is determined, and it decides whether to exit or stay. If it stays, it makes another

[4]Note that since $f(\cdot)$ is type independent, so is $g(\cdot)$.

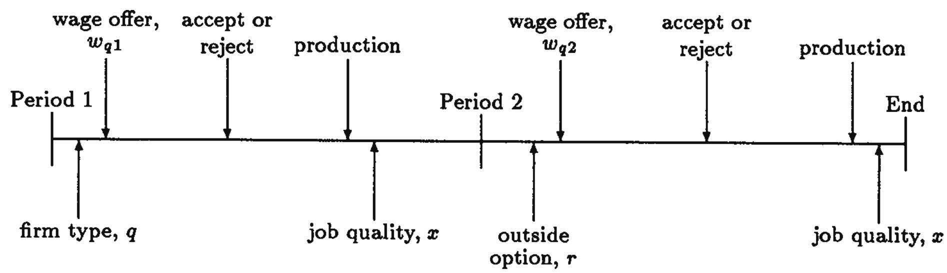


Figure 1: Time Line

wage offer. The worker forms a (revised) posterior belief that the job will be low quality, b_2; and again makes an accept/reject decision. If no job is offered in period 2 or accepted in either period, the game ends.

2.4 Strategies and Payoffs

2.4.1 The Firm

Recall the firm's problem. First, the firm chooses a period 1 wage offer. Then, at the start of period 2, it decides whether to exit or stay; and if it stays, it chooses another wage offer. The good type's period 2 decisions are conditional on both the period 1 job quality and the outside option. The bad type's period 2 behaviour is conditional only on the outside option—it does not offer high quality jobs.

For each type, a pure strategy is comprised of: a first period wage offer; an indicator function for the exit decision (which takes the value 1 if the firm exits, and 0 if it stays); and, if it stays, a period 2 wage function.[5]

The optimal strategy for a type q firm maximizes expected two-period prof-

[5] For simplicity, attention is restricted to pure strategies. Mixed strategies could be permitted but, where separating equilibria exist, none survive the adopted refinement.

its, given the strategy of the other type and the worker's decision rule.

2.4.2 The Worker

The worker's problem consists of deciding whether to accept or reject wage offers, given beliefs about job quality. The first period decision is based solely upon the period 1 wage offer. In the second period, the worker utilises the information revealed by the two wage offers, period 1 job quality and the firm's decision to stay.

A pure strategy for the worker is a pair of indicator functions, one for each period (which take the value 1 if the worker accepts, and 0 otherwise).[6] The optimal strategy maximizes the expected utility over the two periods.

2.5 Equilibria

A (Bayesian) Nash equilibrium for this game is a strategy combination such that both types behave optimally given each other's strategy, and the worker's decision rule. There are two types of equilibria: those in which the introductory wages are pooling, and those in which they are separating. In the latter, firm type is revealed by the period 1 wage offer; in the former, it is not.

In the following sections, I characterise the wage offers in each type of equilibria.

2.5.1 Separating Introductory Wages

Suppose the two types choose different period 1 wage offers, that is $w^*_{G1} \neq w^*_{B1}$. The worker can differentiate between the two types from the wage offer alone. Therefore, the worker's beliefs about job quality are given by:

$$
\begin{aligned}
(2) \quad \beta^*_1(w^*_{G1}) &= \beta^*_2(w^*_{G1}, w_{G2}, x) = 1 - p, \\
\beta^*_1(w^*_{B1}) &= \beta^*_2(w^*_{B1}, w_{B2}, L) = 1.
\end{aligned}
$$

[6] Mixed strategies for the worker could be permitted but are never optimal.

Given these beliefs, consider the period 2 wage offers. Since there is only one source of demand for labour, the (atomistic) worker's wage is bid down to the reservation level—the worker's participation constraint binds with equality. The period 2 wage offers are $(1-p)L$ for the good type; and L for the bad type.

In the light of this behaviour, consider the firm's exit decision at the start of the second period. If, for either type, period 2 profits are exceeded by the value of the outside option, then the firm exits. For the good type these profits are given by:

$$(3) \quad \pi((1-p)L, G) = f(g((1-p)L)) - ((1-p)L) \cdot g((1-p)L) - C_G.$$

And, for the bad type they are given by:

$$(4) \quad \pi(L, B) = f(g(L)) - (L) \cdot g(L) - C_B.$$

I assume that for both types, one-period profits are strictly positive for any non-zero quantity of labour. Hence, if $r = 0$, neither type exits. But if $r = R$, both types may exit. I make two assumptions about the firm's behaviour in these circumstances. First, I assume the good type stays, even if the worker believes the firm is the bad type (in which case the wage is L). Second, I assume the bad type exits, even if the worker believes the firm is the good type (in which case the wage is $(1-p)L$). That is, I assume that:

$$(A1) \qquad \pi(L, G) > R > \pi((1-p)L, B).$$

A necessary (but not sufficient) condition for this to hold is that the bad type's fixed costs exceed the good type's, $C_B > C_G$. Assumption (A1) ensures that the probability of exit is 0 for the good type; and $(1-a)$ for the bad type.[7] Hence, the probability of exit is type dependent (even though the value of the outside option is not); the bad type finds the outside option more attractive than the good type.

[7] Assumption (A1) is sufficient—but not necessary—for the existence of separating equilibria. The necessary and sufficient condition is that the probability of exit is lower for the good type. Else, there are only pooling equilibria. The role of this assumption is discussed further in Section 2.7.

Given this period 2 behaviour, consider the period 1 wage offers. The bad type's offer just satisfies the worker participation constraint, L: a higher wage would lower period 1 profits but would leave the worker's beliefs (and therefore period 2 profits) unaffected.

The good type's offer must ensure that the bad type's behaviour is incentive compatible. In equilibrium, the bad type's (expected) payoff is:

$$(5) \quad \pi(L, B) + a\pi(L, B) + (1 - a)R.$$

If, however, the bad type deviates by mimicking the good type's period 1 offer, its payoff is:

$$(6) \quad \pi(w_{G1}^{*}, B) + a\pi((1 - p)L, B) + (1 - a)R.$$

Let W_B define the wage that equates conditions (5) and (6). If the good type's offer is at least as large as W_B, then the bad type has no incentive to deviate. Notice that since $(1-p)L$ is less than L, W_B is strictly greater than L: to avoid mimicry, the good type must exceed the bad type's post-separation offer.

The good type's behaviour must also be incentive compatible. The good type's equilibrium payoff is:

$$(7) \quad \pi(w_{G1}^{*}, G) + \pi((1 - p)L, G).$$

Suppose the good type deviates by mimicking the bad type. In this case, its type may still be revealed if period 1 job quality is high. I assume that, should this occur, the worker correctly infers that the firm is good. That is, $\beta_2^*(W_{B1}^*, w_{G2}, H) = (1 - p)$. Then, the good type's payoff from the deviation is:

$$(8) \quad \pi(L, G) + (1 - p)\pi(L, G) + p\pi((1 - p)L, G).$$

Let W_G define the wage that equates expressions (7) and (8). To ensure incentive compatibility, the good type's offer must be strictly less than W_G. Notice that like W_B, the wage offer W_G is strictly greater than L.

Clearly, the period 1 offers can be separating only if $W_G > W_B$. This condition is the two-period equivalent of the Mirrlees-Spence single crossing property for this game. As the following lemma makes apparent, this holds only for a particular parameter space.

Lemma 1 *The introductory wage W_G exceeds W_B if, and only if, $a < (1-p)$.*

Proof Recall that W_B is defined by expressions (5) and (6); and that W_G is defined by (7) and (8). Rearranging these expressions gives:

(9) $\pi(W_B, B) = (1+a)\pi(L, B) - a\pi((1-p)L, B),$

and,

(10) $\pi(W_G, G) = (2-p)\pi(L, G) - (1-p)\pi((1-p)L, G).$

Subtracting (10) from (9), and adding fixed costs to both sides gives:

(11) $\pi(W_B) - \pi(W_G) = [a - (1-p)][\pi(L) - \pi((1-p)L)],$

where $\pi(w) = f(g(w)) - w \cdot g(w)$. The lemma follows. QED.

The period 1 wage offer affects the firm's subsequent behaviour in two cases: first, if the firm is bad and stays; and second, if the firm is good and period 1 job quality is low. The good type can separate if, and only if, (conditional on type) the probability of the latter event, $(1-p)$, is greater than that of the former, a.

If this condition holds, there is a continuum of separating equilibria in which the good type's period 1 wage offer is given by $w^*_{G1} \in [W_B, W_G)$. These equilibria can be supported by the belief that any offer outside this interval comes from the bad type. Elimination of some of these equilibria is only possible by imposing further structure on the worker's beliefs off the equilibrium path.

Equilibria with pooling wages are considered in the following section.

2.5.2 Pooling Introductory Wages

Suppose that the two types choose the same period 1 wage offer, $w^*_{p1} = w^*_{G1} = w^*_{B1}$. The worker cannot differentiate between the two types from the first period wage offer alone. The worker's posterior period 1 belief that job quality is low is, therefore, $\beta_1^*(w_{p1}^*) = (1 - zp)$.

Recall that the worker's beliefs in period 2 are dependent, in part, upon the realisation of period 1 job quality. If this was high, the workers know the firm is good. The period 2 wage offer is then $(1-p)L$—just satisfying the worker's participation constraint.

If job quality in the previous period was low and the firm stays, then the worker knows that either the firm is bad and $r = 0$, or the firm is good.[8]

The worker, therefore, updates the period 1 belief, $(1 - zp)$, in the light of this information. Let this posterior belief be denoted $(1 - z'p)$.[9]

In order to satisfy the worker's participation constraint, the period 2 wage must be greater than, or equal to, $(1 - z'p)L$. This is the most efficient pooling wage from the firm's point of view. The wage must, however, be less than L—given any beliefs, the worker will accept this offer. There is a continuum of pooling equilibrium wage offers between these two bounds. Equilibria with wage offers in this interval can be supported by the belief that any other offer comes from the bad type.

Similarly, there is a continuum of pooling period 1 wage offers. The lowest introductory wage at which the two types can pool is $(1-zp)L$; any lower wage does not meet the worker's participation constraint. The highest introductory wage that can be offered is dependent upon the period 2 offer. Suppose, the period 2 pooling wage is $(1 - z'p)L$—the lowest possible pooling wage in that period. Then the bad type's equilibrium payoff is:

(12) $\pi(w_{p1}^*, B) + a\pi((1 - z'p)L, B) + (1 - a)R.$

If it deviates and the worker believes that the deviation comes from the bad type, its payoff is:

(13) $\pi(L, B) + a\pi(L, B) + (1 - a)R.$

[8] Recall that r is private information to the firm.

[9] From Bayes' rule, it can be shown that $z' = z(1-p)/(z(1-p) + (1-z)a)$, such that $z' > z$ if $(1-p) > a$.

Let W'_B define the wage that equates expressions (12) and (13). By definition, this wage exceeds L, but is less than W_B.

The equilibrium payoff for the good type is:

$$(14)\quad \pi(w^*_{p1}, G) + (1-p)\pi((1-z'p)L, G) + p\pi((1-p)L, G).$$

If it deviates and the worker believes that the deviation was made by the bad type, its payoff is:

$$(15)\quad \pi(L, G) + (1-p)\pi(L, G) + p\pi((1-p)L, G).$$

Let W'_G define the wage that equates expressions (14) and (15). It too exceeds L, but is less than W_G.

Lemma 2 *The introductory wage W'_G exceeds W'_B if, and only if, $a < (1-p)$.*

Proof The proof is similar to that of Lemma 1.

The upper bound to the set of pooling equilibria is strictly less than the minimum of W'_B and W'_G. Pooling equilibria with introductory wages in the interval $w^*_{p1} \in [(1-zp)L, [\min(W'_G, W'_B)])$, can be supported by the belief that any offer outside this range comes from the bad type.

