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SKILL DIFFERENTIALS AMONG CANADIAN BLUE-COLLAR WORKERS

by

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ABSTRACT

This thesis is an inquiry into the behaviour of skill differentials among Canadian blue-color workers during the postwar period. It sets forth, mainly for expository purposes, a model of relative wage determination based on three elements: the theory of human capital, the standard theory of the firm, and a set of stock-flow identities pertaining to the skilled and unskilled labour forces. Besides yielding the familiar conclusion that percentage wage differentials vary positively with the discount rate and the length of time spent in skilled training and negatively with the length of the working life and the level of remuneration accorded trainees, the model predicts that differentials will undergo cycles of long duration. Whereas the major portion of the theoretical analysis is set in a framework of perfect competition, some attention is paid to the problem of relative wage determination in the presence of trade unions.

The formal model serves as an organizational structure for a review of the literature. Existing hypotheses concerning the behaviour of skill differentials are distinguished as being either of a long- or of a short-run character. Long-run hypotheses deal with education and training, social attitudes and policy, migration flows, technological change, and the impact of unionization. Short-run hypotheses are those that make reference to the rate of unemployment and the rate of inflation.

The empirical research undertaken includes both time-series and cross-sectional studies. Summary statistics are produced in order to trace the movement of skill differentials among building tradesmen and among production workers in a composite sample of thirty-nine mining and manufacturing industries. The results obtained indicate a downward trend over the period surveyed. In the case of the thirty-nine-industry sample, regression analysis reveals the existence of significant positive relationships between skill differentials and each of the short-run variables, unemployment and inflation. The building trades exhibit no short-run response.

Examination of a number of regional cross sections supports the view that skill differentials tend to be narrower in British Columbia than in other parts of Canada, but this confirmation applies only to manufacturing. In the building trades, British Columbia skill differentials do not manifest an extreme ranking. Examination of an interindustry cross section uncovers no significant relationships between skill differentials and industry-specific factors such as plant scale, labour intensity, and employment concentration. The level of unionization is marginally insignificant as an explanatory variable.

Terence J. Wales
Thesis Supervisor

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Acknowledgement

I should like to thank the Economics and Research Branch of the Canada Department of Labour for providing information which was of great assistance in the conduct of this study.

R.D.S.

Chapter I

INTRODUCTION

This study investigates an important aspect of wage structure in the Canadian economy; namely, the set of relationships that exist between the hourly wages of skilled workers and the hourly wages of unskilled workers. Although textbook summaries dealing with the skilled-unskilled wage differential often seem shot through with statistical detail, the empirical base upon which these discussions rest turns out to be relatively narrow. On the whole, researchers have shown less interest in skill differentials than in other problems of wage determination; and as one might guess, studies pertaining to Canada have been particularly rare.

Yet, interest in the skilled-unskilled dimension of wage structure appears justified on several grounds, apart from that of general neglect. With the advent of human capital theory it became fashionable to compute rates of return to investment in training and to speculate about the possibility of over- or underinvestment in particular fields. In most of these exercises, skill differentials are treated as fixed parameters, even though it is recognized that they change over time in response to a variety of factors. Since practical efforts to compute rates of return must take such changes into account, it is clearly essential to have some prior knowledge of how skill differentials are determined. Furthermore, if one is to quantify the degree of

over- or underinvestment in education for policy-making purposes, finding discrepancies among rates of return is only the initial step. Formulating a long-range programme of expenditure on education and training requires that the authorities attempt to predict the response of wage differentials to policy-induced changes in the flows of graduates entering the labour market. At the same time, planners must be in a position to allow for the concomitant effects of variables not under direct policy control, and they must be able to distinguish between long- and short-run wage movements. Basic research may be of assistance in all these areas.

Human capital theory and educational planning aside, skill differentials have always been of special interest from a distributional standpoint. As we shall presently observe, the typical building tradesman in Canada became accustomed, during the early decades of this century and even as late as the 1940's, to a wage rate which was often more than double that of the labourer employed at his side. In recent years, however, such a tradesman could not expect to obtain a premium of more than thirty or thirty-five per cent in excess of the labourer's rate. Although swings of this magnitude have not occurred in all sectors of the economy, it is reasonable to suspect that changes in skill differentials have had significant distributional repercussions. Such changes, and their possible determinants, thus warrant close scrutiny.

Before we may proceed with any empirical investigations or examine specific theoretical arguments, it is necessary to

consider, in a very general way, how skill differentials are to be measured. There are two conceivable approaches: one may adopt a relative measure, as in the foregoing example, by taking the ratio of a given skilled to a given unskilled wage; or one may choose to employ an absolute measure by computing the difference between these wage rates in dollar terms. Owing to the theoretical significance of relative prices, economists tend to favour the first approach.[1] Whether participants in the labour market share this preference is not entirely clear. At one time in Canada, principally during the 1940's and the early 1950's, it was common to hear trade unions voicing their demands, both with regard to general wage increases and with regard to wage structure, in absolute or dollar terms, whereas in recent years talk has almost always been of relative or percentage adjustments. As we shall see later on, this shift in emphasis may well have been the result, not of a behavioural change, but of economic forces which have nothing to do with revised standards of measurement. In any case, if one accepts the familiar methodological proposition that theoretical models need not imitate the actual decision-making procedures of economic agents, then the fact that unions or other participants in the labour market may, at some time, have determined

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[1] Arthur Ross has nevertheless put forward some contrary arguments. See "The External Wage Structure," in New Concepts in Wage Determination, edited by George W. Taylor and Frank C. Pierson (New York: McGraw-Hill Book Co., 1957), p. 181.

their conscious behaviour by referring to an absolute measure of the skill differential does not, in itself, invalidate the use of a relative measure.

Accordingly, skill differentials will be portrayed as ratios throughout this study. In the interests of variety, the terms "skill differential," "skill premium," "skill margin," "relative wage," and "wage ratio" will be used more or less interchangeably to refer to the same concept.

Although professional, managerial, and other white-collar personnel may be said to possess "skills," the phrase "skilled worker" has a rather narrow interpretation in common usage. It normally denotes an individual trained in a recognized craft and employed at a job which lies within a vaguely defined but identifiable group of blue-collar occupations. Conversely, the phrase "unskilled worker" describes a labourer or other employee who performs simple, predominantly physical tasks--usually, again, within the blue-collar category. Though it would perhaps be feasible to compute wage ratios for "skilled" and "unskilled" workers defined in very general terms on the basis of first principles, this study follows traditional practice by focusing upon the restricted occupational classes just mentioned.

The broad objectives pursued here are to survey, update, and extend previous research. To begin, Chapters II and III present a detailed review of the literature. Chapter II offers a rendition of the relevant neoclassical theory. The purpose here is not to construct a new theoretical model, but rather

to solidify concepts, draw together a number of diverse analytical threads, and establish a framework for subsequent discussions. On the supply side of the labour market, an adaptation of human capital theory furnishes an explanation of occupational choice. On the demand side, we shall resort to familiar propositions from the conventional theory of the firm. These two theoretical components, together with certain stock-flow identities, are joined in an analysis of equilibrium, its comparative static properties, and the process of adjustment over time. Finally, some consideration is given to the possible impact of collective bargaining.

Chapter III is mainly a catalogue of hypotheses that have been suggested over the years to account for the behaviour of skill differentials. As we shall see, virtually all these rationalizations consist of informal, ad hoc arguments, some of which are little more than analytical fragments. They are divided into two groups: those that apply to cyclical or short-run behaviour and those that seek to explain long-run movements. Chapter III opens with a brief historical summary of what is known about trends in skill differentials, both in Canada and elsewhere, during the first half of this century. Familiarity with such trends is essential if one is to understand the hypotheses to which they gave rise.

The review of empirical findings contained in Chapter III also serves to illustrate certain difficiencies which are prevalent in the existing body of quantitative research. Most published studies, it turns out, base their conclusions on

wage data that pertains to a rather narrow sample of skilled and unskilled occupations. There has been a strong tendency for investigators to concentrate on traditional construction and maintenance crafts--bricklayers, carpenters, and the like--and to ignore skilled production occupations ranged throughout the industrial economy. In the case of studies which attempt to survey long periods of time, an orientation of this sort is perhaps unavoidable, since information covering a broad sample of occupations is very difficult to obtain. In other instances, authors may have shied away from the problem of designating as skilled or unskilled jobs carrying unfamiliar titles. Whatever the reason for the narrow research base, one must be alert to the possibility that generalizations supported by such limited evidence may founder when applied across the entire labour market.

Despite the restricted occupational coverage, one does not notice any scarcity of numerical detail. Calculating wage ratios for various pairs of skilled and unskilled occupations at various points in time is not, after all, a very demanding statistical procedure, and authors have sometimes engaged in the sport with considerable abandon. Unfortunately, there have been few attempts to <u>combine</u> individual wage ratios into meaningful summary statistics. In the absence of such aggregative measures, it has been virtually impossible to subject generalized hypotheses to formal testing.