2.6 Refinement

The multiple equilibria can be characterized according to the good type's period one wage offer (see Figures 2 and 3). In the parameter space $a < (1-p)$, the introductory wage is pooling if $(1-zp)L \leq w^*_{G1} < W'_B$; and type-revealing if $W_B \leq w^*_{G1} < W_G$. If $a \geq (1-p)$, the introductory wage is pooling such that $(1-zp)L \leq w^*_{G1} < W'_G$.

The multiplicity of equilibria stems from the indeterminacy of worker's beliefs off the equilibrium path. Bayes' rule restricts the worker's beliefs along the equilibrium path but not off it. The Cho-Kreps Intuitive Criterion can reduce the number of equilibria by restricting off-equilibrium beliefs as follows. Consider a candidate equilibrium, and an out-of-equilibrium offer. Suppose one of

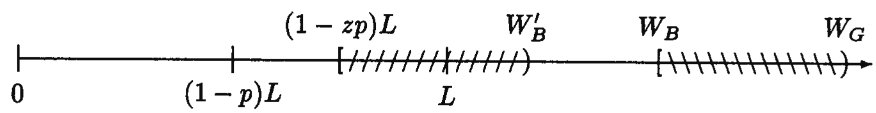


Figure 2: Equilibrium Wages, where $a < (1-p)$

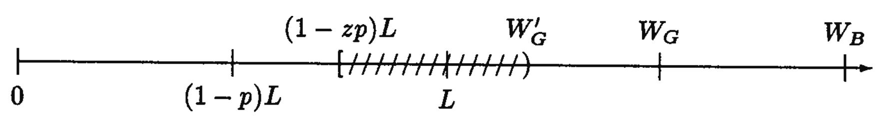


Figure 3: Equilibrium Wages, where $a \geq (1-p)$

the two types obtains a smaller payoff from the deviation than from the candidate equilibrium, regardless of beliefs. Further suppose, that if the worker believes this deviation was made by the other type, then that type's payoff from the deviation is higher than from the candidate equilibrium. Then, the equilibrium does not satisfy the Intuitive Criterion.

This refinement reduces the set of separating equilibria to a singleton. To see this, fix a candidate separating equilibrium such that the good type offers a period 1 wage greater than W_B, and the bad type offers L. Suppose there is a deviation to a wage greater than W_B, but less than the good type's equilibrium offer. Given any beliefs, this deviation yields the bad type a lower payoff than its equilibrium strategy (this follows from the definition of W_B). Therefore, the worker should believe that the deviation was made by the good type, and accept the offer. But, given these beliefs, the good type obtains a higher payoff by deviating than from the conjectured equilibrium, overturning that equilibrium. By this reasoning, there are no equilibria in which the good type's period 1 wage offer exceeds W_B.

A two-period version of the refinement also eliminates some of the pooling equilibria. Fix a pooling equilibrium in which the two types offer w^*_{p1}, and consider a deviation to a higher wage. The equilibrium payoff for the bad type is:

(16) $\pi(w^*_{p1}, B) + a\pi(w^*_{p2}, B) + (1 - a)R.$

If it deviates and the worker believes that the deviation was made by the good type, its payoff exceeds the equilibrium payoff. I assume that, should this occur, the worker maintains this belief, regardless of both the realisation of period 1 job quality and the period 2 wage offer.[10] For these particular beliefs, the bad type's payoff is:

(17) $\pi(w, B) + a\pi((1 - p)L, B) + (1 - a)R.$

[10]The Intuitive Criterion is usually applied to one-period games. By specifying beliefs in this way, I have extended the one period reasoning to the two-period case. This extended criterion is equivalent to the requirement that equilibrium outcomes remain such after the removal of strategies that are strictly inferior to an associated equilibrium strategy.

Let $\widetilde{W}_B$ define the wage that equates expressions (16) and (17).

The equilibrium payoff for the good type is:

$$(18)\quad \pi(w^*_{p1}, G) + (1-p)\pi(w^*_{p2}, G) + p\pi((1-p)L, B).$$

If it deviates, and the worker believes that the deviation was made by the good type (regardless of period 1 job quality or the period 2 offer), its payoff is:

$$(19)\quad \pi(w, G) + \pi((1-p)L, G).$$

Let $\widetilde{W}_G$ define the wage that equates expressions (18) and (19).

Regardless of worker beliefs, a deviation greater than $\widetilde{W}_q$, yields a lower payoff to the type q firm than the conjectured equilibrium. If, and only if, $a < (1-p)$, the wage $\widetilde{W}_G$ exceeds $\widetilde{W}_B$ (the proof is similar to that of Lemma 1). If there is a deviation in the interval $[\widetilde{W}_B, \widetilde{W}_G)$, the worker infers that the deviation was made by the good type. Given these beliefs, the good type obtains a higher payoff from deviation than from its equilibrium strategy, overturning the conjectured pooling equilibrium. In this parameter space, no pooling equilibrium satisfies the (extended) Intuitive Criterion.[11]

On the other hand, where $a \geq (1-p)$, the wage $\widetilde{W}_B$ is weakly greater than $\widetilde{W}_G$. Any deviation that yields the bad type a lower profit than the conjectured equilibrium, also yields a lower profit for the good type. In this case, the Intuitive Criterion does not reduce the set of equilibria.

Proposition 1

1. *If $a < (1-p)$, and beliefs satisfy the (extended) Intuitive Criterion, then there exists a unique outcome such that $w^*_{G1} = W_B > w^*_{B1} = L$, and $w^*_{G2} = (1-p)L < w^*_{B2} = L$.*

2. *If $a \geq (1-p)$, there is a continuum of pooling introductory wage equilibria such that $(1-zp) \leq W^*_{p1} < W'_G$. In the second period, if period 1 job quality was low, the wages are $(1-z'p)L \leq W^*_{p2} < L$; and if it was high, $W^*_{G2} = (1-p)L$.*

[11] Mixed strategy equilibria can be ruled out in a similar fashion.

2.7 Discussion

In the separating equilibria, the introductory compensating differentials have the opposite sign to the usual Smith/Rosen case; workers with lower expected quality jobs are paid less—not more. In the first period, the market rewards workers with more desirable jobs.[12]

Separation is possible in this game because the good type is more likely to stay than the bad type. As noted earlier, this occurs only if the good type's fixed costs are lower. Assumption (A1) simplifies the analysis by ensuring that (even in a pooling equilibrium) the bad type exits with probability $(1-a)$; but, the good type always stays. If I had assumed that the good type's probability of exit was (weakly) greater than the bad type's, all equilibria would have been pooling. In these equilibria, workers cannot distinguish between the two types prior to employment, and the introductory wages are independent of job quality. Notice that, typically the worker does not receive reservation utility, $(1-zp)L$. In fact, the upper bound to the set of pooling equilibria exceeds the bad type's post-separation offer, L.

In both types of equilibria, the firm makes wage offers according to the labour demand schedule. Hence, signalling also impacts on employment levels; any offer above the market clearing level causes introductory-period employment to fall. For example, in the separating equilibrium of Proposition 1, the good type employs fewer workers than if its type were known: $g(W_B) < g((1-p)L)$.

The intuition behind the model is straightforward. Introductory wage offers affect inexperienced worker's beliefs about job quality. Realising this, a firm may resist cutting wage offers to market clearing levels, impacting on employment.

The model can be generalised in a number of ways. For instance, the game can easily be extended to the multi-firm case. Suppose that each firm has a pool of labour (perhaps defined by geographical location or by worker type) to which it alone makes wage offers. Then, with respect to its own pool, each firm

[12]Note that, in a separating equilibrium, wages at a good firm fall through time. I have abstracted from human capital and monitoring considerations that usually ensure an upward sloping wage profile.

behaves as described above. Jobs at good firms do not pay lower introductory wages.[13]

It is also straightforward to allow for more than two periods. As in the two-period game, separation can occur through the introductory wage offer. In any post-separation period, the wage offered is $(1-p)L$ for the good type, and L for the bad type. Alternatively, the equilibria may be pooling. Then, the workers update their beliefs in each post-introductory period exactly as in period 2 of the above game.

Recent work by Mester (1992) suggests another direction in which the model could be extended. In his multi-period, product-market game, the firm has private information which varies through time. This causes "perpetual signalling"—(through pricing) separation can occur in post-introductory periods. In future work, I intend to address the analogous job quality signalling case.

2.8 Conclusions

In this chapter, I have demonstrated, by analysing a specific two-type, two-period example, that introductory wage offers can inform workers about the quality of experience jobs. In this game, the good type offers higher expected quality jobs than the bad type. If the good type is less likely to exit, the game has many equilibria with separating wages. In each of these, the introductory compensating differentials have the opposite sign to the usual Smith/Rosen case: higher expected quality jobs pay more, rather than less. I have also shown that there are pooling equilibria. In this case, the introductory wages are independent of job quality. I have demonstrated that, for some parameter space, the (extended) Intuitive Criterion renders a unique separating equilibrium.

The intuition captured by the model is straightforward. Wage offers affect inexperienced worker's beliefs about job quality. Realising this, the firm resists cutting wage offers to market clearing levels.

This paper has important implications for empirical work on compensating

[13] However, allowing a firm to compete for workers in another firm's pool considerably complicates the analysis.

differentials. Workers with experience jobs are not paid the Smith/Rosen compensating differentials associated with search jobs. Hence, it is unsurprising that many studies report mixed support for the theory (for example, Smith (1976), Brown (1980) and Meng (1989)).

Chapter 3

Compensating Differentials: Some Canadian Self-Report Evidence

3.1 Introduction

The theory of compensating differentials, originally due to Adam Smith [89] and subsequently formalised by Rosen [81], predicts that less desirable jobs pay a wage premium. Smith's own example was the executioner: a distasteful job that paid more than comparable trades.

In this chapter, I present Canadian evidence that tests and supports the theory of compensating differentials for a variety of job characteristics. Previous Canadian studies, such as those by Meng [64 and 65], Martinello and Meng [62], and Cousineau et al [22] have found support for the theory for risk of injury or death. But no previous research has found Canadian evidence of compensating wage payments for non-hazardous job characteristics.

The data used in this study come from the National Survey of Class Structure and Labour Process in Canada (NSCS). These unique data, which are cross-sectional and relate to 1981 incomes, provide detailed self-report information about the respondents' job quality and personal characteristics.

Meng's [64] study of compensating differentials also used this data set. However, to measure job quality, Meng used occupational-trait data developed by Statistics Canada and Employment and Immigration Canada, rather than the self-report information contained in the Survey. The use of occupational-trait data is quite common in the compensating differential literature; this approach has also been used by (among others) Brown [17], Garen [35] and Biddle and Zarkin [15]. Unfortunately, as Smith [92] has noted, occupational-trait data provide information on averages across broad occupational categories and industries, introducing error into the job quality variables. Using self-report data avoids this problem.

After controlling for personal characteristics, I find evidence of compensating differentials for working with data, working with hands, bureaucratic procedures, and responsibility over other workers. I also find evidence of differentials for the control of hours and pace. Although these characteristics are generally held to be desirable, I find that they are associated with higher, rather than lower, earnings. That is, the coefficients have the "wrong" signs. I find no evidence of differentials for working with people, working with machines and the freedom to design work.

Most researchers have used Ordinary Least Squares (OLS) to estimate an hedonic earnings or wage equation. However, Viscusi [98], Garen [35], Biddle and Zarkin [15] and Kostiuk [53] have argued that job quality is endogenous. If job quality is a normal good, richer workers will choose higher quality jobs. This effect causes the estimated coefficients on the job quality variables to be biased downwards. In studies with a small number of continuous job characteristics, endogeneity can be easily dealt with by using instrumental variables. However, in cases in which there are many, binary job quality variables—such as this one—this is impossible. For this reason, I first construct and then instrument for an aggregate job quality index in the earnings equation. I also estimate a more general model, suggested by Garen [35], in which productivity is a function of job quality. The results confirm the existence of compensating differentials for undesired job characteristics.