The empirical work displayed here was undertaken with the preceding difficulties firmly in mind. The entire research

effort actually consisted of three separate studies, one dealing with aggregate time-series and two with cross-sectional analysis. The purpose of the time-series investigation, reported in Chapter IV, was: first, to develop the necessary summary measures with which to describe, over as much as possible of the postwar period, the behaviour of skill differentials among Canadian blue-collar workers; then, to employ the figures thus derived in order to distinguish between long-run movements and cyclical fluctuations; and finally, to test certain hypotheses concerning the potential determinants of short-run behaviour. As we shall observe in Chapter III, it has been alleged, and indeed widely accepted, that skill differentials respond in the short run to both the rate of unemployment and the rate of consumer-price inflation. The regression results obtained in Chapter IV provide these hypotheses with rigourous confirmation for the first time.

Chapter V next explores the behaviour of skill differentials in cross section. It looks first at the regional pattern of variation in an effort to test certain descriptive generalizations which have been advanced on the subject. It then applies the technique of multiple regression in an attempt to explain the observed pattern of interindustry variation. Although the latter project proved somewhat disappointing, it served to indicate several promising lines of future research.

Chapter VI summarizes the main theoretical arguments, enumerates the major empirical findings, and adds some concluding observations.

It is perhaps worth noting, as a final word of introduction, that the economic framework within which the present study is cast does not constitute the only system of logic which one might apply to the analysis of skill differentials. Though economists are inclined to regard wage determination as their exclusive preserve, specialists in sociology as well as those in a number of other disciplines have occasionally trespassed in the field, particularly in that part of it which concerns wage structure.[2] As one might expect, these commentators pay little attention to supply-and-demand factors in their treatment of skill differentials but emphasize, instead, such things as the amount of prestige residing in various occupations and the degree of skill that is assumed to be necessary for the performance of tasks (as opposed to the amount that is actually necessary). Though it would be inappropriate in a study of this kind to conduct a review of the sociological literature,[3] one should bear in mind the possibility that disciplines other than economics may furnish valuable insights into the problem discussed here.

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[2]The determination of skill differentials has even been viewed as a purely technical problem. See Elliott Jacques, "Objective Measures of Paid Differentials," Harvard Business Review, XL (January-February, 1962), 133-138.

[3]Some idea of the directions taken can be gained from the classic, Theodore Caplow, The Sociology of Work (Minneapolis: University of Minnesota Press, 1954), ch. 7, or from a recent text, Lee Taylor, Occupational Sociology (New York: Oxford University Press, 1968).

Chapter II

THEORETICAL FRAMEWORK

This chapter brings together various elements of labour-market theory in order to construct a formal model of relative wage determination. Although the model developed here cannot be made fully operational, it provides, at the very least, a useful framework for assessing the many informal hypotheses offered in the literature.

The first section of the analysis deals with the supply side of the labour market; the second, with the demand side. The third section unites the resulting demand and supply relationships in order to determine the value of the skill premium at a point of long-run equilibrium. The concluding section investigates departures from equilibrium that may occur in the presence of collective bargaining.

The Supply Side

To simplify the argument, let us assume that the economy in question provides a range of work opportunities consisting of one skilled occupation and one unskilled occupation. Upon reaching a certain age, individuals destined to enter the labour force must decide between these two occupations and begin the appropriate training. Hence, at any given time, the skill mix available to firms within the economy depends upon the

pattern of individual decision making over a number of previous periods.

Let us denote the number of workers adhering to each skill category by L^s and L^u respectively. The size of the total labour force L is therefore given by $L^s + L^u$. The skill mix prevailing at time T, namely Q_T, may now be defined as

$$(1) \quad Q_T \equiv L_T^s / L_T^u \ .$$

If we abstract from adjustments in hours worked and changes in labour-force participation rates, and if we further assume that workers never compete for jobs across occupational lines, then equation (1) represents the relative supply function of labour in the short run.