The theory of compensating differentials is based upon the notion of competitive labour markets. The observed relationship between job quality and wages is the result of sorting by both workers and firms. An alternative theory of wage determination is that the labour market is characterised by non-competitive behaviour, that prevents matching. This may be particularly true of the unionised sector—one interpretation of union behaviour being that they reduce the variation in their members' earnings—but may also hold for non-unionised workers. For both types of workers, firm's pay evaluation schemes often dictate wages, rather than allowing competitive forces to prevail. An important finding of this chapter is that labour markets are sufficiently competitive for compensating differentials to be important determinants of earnings, regardless of the gender or union status of the workers.

The rest of the chapter is organised as follows. In the following section, I review the related literature. In Section 3.3, I set out the empirical model and provide details of the data. I present my results in Section 3.4. In Section 3.5, I draw some conclusions, and make some suggestions for subsequent research.

3.2 Related Literature

A number of researchers have surveyed the empirical literature on compensating differentials. Smith [92], Rosen [82], Digby and Riddell [24], Jones-Lee [47], Moore and Viscusi [69] and Viscusi [104] all provide excellent reviews.

Many studies have found a positive relationship between earnings and both fatality and injury rates. Examples include the US studies by Viscusi [100], and Olson [75]; and the Canadian studies by Cousineau et al [22], and Martinello and Meng [62].

Outside the value of workplace safety literature, the support for compensating differentials in multi-characteristic studies is weaker. In particular, Smith [92] and Brown [17] have found little support on US data. In the only Canadian study (on non-hazardous characteristics), Meng [64] has found similar results for Canada. On the other hand, the US study by Lucas [59] is broadly supportive, as is one by McNabb [63] on UK data. All of these studies have used male workers; appropriate data for females are very scarce.

A number of studies have examined the impact of unionisation on compensating differentials. Since unions are in a better position to monitor job quality than individual workers, one might expect larger differentials for unionised workers. But unions also tend to reduce the variance in wages of their members—creating an offsetting effect. A number of US researchers, including Duncan and Stafford [30], Olson [75] and Fairris [31] have found that unionised workers do receive larger compensating differentials. However, using British data Marin and Psacharopoulos [61] have found that they receive smaller premia; as has Meng [64] using Canadian data.

Like this study, Meng [64] also used data from the NSCS. This survey provides detailed, self-report information about the job quality and personal characteristics of the respondents. Meng used only the information on personal characteristics. To capture job quality, he used occupational-trait data developed by Statistics Canada and Employment and Immigration Canada. The use of occupational-trait data is quite common in the compensating differential literature; the approach has also been used by (among others) Brown [17], Garen [35] and Biddle and Zarkin [15]. Unfortunately, as Smith [92] has noted, occupational-trait data provide information on averages across broad occupational categories and industries, introducing error into the job quality variables. Within an occupational title, the tasks involved can be extremely varied. For example, the term "general labourer" can cover a variety of jobs. In some circumstances, a labourer may have to work with machines, in others (s)he may not. Job quality may also vary greatly with location; for example, the characteristics of a police officer's job depend heavily on the allotted "beat". Quality may also vary with industry. An engineer in the mining industry may experience different working conditions from one in the service sector. Using self-report data avoids these problems since the data are (by definition) job specific, but at the cost of objectivity. This could be a problem if respondents with lower pay (falsely) report dissatisfaction with non-pecuniary job characteristics—introducing a spurious correlation between wages and job quality.

Brown [17] and Duncan and Holmlund [29] have noted the omitted variable bias caused by unobserved worker ability. Ability is likely to be negatively correlated with desirable job characteristics, causing the estimates of the compensating differentials to be biased downwards. Estimating fixed effect wage equations mitigates this bias, but is impossible for the (cross-sectional) NSCS data.

Most researchers have used Ordinary Least Squares (OLS) to estimate an hedonic earnings or wage equation. Viscusi [98], Garen [35], Biddle and Zarkin [15] and Kostiuk [53] have argued that the job quality variables—which appear on the right-hand side—may be endogenous. If job quality is a normal good, richer workers will choose higher quality jobs. This effect causes the estimated coefficients on the job quality variables to be biased downwards. With a small number of job characteristics, a simple way to deal with this problem is to instrument for the endogenous variables in the earnings equation. Unfortunately, this is impossible if there are many, dichotomous job quality variables—as there are in this case. (Hence, I instrument for an aggregate job quality index in the earnings equation.)

Garen [35] has noted that a worker's productivity may be a function of job quality. For example, some individuals may possess an unobserved characteristic (perhaps, dexterity) that makes them particularly productive when working with their hands. In this case, the instrumental variables technique yields biased estimates. Garen [35] has shown that consistent estimates can be obtained by constructing the predicted residuals from an OLS job quality equation, and including them, together with an interaction term, into the wage equation.

3.3 Model and Data

This study is based upon the following earnings equation:

$$(20)\quad lnY = \alpha_0 + \sum_{i=1}^{m} \alpha_i PC_i + \sum_{j=m+1}^{z} \alpha_j Q_j + \epsilon,$$

where Y denotes hourly earnings, PC_i a series of personal characteristics; and Q_j a series of job quality variables. A full list of these variables and their means are given in Table 1.[14]

All data are taken from the NSCS, a cross-sectional survey that contains information on approximately 3,000 respondents. The survey was carried out by Canada Facts, who conducted face-to-face interviews. I exclude workers over 64 and under 18, and anyone with non-positive 1981 earnings or hours worked per week. After removing the self-employed, who were not asked many of the job quality questions, and those who did not work year round, the final sample is 993.

[14] Means by sex and union status together with the means of the variables used to instrument for job quality are given in Appendix 1.

Table 1:
Variable definitions and means

Name	Definition	Mean
Individual characteristics		
ANY	Annual income	\$22,685
WY	ANY per week	\$435.08
Y	WY per hour usually worked	\$11.29
ln Y	Natural log of Y	2.27
EDUC	Years of education	12.91
AGRADE	Attained GRADE = 1; otherwise = 0	0.09
ASOME	Attained SOME = 1; otherwise = 0	0.17
AHIGH	Attained HIGH = 1; otherwise = 0	0.18
ACOLL	Attained COLL = 1; otherwise = 0	0.36
ABACH	Attained BACH = 1; otherwise = 0	0.13
APOST	Attained POST = 1; otherwise = 0	0.07
EXP	Experience in years	17.95
EXP2	EXP squared	481.68
UNION	Union member = 1; otherwise = 0	0.46
TEN	Years of tenure with present employer	7.78
TEN2	TEN squared	125.52
BIL	Bilingual = 1; otherwise = 0	0.19
SEX	Male = 1; otherwise = 0	0.54
Location		
ATL	Atlantic =1; otherwise = 0	0.08
QUE	Quebec = 1; otherwise = 0	0.29
ONT	Ontario = 1; otherwise = 0	0.36
PRA	Prairies = 1; otherwise =0	0.15
BC	British Columbia = 1; otherwise = 0	0.12
CITY	Community $> 100,000$ = 1; otherwise = 0	0.62
Job characteristics		
CDESN	Control design of work = 0; otherwise = 1	0.49
CHRS	Control hours of work = 0; otherwise = 1	0.72
CPACE	Control pace of work = 0; otherwise = 1	0.53
RESP	Responsibility over others =1; otherwise = 0	0.38
BUR	Bureaucratic procedures = 1; otherwise = 0	0.50
HANDS	Work with hands = 0; otherwise = 1	0.47
PEOPLE	Work with people = 0; otherwise = 1	0.34
DATA	Work with data = 1; otherwise = 0	0.52
MACHINES	Work with machines = 1; otherwise = 0	0.75
Q	Job quality index	4.70

The hourly earnings variable is constructed as follows. Respondents to the NSCS were asked to estimate their personal income in 1981, and the number of hours usually worked per week. Having removed from the sample those who did not work year round, I calculate the earnings per hour usually worked.

The human capital variables are years of education and six dummies reflecting the highest level of schooling achieved. The dummy variables are as follows: grade school diploma or less (AGRADE), some high school (ASOME), completed high school (AHIGH), college/vocational school (ACOLL), bachelor's degree (ABACH), and postgraduate/professional degree (APOST).

As mentioned earlier, the unique feature of these data is the quantity of job quality information. The respondents were asked a series of questions about their self-control in the job including whether they could: design their own work; decide their hours worked; and adjust their pace of work. They were also asked about their responsibility for other workers and the control others have over them in the form of written bureaucratic procedures. In addition, there were a battery of questions about "job complexity": whether the job required working with hands, people, information and machines. These last questions are particularly interesting. Some researchers have looked at the compensating differentials paid for working with machines; but not for these other aspects of job complexity.

The drawback to using this self-report data is that the information is based upon individual assessments of job quality. They are, by definition, subjective.

The sign of the coefficients on the job quality variables is a controversial (and much discussed) issue in the literature. The coefficients should reflect the preferences of the marginal worker; if that worker finds the characteristic undesirable, the coefficient should be positive. The researcher may have some a priori beliefs about the marginal worker's preferences—perhaps based upon his/her own preferences—but these are very imprecise. A characteristic that I find desirable, such as bureaucratic procedures, the marginal worker may find attractive. The issue is further clouded by the possibility of omitted variable bias. Some of the job characteristics could be correlated with some unobserved aspects of ability, biasing the coefficients. For example, in some firms' job evaluation plans, "autonomy" is associated with higher payments in order to reward more able workers. Hence, the coefficients on the self-control variables may be biased.

I construct the job characterisitics dummies such that each variable takes the value one in what I expect to be (a priori) the undesirable state. The aggregate job quality index is simply the sum of the job characteristic variables; the index has a maximum score of 9 and a minimum of zero. I also constructed a job quality index using the coefficients from an OLS earnings equation as weights. However, the results are largely similar to those using the simple (unweighted) index, and so are not reported.

3.4 Results

The results are presented in Tables 2 and 3.[15]

The first column of Table 2 includes only the personal characteristics of the respondents. Column (2) includes these and the job quality variables. The third column includes the same personal characteristics as Column (2), but the job quality variables are replaced with the aggregate index, Q. The fourth column includes an instrumental variable for the job quality index, $\hat{Q}$. The OLS job quality regression used to construct the instrument is shown in Appendix 1, Table C. To capture the impact of job quality on marginal productivity (Garen's model), the fifth column includes the aggregate index Q, together with the predicted residuals from the job quality equation, $\hat{\eta}$, and an interaction term, $Q \cdot \hat{\eta}$. The final column includes the same variables but uses White's [109] correction for heteroskedasticity.

From the first column of Table 2, it is apparent that the variables for the personal characteristics are generally significant at the 10% level, and have the expected sign. However, the location dummies are insignificant, apart from those for living in British Columbia (BC) and living in a city (CITY), which

[15] I have used sample weights that reflect the population by region and household size. The results from unweighted regressions are similar.

Table 2:
Regression equations; dependent variable ln Y

Variable	(1)	(2)	(3)	(4)	(5)	(6)
EDUC	0.038	0.030	0.038	0.041	0.042	0.036
	(5.298)	(4.246)	(5.302)	(5.648)	(5.718)	(4.958)
AGRADE	-0.241	-0.160	-0.241	-0.228	-0.227	-0.256
	(-3.460)	(-2.321)	(-3.453)	(-3.278)	(-3.271)	(-3.877)
ASOME	-0.166	-0.141	-0.167	-0.169	-0.170	-0.185
	(-3.208)	(-2.791)	(-3.208)	(-3.276)	(-3.295)	(-3.485)
ACOLL	0.015	-0.218	0.138	-0.018	-0.016	-0.012
	(0.332)	(-0.498)	(0.312)	(-0.403)	(-0.361)	(-0.261)
ABACH	0.119	0.045	0.121	0.187	0.193	0.234
	(1.919)	(0.721)	(1.937)	(2.829)	(2.926)	(3.331)
APOST	0.261	0.167	0.263	0.330	0.323	0.311
	(3.184)	(2.060)	(3.196)	(3.874)	(3.802)	(3.807)
EXP	0.023	0.021	0.023	0.023	0.023	0.018
	(5.032)	(4.643)	(5.027)	(4.960)	(4.922)	(3.706)
EXP2	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000
	(-3.297)	(-3.236)	(-3.290)	(-3.124)	(-3.130)	(-2.325)
UNION	0.112	0.182	0.109	0.006	0.005	-0.041
	(3.702)	(5.464)	(3.457)	(0.126)	(0.108)	(-0.885)
TEN	0.023	0.022	0.022	0.022	0.007	0.015
	(4.009)	(3.912)	(4.000)	(3.763)	(0.884)	(1.630)
TEN2	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
	(-3.518)	(-3.527)	(-3.509)	(-3.285)	(-3.203)	(-3.226)
BIL	0.058	0.038	0.058	0.073	0.077	0.082
	(1.352)	(0.911)	(1.359)	(1.694)	(1.804)	(1.862)
SEX	0.307	0.267	0.307	0.313	0.315	0.332
	(9.980)	(8.569)	(9.979)	(10.19)	(10.29)	(10.39)

Table 2 cont.						
Variable	(1)	(2)	(3)	(4)	(5)	(6)
ATL	-0.071	-0.052	-0.071	-0.085	-0.072	-0.052
	(-1.198)	(-0.896)	(-1.204)	(-1.441)	(-1.221)	(-0.839)
QUE	0.001	0.012	0.001	-0.002	-0.006	0.006
	(0.014)	(0.294)	(0.012)	(-0.055)	(-0.147)	(0.145)
PRA	0.053	0.059	0.053	0.060	0.059	0.030
	(1.147)	(1.317)	(1.151)	(1.302)	(1.272)	(0.605)
BC	0.093	0.100	0.092	0.089	0.093	0.133
	(1.853)	(2.048)	(1.850)	(1.784)	(1.878)	(2.598)
CITY	0.072	0.076	0.072	0.079	0.083	0.063
	(2.275)	(2.465)	(2.280)	(2.513)	(2.639)	(1.957)
CDESN		-0.030				
		(-0.877)				
CHRS		-0.083				
		(-2.177)				
CPACE		-0.076				
		(-2.380)				
RESP		0.104				
		(3.179)				
BUR		0.052				
		(1.675)				
HANDS		0.084				
		(2.569)				
PEOPLE		-0.580				
		(-0.166)				
DATA		0.124				
		(3.757)				
MACHINES		0.016				
		(0.447)				

Table 2 cont.						
Variable	(1)	(2)	(3)	(4)	(5)	(6)
Q			0.003		0.107	0.122
			(0.293)		(2.373)	(2.428)
$\hat{Q}$				0.127		
				(2.849)		
$\hat{\eta}$					-0.067	-0.048
					(-1.237)	(-0.803)
$Q \cdot \hat{\eta}$					-0.015	-0.017
					(-2.298)	(-2.387)
$Q \cdot TEN$					0.003	0.002
					(2.431)	(1.182)
CONSTANT	1.147	1.232	1.131	0.556	0.665	0.690
	(10.21)	(9.902)	(9.154)	(2.361)	(2.797)	(2.714)
N	993	993	993	993	993	993
$\bar{R}^2$	0.350	0.393	0.349	0.355	0.361	0.344

Note: t-statistics in brackets

have positive coefficients. Meng [64] found broadly similar results for these variables.

The inclusion of the job quality variables, Column (2), reveals some support for the theory of compensating differentials, but not for all job attributes. Support for the self-control variables is particularly weak. Control of hours (CHRS) and control of pace (CPACE) are significant at the 10% level, but the coefficients are incorrectly signed. The other self-control variable, for designing work (CDESN), is insignificant and incorrectly signed. One interpretation of these results is that the marginal worker does not require compensation for self-control characteristics. Alternatively, these variables may be correlated with some omitted variable, such as ability, biasing the estimated coefficients.

Support is stronger for the responsibility (RESP) and bureaucratic procedures (BUR) variables: the coefficients on both of these have the anticipated (positive) sign. Both are significant at the 10% level.

The dummy variables for working with hands (HANDS), and for working with data (DATA) are also significant at the 10% level. As expected, the coefficients on these variables are positive. There appear, however, to be no differentials for working with people (PEOPLE) or working with machines (MACHINES).

Unfortunately, including the job quality index instead of the individual characteristics, Column (3), contradicts this support for the theory of compensating differentials. The index variable is insignificant, and the coefficient rather small. However, the instrumental variable, included in Column (4) is significant, with a correctly signed coefficient. This suggests that the OLS estimates were biased by endogeneity and that job quality is a normal good: richer workers choose higher quality jobs.

The specification proposed by Garen [35] is shown in Column (5). This allows for the fact that productivity is likely to be a function of job quality. The estimated job quality coefficient is smaller than in the instrumental variable case, but much larger than the OLS estimate. The negative sign on the $\hat{\eta}$ term confirms that job quality is a normal good: richer workers choose better jobs. (If the coefficient had been positive, lower job quality would have been associated with higher earnings—suggesting that job quality was an inferior good.) The negative sign on the $Q \cdot \hat{\eta}$ term indicates that workers with unobserved returns to low quality jobs choose more desirable jobs. The interaction term involving job quality and tenure, $Q \cdot TEN$, has a positive coefficient: more senior workers receive larger compensating payments for undesirable characteristics.

The Breusch-Pagan test indicates that the null hypothesis of homoskedasticity is rejected at the 5% level. The heteroskedasticity-corrected regression, Column (6), has a slightly larger job quality coefficient, but gives broadly similar results.

The four columns of Table 3 give the (heteroskedasticity-corrected) results for the male, female, union and non-union sub-samples respectively. The results in Columns (1) and (2) reveal substantial differences between the earnings equations for male and female workers.[16] In common with many other studies, I find that the returns to years of education are lower for females; however,

[16]An F-test of the hypothesis that there is no difference between the male and female coefficients is rejected at the 5% significance level.

the coefficients on the education level dummies are larger in absolute value.[17] Unlike for females, job quality is insignificant for males. However, in both cases, job quality has important interaction effects—even if job quality does not have direct effects on earnings, it has indirect effects.

Columns (3) and (4) reveal considerable differences between the earnings equations for union and nonunion workers.[18] Since workers self-select into union coverage, I include a selectivity term (λ) in the earnings equations. This is constructed from a probit estimate of union status (shown in Appendix 1). I find that for the union sector the regression constant is larger, and that the returns to years of education (EDUC) and tenure (TEN) are smaller, as is the wage premium for being male (SEX). Hence, there is some support for the notion that unions reduce the variance in their members' earnings. Job quality is insignificant for union workers, but significant for non-union workers. Again, job quality has important interaction effects.

It seems that the theory of compensating differentials—based upon the notion of competitive labour markets—is an important determinant of earnings for males, females, union and non-union workers. Even though some labour markets may be non-competitive, the sorting process betweeen workers and firms is sufficiently strong for the theory to be meaningful.

In the previous chapter, I have argued that the Smith/Rosen theory of compensating differentials is sensitive to the assumed information structure. If workers have difficulty learning job quality, firms may signal this private information through wage offers. In these circumstances, more desirable jobs may pay higher, rather than lower, wages. In an attempt to analyse this issue, I estimate compensating differentials for sub-samples of senior workers. The results for workers with greater than 1, 3 and 5 years of tenure are shown in Appendix 1, Table D, Columns (1), (2) and (3) respectively. Because more senior workers are better informed about job quality, their wages may be less influenced by signalling. However, I find little evidence of this; the estimated compensating

[17] See Gunderson and Riddell [38] for a review of the literature on male/female earnings differentials.

[18] A test of the hypothesis that there is no difference between the union and nonunion coefficients is rejected at the 5% significance level.

Table 3:
Regression equations; dependent variable ln Y

Variable	(1)	(2)	(3)	(4)
EDUC	0.040	0.030	0.023	0.048
	(4.214)	(2.539)	(2.990)	(3.299)
AGRADE	-0.244	-0.269	-0.099	-0.376
	(-3.321)	(-1.971)	(-1.241)	(-3.454)
ASOME	-0.126	-0.216	-0.146	-0.200
	(-1.894)	(-2.351)	(-1.938)	(-2.716)
ACOLL	0.011	0.001	0.032	-0.027
	(0.178)	(0.011)	(0.532)	(-0.398)
ABACH	0.147	0.284	0.234	0.164
	(1.626)	(2.767)	(2.784)	(1.532)
APOST	0.212	0.454	0.300	0.255
	(2.162)	(3.016)	(3.124)	(2.083)
EXP	0.029	0.008	0.010	0.023
	(4.799)	(0.973)	(1.727)	(3.067)
EXP2	-0.000	-0.000	-0.000	-0.000
	(-3.245)	(-0.664)	(-1.164)	(-1.847)
UNION	-0.056	0.082		
	(-0.961)	(1.332)		
TEN	0.008	0.034	-0.005	0.026
	(0.827)	(1.731)	(-0.536)	(1.960)
TEN2	-0.001	-0.001	-0.000	-0.001
	(-2.366)	(-2.747)	(-0.345)	(-3.789)
BIL	0.138	-0.017	0.128	0.049
	(2.576)	(-0.230)	(2.298)	(0.759)
SEX			0.241	0.387
			(5.985)	(7.649)

Table 3 cont.				
Variable	(1)	(2)	(3)	(4)
ATL	-0.043	-0.076	-0.067	-0.032
	(-0.661)	(-0.659)	(-1.100)	(-0.332)
QUE	-0.034	0.067	-0.010	-0.038
	(-0.697)	(0.878)	(-0.188)	(-0.567)
PRA	-0.009	0.035	0.000	0.021
	(-0.015)	(0.454)	(0.003)	(0.309)
BC	0.241	-0.037	0.144	0.110
	(3.559)	(-0.477)	(1.972)	(1.511)
CITY	0.026	0.094	0.033	0.087
	(0.702)	(1.592)	(0.835)	(1.862)
Q	0.054	0.109	0.047	0.071
	(0.927)	(1.778)	(1.007)	(1.775)
$\hat{\eta}$	0.011	0.011	-0.066	0.059
	(0.163)	(0.127)	(-1.094)	(0.790)
$Q \cdot \hat{\eta}$	-0.015	-0.026	-0.000	-0.032
	(-2.112)	(-1.894)	(-0.035)	(-3.017)
$Q \cdot TEN$	0.002	0.001	0.003	0.003
	(1.266)	(0.212)	(2.374)	(1.181)
λ			0.052	-0.034
			(1.183)	(-0.530)
CONSTANT	1.215	0.851	1.358	0.659
	(4.024)	(2.639)	(5.048)	(1.666)
N	569	424	449	544
$\bar{R}^2$	0.301	0.230	0.272	0.377

Note: t-statistics in brackets

differentials for cut-off points less than 5 years are similar to those for the full sample. For more senior workers, the job quality terms are insignificant.

3.5 Conclusions

In this chapter, I have presented Canadian evidence that tests and supports the theory of compensating differentials for a variety of job characteristics. Previous Canadian studies, such as those by Meng [64 and 65], Martinello and Meng [62], and Cousineau et al [22] have found support for the theory for risk of injury or death. This is the first study, however, to have found Canadian evidence of compensating wage payments for non-hazardous characteristics.

By exploiting the self-report information contained in the NSCS, I have avoided using the occupational-trait data used by Meng [64]. Occupational-trait data provide information on averages across broad occupational categories and industries, introducing error into the job quality variables.

After controlling for personal characteristics, I have found evidence of compensating payments for working with data, working with hands, bureaucratic procedures, and responsibility over other workers. I have also found evidence of differentials for the control of hours and pace, though the coefficients are incorrectly signed. No evidence of differentials was found for working with people, working with machines or for the freedom to design work. I have also found evidence supporting the theory using a job quality index constructed from the various job characteristics.

Chapter 4

The Great Canadian Training Robbery

4.1 Introduction

The mismatch between the skill requirements of jobs and the educational attainments of workers has long concerned social scientists. In his seminal work, "The Great Training Robbery", Ivar Berg [14] argued that overeducated workers may be less productive than their less skilled counterparts because they become bored with their jobs and lose motivation. A similar view was expressed by Freeman [33 and 34] who coined the phrase "the overeducated American". Some researchers, (among others) Kuttner [57], Picot et al [77] and Bluestone and Harrison [16] argued that the incidence of skill or educational mismatch (hereafter, I use the terms interchangeably) is increasing.[19] Industrial restructuring has caused a number of traditional, medium- to high-skill jobs to disappear—the so-called "declining middle"—forcing many skilled workers into low-skill, service-sector jobs.

Despite the widespread concern over educational mismatch, there have been few studies of its impact on earnings; data sets rarely contain information on both the educational attainments of workers and the requirements of jobs. A small number of studies have used either US or Dutch data; but there have been no previous Canadian studies. Duncan and Hoffman [28], Rumberger [84], Hersch [43] and Sicherman [87] have estimated earnings (or wage) equations including both the years of required schooling for the job, and the years of over- or undereducation. These researchers found strong evidence that the earnings of overeducated workers are greater than their counterparts with exactly the

[19] The term "skill mismatch" is sometimes used to refer to differences between the kind of skills required by firms and those attained by unemployed workers. In this chapter, however, I use the term to refer to differences between required and attained levels of education.

required level of schooling; and, that the earnings of undereducated workers are lower. (Hereafter, I shall refer to workers who are not mismatched, but are in jobs with the same educational requirements as "otherwise identical".) Assuming earnings reflect marginal productivity, their results so not support Berg's [14] hypothesis: overeducated workers earn more—not less—than otherwise identical workers.

In this chapter, I use Canadian data from the National Survey of Class Structure and Labour Process in Canada (NSCS) to estimate the returns to educational mismatch. I measure both education and educational mismatch in terms of discrete levels of achievement, rather than years of schooling. I find that the returns to over- and undereducation are sensitive to the level of required education. There is evidence of positive returns to overeducation for jobs that require a university bachelor's degree; but, in general, the returns are insignificant. I find evidence of lower pay for undereducated workers with low education requirements. I also estimate separate equations for male and female workers. Although I find that the results for the male sub-sample are similar to the full sample, I find that the returns to over- and undereducation for females are insignificant for all levels of required education.

For Canadian policy makers concerned with the returns to education, these results are a mix of good and bad news. On the one hand, the hypothesis that overeducated workers have identical earnings to otherwise identical workers cannot (in general) be rejected, so the Canadian evidence does not support Berg's [14] claim. In Canada, overeducated workers do not receive lower earnings than otherwise identical workers. On the other hand, those workers with educational attainments in excess of requirements do not receive the full returns to their attained education: their earnings would have been higher in a job with requirements that matched their attainments. This finding will concern policy makers: rising educational attainments are insufficient to guarantee higher earnings for workers.

Evidently, job requirements or "pigeonholes" are important determinants of earnings—and particularly so for females. This chapter, therefore, offers some support for Thurow's [94] claim that marginal productivity resides in the job, rather than in the individual characteristics of the worker.

The rest of the chapter is organised as follows. In the following section, I review the related literature. In Section 4.3, I discuss the incidence of educational mismatch. I set out the empirical model in Section 4.4; and present the results in Section 4.5. I draw some conclusions in the final section.

4.2 Related Literature

As already noted, the literature on skill mismatch can be traced back to Ivar Berg [14]. He argued that if highly trained workers perform low-skill jobs, they become bored, and their productivity falls below that of their less-skilled counterparts.

Economists in the US and Canada became concerned about this issue in the 1970s, when increases in educational attainments coincided with declines in the monetary returns to education. Freeman [33 and 34], coining the phrase "the overeducated American", argued that the entry of the "baby-boom" generation into the labour force caused an increased supply of highly educated workers. At the same time, the demand for these workers fell, forcing many of them into jobs with lower educational requirements. Dooley [27] identified similar demographic and demand-side changes in Canada.

There have been a number of studies concerned with recent industrial restructuring which suggest educational mismatch has been increasing. Kuttner [57], Picot et al [77] and Bluestone and Harrison [16] have argued that many traditional, high-skill jobs are disappearing—the so-called "declining middle"—displacing some skilled labour into low-pay, low-skill jobs in the personal services and retail trades (see Gunderson and Riddell [38]). As a result, there has been some increase in wage polarisation.

Despite the widespread concern over educational mismatch, there have been very few studies of its impact on earnings; data sets rarely contain information on both the educational attainments of workers, and the requirements of jobs. A small number of studies have used either US or Dutch data; but, there have been no previous Canadian studies. Duncan and Hoffman [28], Rumberger [84], Hersch [43] and Sicherman [87] have estimated earnings (or wage) equations including both the years of required schooling, and the years of over- or undereducation. These researchers found strong evidence that the earnings of overeducated workers are higher than the earnings of otherwise identical, non-mismatched workers; and, that the earnings of undereducated workers are lower. Assuming that earnings reflect marginal productivity, their studies do not support Berg's [14] proposition.

Most researchers have measured skill mismatch by years of schooling. Using a (small) Dutch data set, Hartog [41] has estimated a model in which educational attainments and requirements are measured by discrete "levels" of difficulty—such as graduating from high school or completion of an undergraduate degree. In the labour market, education is usually measured in this way—job advertisements usually specify education levels rather than years of schooling. Hartog found that the returns to educational mismatch varied with required education; and that over- (under-) educated workers generally earned more (less) than otherwise identical workers.

Only two previous studies have examined male-female differences in the returns to skill mismatch. Using US data, Duncan and Hoffman [28] found positive, significant returns to overeducation for both sexes; and, negative, significant returns to undereducation for males. In a subsequent study, Hartog and Oosterbeek [42] found similar results using a small sample of Dutch workers; but, in addition, found negative, significant returns to undereducation for females.

In this chapter, using Canadian data, I find that for males the returns to under- and overeducation vary with the level of required education. For females, I find that the returns to both under- and overeducation are insignificant for all levels of required education.

4.3 The Incidence of Educational Mismatch

The data are taken from the NSCS, a cross-sectional survey that contains information on approximately 3,000 respondents. This survey was carried out by

Canada Facts, who conducted face to face interviews. I have excluded workers over 64 and under 18, and anyone with non-positive 1981 earnings or hours worked per week. After removing the self-employed, and those who did not work year round, the final sample is 993, of which 424 are female.

These Canadian data are unique in that respondents were asked about both their attained education, and the educational requirements for the job. The following question was asked about educational attainments: "What is the highest level of education you have completed?". The answers were categorised into six classes: grade school diploma or less (GRADE), some high school (SOME), completed high school (HIGH), college/vocational school (COLL), bachelor's degree (BACH), and postgraduate/professional degree (POST). The question asked about required education was: "What type of formal schooling is now normally required for people who do your type of work?". Individuals were defined as over- (under-) educated if their attained schooling was greater (less) than their required education. Since the second question inquired about schooling "now normally required", the resulting variable arguably understates (overstates) the extent of overeducation (undereducation)—education requirements have generally increased with time.

This self-report approach is preferable to Rumberger's [84] in which required schooling is measured by occupational means. Educational requirements can vary greatly within occupations. For example, the schooling requirements for a post as an economist can vary from an undergraduate degree for some private sector jobs, to a Ph.D. for academic jobs. Furthermore, Rumberger's measure was calculated from the Dictionary of Occupational Titles (DOT), which reports three distinct measures of "General Educational Development". Unfortunately, there is little consensus on how to aggregate these measures (see Cain and Treiman [18]).

The incidence of educational mismatch in the NSCS is described in Table 4. There are a number of striking features about these data. First, educational mismatch is a common phenomenon; but, the incidence of overeducation (males 30%, females 32%) is greater than the incidence of undereducation (males 24%,

Table 4:
Incidence of Skill Mismatch

Attained	Required						
	GRADE	SOME	HIGH	COLL	BACH	POST	TOTAL
Males n=569							
GRADE	34	15	16	3	0	0	68
SOME	19	32	39	13	3	0	106
HIGH	8	23	47	10	11	4	103
COLL	12	15	56	72	13	4	172
BACH	0	2	4	10	51	5	72
POST	0	0	2	0	18	28	48
TOTAL	73	87	164	108	96	41	569
Females n=424							
GRADE	20	6	2	0	0	0	28
SOME	23	26	23	6	2	0	80
HIGH	8	7	54	9	3	0	81
COLL	2	11	58	71	16	2	160
BACH	0	3	7	8	40	1	59
POST	0	0	3	1	6	6	16
TOTAL	53	53	147	95	67	9	424

females 17%). Second, attained schooling is generally within one education level of required schooling; the incidence of skill mismatch outside this interval is small. Third, for both sexes, the peak in required schooling is at the HIGH level, but the peak in attained education is at COLL. Fourth, the distributions of attained and required education are flatter for males; the job market is particularly thin for females in the upper tail.

4.4 Empirical Model

Consider the following earnings equation:

$$(21)\quad lnY = \beta'\,PC + \alpha'\,REQ + \tau'\,OVER + \delta'\,UNDER + \epsilon,$$

where Y denotes hourly earnings, and PC a vector of personal characteristics (including a constant). The vector REQ contains one dummy variable for each required education level. The vectors $OVER$ and $UNDER$ contain dummy variables for over- and undereducation respectively; each variable corresponds to a specific required schooling level. It is, of course, possible to allow a dummy for each combination of attained and required education. Recall from Table 4, however, that required education is rarely more than one education level from attained education. Hence, such a model yields little additional insight.

A full list of the variables and their means are given in Table 5. The hourly earnings variable is constructed as follows. Respondents to the NSCS were asked to estimate their personal income in 1981, and the number of hours worked per week. After removing those who did not work year round, the earnings per hour usually worked is calculated.

If Berg's proposition is correct, the coefficients on the overeducation dummies should be negative.

4.5 Results

The results from the OLS regressions are presented in Table 6.[20] The first column includes only the personal characteristics of the respondents and the control variables. Column (2) includes these and the education variables from Equation (21). The third column includes the same variables as Column (2), but the sample is restricted to male workers; and the final column includes only females.

From the first column, it is apparent that the personal characteristic variables are generally significant at the 10% level (t-statistics in brackets), and have the expected sign. The occupational dummies are all significant; as are all the industry dummies, except public services (PUB). The dummy for retail and other services (RET) has a particularly strong (negative) impact on earnings.[21] The location dummies are insignificant, apart from those for living in British Columbia (BC) or living in a community with a population greater than 100,000 (CITY), which both have positive coefficients.

[20] I have used sample weights that reflect the population by region and household size. The results from unweighted regressions are similar.

[21] Using job characteristics (see the previous chapter) rather than occupational and industry dummies yields similar results.

Table 5:
Variable definitions and means

Name	Definition	Males	Females
Personal characteristics			
ANY	Annual income	$27,556	$16,866
WY	ANY per week	$528.49	$323.48
Y	WY per hour usually worked	$13.08	$9.15
ln Y	Natural log of Y	2.45	2.06
EXP	Experience in years	19.94	15.56
EXP2	EXP squared	561.84	385.92
UNION	Union member = 1; otherwise = 0	0.51	0.39
SEX	Male = 1; female = 0	1.00	0.00
TEN	Years of tenure with present employer	9.33	5.93
TEN2	TEN squared	162.97	80.79
BIL	Bilingual = 1; otherwise = 0	0.23	0.15
Industry			
EXTR	Extraction and construction = 1; otherwise = 0	0.08	0.02
MANUF	Manufacturing = 1; otherwise = 0	0.32	0.10
DIST	Distribution = 1; otherwise = 0	0.17	0.10
PUB	Public services = 1; otherwise = 0	0.24	0.40
INFO	Information services = 1; otherwise = 0	0.06	0.16
RET	Retail and other services = 1; otherwise = 0	0.13	0.21
Occupation			
PROF	Professional = 1; otherwise = 0	0.19	0.14
SEMI	Semi-professional = 1; otherwise = 0	0.16	0.17
SUPER	Supervisory = 1; otherwise = 0	0.07	0.03
SKILL	Skilled trade = 1; otherwise = 0	0.25	0.24
SEMUN	Semi-skilled and unskilled = 1; otherwise = 0	0.34	0.41
Location			
ATL	Atlantic = 1; otherwise = 0	0.08	0.09
QUE	Quebec = 1; otherwise = 0	0.33	0.25
ONT	Ontario = 1; otherwise = 0	0.36	0.35
PRA	Prairies = 1; otherwise = 0	0.12	0.18
BC	British Columbia = 1; otherwise = 0	0.11	0.12
CITY	Community $> 100,000$ = 1; otherwise = 0	0.58	0.65

Table 5 cont.

Name	Definition	Males	Females
Education			
EA	Attained education in levels	3.44	3.49
ER	Required education in levels	3.32	3.30
AGRADE	Attained GRADE = 1; otherwise = 0	0.12	0.07
ASOME	Attained SOME = 1; otherwise = 0	0.17	0.17
AHIGH	Attained HIGH = 1; otherwise = 0	0.17	0.18
ACOLL	Attained COLL = 1; otherwise = 0	0.32	0.39
ABACH	Attained BACH = 1; otherwise = 0	0.13	0.14
APOST	Attained POST = 1; otherwise = 0	0.09	0.04
REQ vector			
RGRADE	Required GRADE = 1; otherwise = 0	0.14	0.10
RSOME	Required SOME = 1; otherwise = 0	0.15	0.12
RHIGH	Required HIGH = 1; otherwise = 0	0.28	0.35
RCOLL	Required COLL = 1; otherwise = 0	0.18	0.23
RBACH	Required BACH = 1; otherwise = 0	0.17	0.17
RPOST	Required POST = 1; otherwise = 0	0.07	0.02
OVER vector			
OGRADE	Overed. & required GRADE = 1; otherwise = 0	0.07	0.06
OSOME	Overed. & required SOME = 1; otherwise = 0	0.08	0.05
OHIGH	Overed. & required HIGH = 1; otherwise = 0	0.13	0.15
OCOLL	Overed. & required COLL = 1; otherwise = 0	0.02	0.02
OBACH	Overed. & required BACH = 1; otherwise = 0	0.03	0.02
UNDER vector			
USOME	Undered. & required SOME = 1; otherwise = 0	0.02	0.02
UHIGH	Undered. & required HIGH = 1; otherwise = 0	0.09	0.06
UCOLL	Undered. & required COLL = 1; otherwise = 0	0.04	0.03
UBACH	Undered. & required BACH = 1; otherwise = 0	0.05	0.05
UPOST	Undered. & required POST = 1; otherwise = 0	0.02	0.04

Table 6:
Regression equations; dependent variable ln Y

Variable	(1)	(2)	(3)	(4)
EXP	0.020	0.020	0.022	0.017
	(4.488)	(4.505)	(3.871)	(2.330)
EXP2	-0.000	-0.000	-0.000	-0.000
	(-4.214)	(-3.390)	(-3.017)	(-1.637)
UNION	0.095	0.107	0.069	0.140
	(2.840)	(3.280)	(1.707)	(2.479)
SEX	0.303	0.285		
	(9.389)	(9.088)		
TEN	0.018	0.017	0.017	0.016
	(3.241)	(3.238)	(2.540)	(1.735)
TEN2	-0.001	-0.001	-0.001	-0.000
	(-2.646)	(-3.235)	(-2.723)	(-1.274)
BIL	0.081	0.050	0.121	-0.066
	(1.946)	(1.253)	(2.463)	(-0.949)
EXTR	0.162	0.137	0.110	0.213
	(2.320)	(2.041)	(1.579)	(1.264)
DIST	0.083	0.035	-0.013	0.086
	(1.687)	(0.731)	(-0.259)	(0.812)
PUB	0.036	-0.056	-0.012	-0.140
	(0.791)	(-1.268)	(-0.238)	(-1.546)
INFO	0.132	0.042	0.105	-0.027
	(2.262)	(0.735)	(1.289)	(-0.268)
RET	-0.204	-0.230	-0.156	-0.298
	(-4.081)	(-4.799)	(-2.620)	(-3.306)

Table 6 cont.				
Variable	(1)	(2)	(3)	(4)
PROF	0.511	0.158	0.179	0.114
	(10.65)	(2.508)	(2.212)	(1.153)
SEMI	0.487	0.285	0.242	0.311
	(10.72)	(5.442)	(3.664)	(3.600)
SUPER	0.285	0.167	0.172	0.082
	(4.140)	(2.453)	(2.169)	(0.632)
SKILL	0.233	0.142	0.162	0.092
	(6.125)	(3.620)	(3.220)	(1.434)
ATL	-0.075	-0.073	-0.107	-0.016
	(-1.300)	(-1.333)	(-1.531)	(-0.175)
QUE	-0.025	-0.007	-0.063	0.070
	(-0.633)	(-0.170)	(-1.288)	(1.098)
PRA	0.035	0.032	-0.001	0.040
	(0.775)	(0.723)	(-0.013)	(0.596)
BC	0.110	0.089	0.223	-0.054
	(2.230)	(1.870)	(3.676)	(-0.708)
CITY	0.068	0.051	0.012	0.124
	(2.202)	(1.690)	(0.343)	(2.374)
RGRADE		-0.314	-0.312	-0.322
		(-3.944)	(-3.151)	(-2.323)
RSOME		-0.155	-0.081	-0.219
		(-2.046)	(-0.813)	(-1.861)
RCOLL		0.051	-0.001	0.110
		(0.846)	(-0.006)	(1.244)
RBACH		0.251	0.209	0.330
		(3.353)	(2.027)	(2.942)

Table 6 cont.

Variable	(1)	(2)	(3)	(4)
RPOST		0.514	0.370	0.886
		(5.170)	(3.070)	(4.470)
OGRADE		-0.070	0.000	-0.156
		(-0.852)	(0.005)	(-1.098)
OSOME		0.030	-0.058	0.188
		(0.376)	(-0.591)	(1.374)
OHIGH		0.018	0.039	0.010
		(0.306)	(0.467)	(0.115)
OCOLL		-0.049	-0.180	0.089
		(-0.460)	(-1.285)	(0.527)
OBACH		0.208	0.172	0.161
		(2.188)	(1.573)	(0.866)
USOME		-0.120	-0.264	0.088
		(-1.020)	(-1.904)	(0.420)
UHIGH		-0.121	-0.162	-0.019
		(-1.774)	(-1.833)	(-0.165)
UCOLL		-0.033	-0.053	0.035
		(-0.388)	(-0.524)	(0.237)
UBACH		-0.052	0.072	-0.165
		(-0.657)	(0.691)	(-1.349)
UPOST		-0.151	-0.094	-0.231
		(-1.088)	(-0.654)	(-0.611)
CONSTANT	1.507	1.672	1.979	1.673
	(24.32)	(22.73)	(20.14)	(12.96)
N	993	993	569	424
$\bar{R}^2$	0.383	0.440	0.393	0.364

Note: t-statistics in brackets

The inclusion of the education variables, Column (2), reveals that the returns to over- and undereducation vary with the required level of education. Generally, the educational mismatch dummies are insignificant at the 10% level. However, the overeducation dummy at the BACH level of required education and the undereducation dummy at the HIGH level are significant. In these cases, overeducation is associated with higher earnings, and undereducation with lower earnings. Nevertheless, in general, workers are neither penalised nor rewarded for having educational attainments that differ from requirements.[22]

Restricting the sample to males and females in turn, Columns (3) and (4) respectively, reveals some startling differences between the sexes.[23] First, the coefficients for the required schooling variables at the BACH and POST levels are much larger for females. Second, although the impacts of the educational mismatch variables for males are similar to those for the full sample, all these terms are insignificant for females.

Table 7 shows the contributions of the explanatory variables to the male-female earnings gap. For each variable, I use Doiron and Riddell's [26] gender gap decomposition—a variant of that used by Oaxaca [73]. This decomposes the gap into the difference in the sample means multiplied by the estimated male coefficient (see Column 1) and the difference in the coefficients multiplied by the female mean, (see Column 2). The first component shows the difference due to male-female characteristics; the second, the return to these characteristics. The latter is sometimes attributed to discrimination. The largest proportion of the gap is explained by the returns to personal characteristics. The over- (under-) education variables have relatively small impacts; and their net effect is negative. The majority of the earnings gap accounted for by the educational mismatch variables is due to the characteristics themselves, rather than the returns to the characteristics.

For comparison, Table 8, Columns (1), (2) and (3) include dummies for attained—rather than required—education for the full, male and female samples

[22]F-tests of the hypotheses that the coefficients on the over- undereducation dummies are identical cannot be rejected at the 5% level.

[23]An F-test of the hypothesis that there is no difference between the male and female coefficients was rejected at the 5% significance level.

Table 7:
Male-female earnings decomposition

	characteristics	returns
PC	0.080	0.320
REQ	0.008	-0.040
OVER	0.001	-0.004
UNDER	-0.020	0.007
TOTAL	0.069	0.283

respectively. The returns to attained education are much lower than the returns to required education. The earnings profile is considerably flatter for the full sample, males and females. In Figures 4, 5 and 6 the coefficients on the required and attained dummies for each sample are plotted. The returns to attained education conditional on having a job with matching educational requirements are considerably higher than the unconditional returns.

4.6 Conclusions

In his seminal work, "The Great Training Robbery", Ivar Berg [14] argued that overeducated workers may be less productive than their less skilled counterparts because they become bored with their jobs and lose motivation. Earlier US and Dutch studies do not support Berg's [14] proposition; they found that overeducated workers earn more than their counterparts.

In this chapter, I have used Canadian data from the NSCS to estimate the returns to educational mismatch; and have shown that the returns to overeducation are sensitive to both the educational requirements of the job and the sex of the workers. For males, there is weak evidence of positive returns to overeducation if the job requires a university bachelor degree; but, the returns are insignificant for other required education levels. Unlike previous studies, I have found little evidence of lower pay for undereducated males: they are only penalised in jobs with low education requirements. Remarkably, I have found no evidence of returns to either over- or undereducation for females.

Table 8:
Regression equations; dependent variable ln Y

Variable	(1)	(2)	(3)
EXP	0.020	0.023	0.015
	(4.476)	(4.148)	(2.068)
EXP2	-0.000	-0.000	-0.000
	(-3.384)	(-3.159)	(-1.452)
UNION	0.096	0.047	0.156
	(2.921)	(1.176)	(2.724)
SEX	0.287		
	(9.022)		
TEN	0.019	0.176	0.020
	(3.401)	(2.657)	(2.054)
TEN2	-0.001	-0.001	-0.000
	(-2.999)	(-2.627)	(-1.434)
BIL	0.065	0.119	-0.003
	(1.588)	(2.400)	(-0.050)
EXTR	0.149	0.135	0.134
	(2.182)	(1.902)	(0.775)
DIST	0.065	0.003	0.123
	(1.342)	(0.053)	(1.155)
PUB	-0.013	0.022	-0.112
	(-0.300)	(0.414)	(-1.222)
INFO	0.079	0.116	0.024
	(1.366)	(1.380)	(0.249)
RET	-0.216	-0.158	-0.294
	(-4.416)	(-2.601)	(-3.248)

Hence, the hypothesis that overeducated workers have identical earnings to otherwise identical workers cannot (in general) be rejected, so the Canadian evidence does not support Berg's [14] claim. In Canada, overeducated workers do not receive lower earnings than otherwise identical workers. But, those workers with educational attainments in excess of requirements do not receive the full returns to their attained education: their earnings would have been higher in a job with requirements that matched their attainments. This finding will concern policy makers: rising educational attainments are insufficient to ensure higher earnings for workers.

Table 8 cont.			
Variable	(1)	(2)	(3)
PROF	0.320	0.329	0.297
	(5.663)	(4.535)	(3.268)
SEMI	0.392	0.353	0.410
	(8.186)	(5.860)	(5.094)
SUPER	0.226	0.217	0.195
	(3.318)	(2.762)	(1.503)
SKILL	0.195	0.211	0.148
	(5.106)	(4.412)	(2.329)
ATL	-0.072	-0.089	-0.054
	(-1.285)	(-1.249)	(-0.582)
QUE	-0.018	-0.060	0.031
	(-0.450)	(-1.227)	(0.490)
PRA	0.030	-0.001	0.030
	(0.670)	(-0.020)	(0.441)
BC	0.089	0.229	-0.049
	(1.847)	(3.683)	(-0.642)
CITY	0.052	0.019	0.114
	(1.704)	(0.510)	(2.171)
AGRADE	-0.252	-0.244	-0.220
	(-3.988)	(-3.290)	(-1.877)
ASOME	-0.151	-0.074	-0.211
	(-3.082)	(-1.204)	(-2.545)
ACOLL	-0.004	0.032	-0.000
	(-0.095)	(0.591)	(-0.001)
ABACH	0.116	0.119	0.144
	(2.016)	(1.625)	(1.556)
APOST	0.322	0.282	0.412
	(4.404)	(3.175)	(3.116)
CONSTANT	1.597	1.857	1.647
	(23.51)	(22.56)	(13.60)
N	993	569	424
$\bar{R}^2$	0.412	0.357	0.327

Note: t-statistics in brackets

Figure 4: Earnings Profile - Full Sample

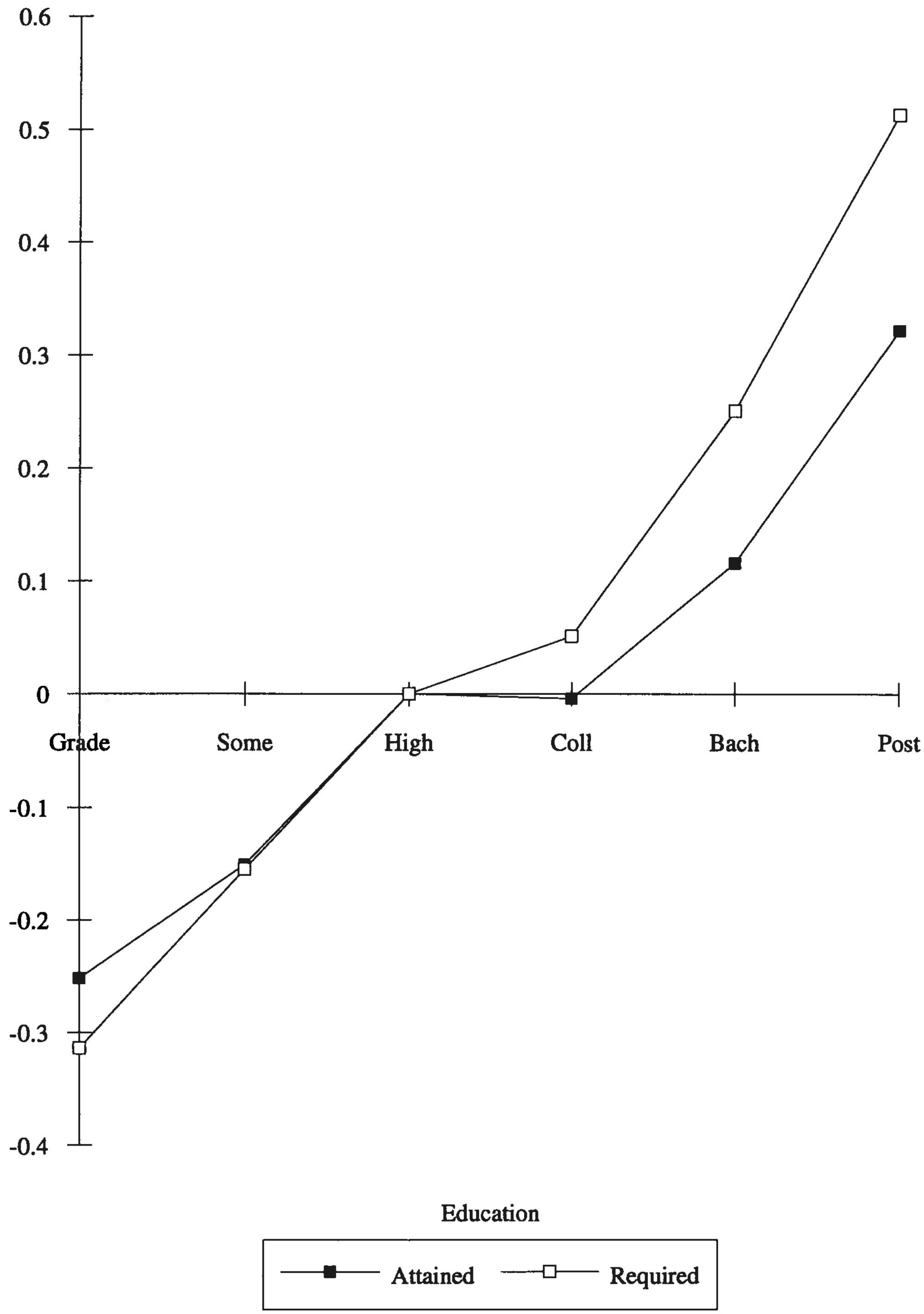


Figure 5: Earnings Profile - Males

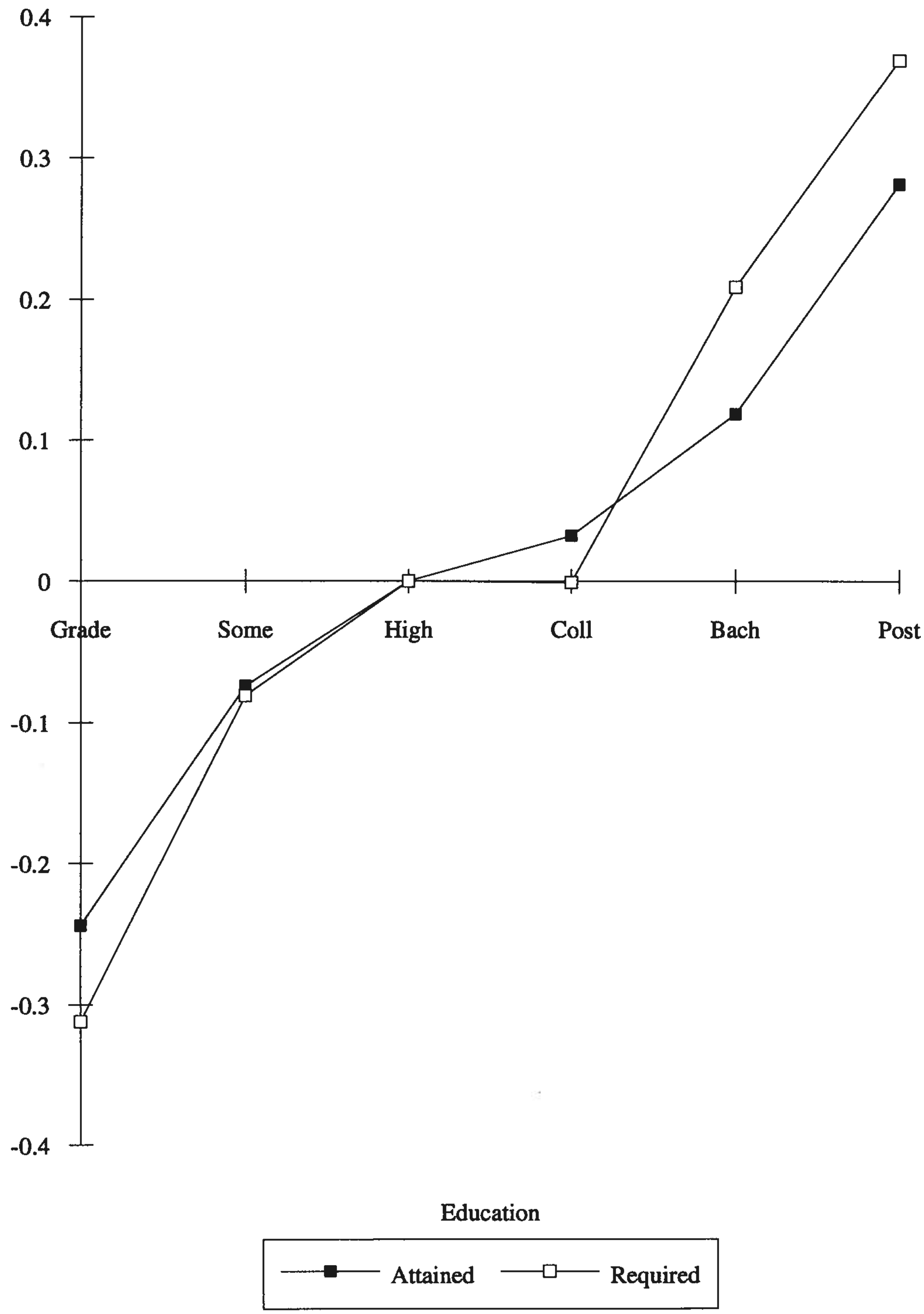
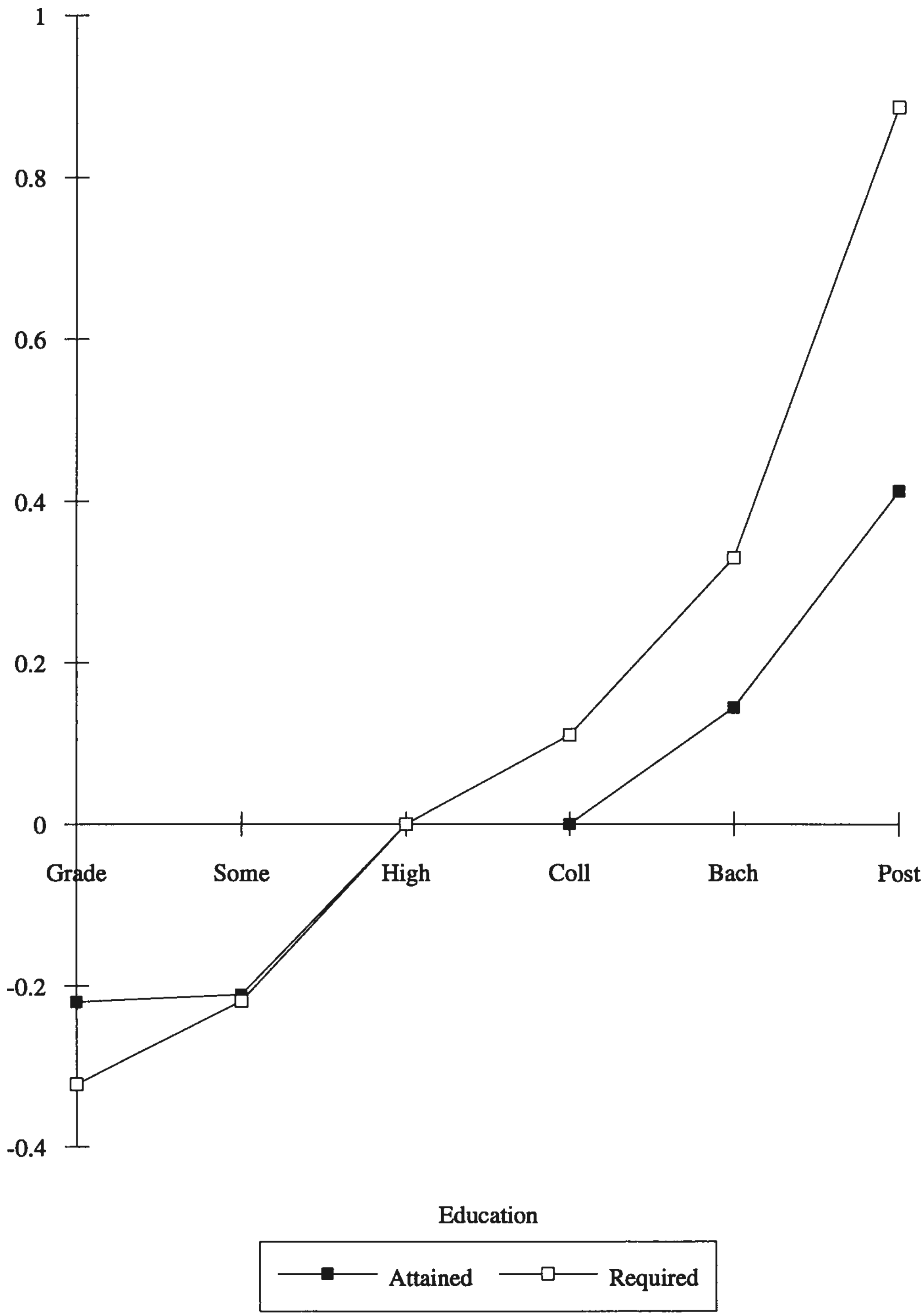


Figure 6: Earnings Profile - Females



Chapter 5

Conclusions

This thesis has taken the form of three related essays about the labour market implications of job quality.

In the first essay, Chapter 2, I have demonstrated, by analysing a specific two-type, two-period example, that introductory wage offers can inform workers about the expected quality of experience jobs. In this game, the good type of firm offers higher expected quality jobs than the bad type. If the good type is less likely to exit, the game has many equilibria with separating wages. In each of these, the introductory compensating differentials have the opposite sign to the usual Smith/Rosen case: higher expected quality jobs pay more, rather than less. I have also shown that there are pooling equilibria. In this case, the introductory wages are independent of job quality. I have demonstrated that, for some parameter space, the (extended) Intuitive Criterion renders a unique separating equilibrium.

In the second essay, Chapter 3, I have presented Canadian evidence that tests and supports the theory of compensating differentials for a variety of job characteristics. Previous Canadian studies, such as those by Meng [64 and 65], Martinello and Meng [62], and Cousineau et al [22] have found support for the theory for risk of injury or death. This is the first study, however, to have found Canadian evidence of compensating wage payments for non-hazardous characteristics.

By exploiting the self-report information contained in the NSCS, I have avoided using the occupational-trait data used by Meng [64]. Occupational-trait data provide information on averages across broad occupational categories and industries, introducing error into the job quality variables.

After controlling for personal characteristics, I have found evidence of compensating payments for working with data, working with hands, bureaucratic procedures, and responsibility over other workers. I have also found evidence of differentials for the control of hours and pace, though the coefficients are incorrectly signed. I have found no evidence of differentials for working with people, working with machines or the freedom to design work.

The third essay, Chapter 4, takes a slightly different perspective on job quality. I have focused on the mismatch between the educational requirements of jobs and the educational attainments of workers. In his seminal work, "The Great Training Robbery", Ivar Berg [14] argued that overeducated workers may be less productive than their less skilled counterparts because they become bored with their jobs and lose motivation. Earlier US and Dutch studies do not support Berg's [14] proposition; they found that overeducated workers earn more than otherwise identical workers (with just the required level of schooling).

I have used Canadian data from the NSCS to estimate the returns to educational mismatch; and have shown that the returns to overeducation are sensitive to both the educational requirements of the job and the sex of the workers. For males, there is evidence of positive returns to overeducation if the job requires a university bachelor degree; but, the returns are insignificant for other required education levels. I have also found little evidence of lower pay for undereducated males; though they are penalised in jobs with low education requirements. Remarkably, I have found no evidence of returns to either over- or undereducation for females.

Since, in general, the hypothesis that overeducated workers have the same earnings as otherwise identical workers (with the required level of schooling) cannot be rejected, the evidence does not support Berg's [14] claim. However, job requirements or "pigeonholes" are important determinants of earnings—and particularly so for females. This chapter, therefore, offers some support for Thurow's [94] notion that marginal productivity resides in the job, rather than in the individual characteristics of the worker.

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Appendix 1

Table A:
Variable means by sex and union status

Name	Male	Female	Union	Nonunion
Individual characteristics				
ANY	$27,576	$16,866	$23,317	$22,155
WY	$528.49	$323.48	$447.20	$424.91
Y	$13.08	$9.15	$11.67	$10.97
ln Y	2.45	2.06	2.37	2.19
EDUC	13.00	12.79	12.92	12.89
AGRADE	0.12	0.07	0.10	0.09
ASOME	0.17	0.17	0.17	0.17
AHIGH	0.17	0.18	0.17	0.18
ACOLL	0.32	0.39	0.36	0.35
ABACH	0.13	0.14	0.13	0.13
APOST	0.09	0.04	0.06	0.07
EXP	19.94	15.56	18.64	17.36
EXP2	561.84	385.92	502.04	464.60
UNION	0.51	0.39	1.00	0.00
TEN	9.33	5.94	9.10	6.68
TEN2	162.97	80.79	152.40	102.97
BIL	0.23	0.15	0.21	0.18
SEX	1.00	0.00	0.61	0.49
Location				
ATL	0.08	0.09	0.09	0.07
QUE	0.33	0.25	0.33	0.26
ONT	0.36	0.35	0.32	0.39
PRA	0.12	0.18	0.13	0.17
BC	0.11	0.13	0.13	0.11
CITY	0.58	0.65	0.61	0.62
Job characteristics				
CDESN	0.42	0.58	0.59	0.42
CHRS	0.67	0.77	0.86	0.60
CPACE	0.49	0.58	0.65	0.44
RESP	0.43	0.31	0.28	0.46
BUR	0.51	0.48	0.67	0.36
HANDS	0.47	0.45	0.37	0.55
PEOPLE	0.40	0.27	0.44	0.25
DATA	0.55	0.49	0.51	0.53
MACHINES	0.75	0.74	0.80	0.71
Q	4.70	4.70	5.16	4.31

Table A cont.				
Name	Male	Female	Union	Nonunion
MAR	0.76	0.52	0.65	0.64
HOME	0.70	0.56	0.63	0.65
APP	0.25	0.11	0.18	0.19
UNEM	1.29	0.63	1.30	0.73
Industry				
EXTR	0.08	0.02	0.07	0.04
MANUF	0.32	0.10	0.25	0.20
DIST	0.17	0.10	0.17	0.11
PUB	0.24	0.40	0.45	0.20
INFO	0.06	0.16	0.01	0.19
RET	0.13	0.21	0.05	0.26
Occupation				
PROF	0.19	0.14	0.13	0.20
SEMI	0.15	0.17	0.18	0.15
SUPER	0.07	0.03	0.03	0.07
SKILL	0.25	0.24	0.27	0.23
SEMUN	0.34	0.41	0.39	0.36

Table B:
Further means and definitions, full sample

Name	Definition	Mean
MAR	Married = 1; otherwise = 0	0.65
HOME	Own home = 1; otherwise = 0	0.64
APP	Apprenticeship = 1; otherwise = 0	0.18
UNEM	Number of times unemployed	0.99
Industry		
EXTR	Extraction and construction = 1; otherwise = 0	0.05
MANUF	Manufacturing = 1; otherwise = 0	0.22
DIST	Distribution = 1; otherwise = 0	0.14
PUB	Public services = 1; otherwise = 0	0.31
INFO	Information services = 1; otherwise = 0	0.11
RET	Retail and other services = 1; otherwise = 0	0.17
Occupation		
PROF	Professional = 1; otherwise=0	0.17
SEMI	Semi-professional = 1; otherwise =0	0.16
SUPER	Supervisory = 1; otherwise = 0	0.05
SKILL	Skilled trade = 1; otherwise = 0	0.25
SEMUN	Semi-skilled and unskilled = 1; otherwise =0	0.37

Table C:
Job quality and union status equations

Variable	Q	Union
EDUC	-0.021	0.007
	(-1.015)	(0.304)
AGRADE	-0.115	0.081
	(-0.564)	(0.377)
ASOME	-0.013	-0.175
	(-0.084)	(-1.082)
ACOLL	0.267	-0.065
	(2.069)	(-0.453)
ABACH	-0.420	0.085
	(-2.221)	(0.408)
APOST	-0.327	0.125
	(-1.307)	(0.452)
EXP	-0.000	-0.010
	(-0.015)	(-0.686)
EXP2	-0.000	0.000
	(-0.292)	(0.043)
UNION	0.609	
	(6.130)	
TEN	0.011	0.068
	(0.684)	(3.963)
TEN2	-0.000	-0.001
	(-0.561)	(-2.513)
BIL	-0.104	-0.007
	(-0.848)	(-0.050)
SEX	-0.148	0.267
	(-1.465)	(2.378)

Table C cont.		
Variable	Q	Union
ATL	0.167	0.070
	(0.981)	(0.406)
QUE	0.080	0.269
	(0.673)	(2.134)
PRA	-0.021	-0.148
	(-0.157)	(-1.012)
BC	0.085	0.481
	(0.584)	(2.847)
CITY	-0.040	0.206
	(-0.435)	(2.137)
MAR	0.029	0.078
	(0.293)	(0.665)
HOME	-0.015	-0.137
	-0.146	(-1.188)
APP	0.097	0.040
	0.861	(0.330)
UNEM	0.045	0.073
	2.018	(3.087)
EXTR	-0.257	0.271
	-1.246	(1.373)
DIST	0.099	0.226
	0.677	(1.546)
PUB	-0.120	0.859
	(-0.886)	(6.102)
INFO	-0.170	-1.499
	(-0.978)	(-5.864)
RET	-0.858	-1.068
	(-5.849)	(-6.359)

Table C cont.		
Variable	Q	Union
PROF	-0.445	-0.957
	(-2.563)	(-4.813)
SEMI	-0.181	-0.408
	(-1.217)	(-2.512)
SUPER	-0.383	-0.912
	(-1.217)	(-4.018)
SKILL	-0.321	-0.217
	(-2.738)	(-1.724)
CONSTANT	5.078	-0.465
	(14.77)	(-1.255)
N	993	993
$\bar{R}^2$	0.170	0.291

Note: t-statistics in brackets

Table D:
Senior workers, regression equations; dependent variable ln Y

Variable	(1)	(2)	(3)
EDUC	0.035	0.036	0.032
	(4.574)	(4.074)	(3.607)
AGRADE	-0.248	-0.221	-0.257
	(-3.445)	(-2.726)	(-3.071)
ASOME	-0.247	-0.207	-0.211
	(-4.139)	(-3.156)	(-3.082)
ACOLL	-0.039	-0.038	-0.015
	(-0.735)	(-0.670)	(-0.245)
ABACH	0.322	0.237	0.246
	(3.822)	(2.424)	(2.494)
APOST	0.284	0.211	0.179
	(3.253)	(2.111)	(1.756)
EXP	0.022	0.024	0.027
	(3.458)	(2.973)	(2.528)
EXP2	-0.000	-0.000	-0.000
	(-2.623)	(-2.471)	(-2.321)
UNION	-0.088	-0.076	-0.049
	(-1.780)	(-1.425)	(-0.961)
TEN	0.002	0.012	0.003
	(0.176)	(0.816)	(0.174)
TEN2	-0.000	-0.000	-0.000
	(-0.632)	(-1.467)	(-1.518)
BIL	0.108	0.093	0.101
	(2.271)	(1.866)	(1.953)
SEX	0.306	0.312	0.337
	(8.731)	(8.512)	(8.249)

Table D cont.			
Variable	(1)	(2)	(3)
ATL	-0.025	-0.011	0.007
	(-0.398)	(-0.140)	(0.093)
QUE	-0.003	-0.010	-0.018
	(-0.069)	(-0.228)	(-0.373)
PRA	0.058	0.069	0.042
	(1.040)	(1.104)	(0.627)
BC	0.169	0.157	0.118
	(2.734)	(2.074)	(1.519)
CITY	0.071	0.060	0.001
	(2.002)	(1.491)	(0.016)
Q	0.155	0.111	0.017
	(2.623)	(1.609)	(0.249)
$\hat{\eta}$	-0.052	-0.014	-0.009
	(-0.804)	(-0.203)	(-0.130)
$Q \cdot \hat{\eta}$	-0.018	-0.016	-0.006
	(-2.261)	(-1.894)	(-0.684)
$Q \cdot TEN$	0.001	0.001	0.003
	(0.481)	(0.419)	(1.189)
CONSTANT	0.671	0.772	1.235
	(2.584)	(2.610)	(4.492)
N	781	612	511
$\bar{R}^2$	0.353	0.335	0.344

Note: t-statistics in brackets