Over time, variations in the skill mix may occur only as trainees enter the labour force and as older workers retire. To deal with the simplest case first, suppose that the population P is constant in size and composition, so that the number of individuals embarking on careers every period is constant and equal to the number passing into retirement. Gross turnover in the labour force is thus given by cP/v, where c stands for the participation rate (assumed fixed) and v, for the span of time typically spent in training and work. Of those entering the stream at time t, some proportion q_t will select the skilled occupation, and $(1 - q_t)$ will select the unskilled occupation. Therefore, if d^s and d^u denote the training time required of workers in each of these respective categories, we may write

$$(2a) \quad L_T^s = (cP/v) \sum_{t=T-v}^{T-d^s} q_t$$

$$(2b) \quad L_T^u = (cP/v) \sum_{t=T-v}^{T-d^u} (1 - q_t) \ .$$

Hence

$$(3) \quad Q_T = \frac{\sum_{t=T-v}^{T-d^s} q_t}{\sum_{t=T-v}^{T-d^u} (1 - q_t)} \ .$$

If the number of entrants is not the same in each period--because the population is growing or because participation rates change--then equation (3) must be rewritten in a slightly more complicated form. Specifically, one must introduce the values of the periodic increments for use as weights in performing the indicated summations.

This modification is easily carried out and does not materially affect the central problem of this discussion, namely, the derivation of a long-run relative supply function. Accomplishing this task consists in transforming (3) from an identity into a behavioural equation by specifying the determinants of q. We must therefore analyse the individual's decision to invest in skilled training.

The basic human capital model.[1] In choosing an occupation, the rational individual will presumably weigh the

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[1] The argument developed here is an amended version of one originally supplied by Jacob Mincer, "The Distribution of Labor Incomes: a Survey," Journal of Economic Literature, VII (March, 1970), 5-7.

remuneration available in alternative employments against the cost of the required training. Suppose that our skilled occupation offers a monetary wage of W^s per hour plus an intangible reward of w^s per hour in money terms, whereas the unskilled occupation offers W^u and w^u. If skilled and unskilled jobs ordinarily provide h^s and h^u hours of work respectively per period, individuals earn $h^s(W^s + w^s)$ per period in skilled employment and $h^u(W^u + w^u)$ per period in unskilled employment. Now, if C^s and C^u represent tuition expenses and any other direct costs of training, the individual realizes over his active lifetime v the present value

$$(4a) \quad PV^s = h^s(W^s + w^s) \cdot \int_{d^s}^{n^s+d^s} e^{-r^i t}\, dt - C^s \cdot \int_0^{d^s} e^{-r^i t}\, dt$$

$$= (1/r^i)h^s(W^s+w^s)e^{-r^i d^s}(1-e^{-r^i n^s}) - (1/r^i)C^s(1-e^{-r^i d^s})$$

$$= [1/r^i][h^s(W^s+w^s)X^s - C^s Y^s]$$

by choosing the skilled occupation, and the present value

$$(4b) \quad PV^u = [1/r^i][h^u(W^u+w^u)X^u - C^u Y^u]$$

by choosing the unskilled occupation. In these expression, which are derived in precisely the same manner, n denotes the working life in the given occupation (so that $v^j = n^j + d^j$,

j = s or u), and r^i is the rate at which individual i discounts future earnings. The W^T, the w^j, and the h^j are assumed constant. For compactness, X's and Y's have been used to replace factors containing e, the base of natural logarithms.

The individual will presumably experience indifference between alternative employments whenever

$$(5) \quad PV^s = PV^u \ .$$

Note that this specification abstracts from differences in the amounts of leisure enjoyed by skilled and unskilled workers whenever $h^s \neq h^u$. Upon substitution from (4a) and (4b) and some re-arrangement, the indifference condition becomes[2]

$$(6) \quad \frac{h^s(W^s + w^s)}{h^u(W^u + w^u)} = \frac{X^u}{X^s} + \frac{C^sY^s - C^uY^u}{h^u(W^u + w^u)X^s} \ .$$

Though equation (6) has the virtue of being highly general, data limitations, the presence of intangible variables, and the functional form make it empirically unmanageable. Its usefulness lies mainly in demonstrating what must be left out of any practical specification.

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[2]Although this expression is already rather cumbersome, one might extend its scope by recognizing the existence of intangible rewards that do not depend on the number of hours worked. The mere possession of a particular job or of the required training confers upon the individual a certain fixed benefit in terms of social status. Symbolically, if we let J^s and J^u denote the monetary equivalent of the present value of status benefits, we may add to the right side of (6) the term $(J^u - J^s)/h^u(W^u + W^u)X$. Hence, the greater is the skilled-unskilled status differential, the smaller will be the money wage differential at which the individual experiences indifference.

To begin the simplifying process, let us assume that $h^s = h^u$. Let us ignore the nonmonetary aspects of alternative occupations by setting $w^s = w^u = 0$. Given the nature of unskilled work, we may reasonably assume that $C^u = 0$. The second term on the right hand side of (6) then reduces to a fraction--namely, $C^s Y^s / h^u w^u X^s$--which may be given the following interpretation. The numerator represents the present value of the direct costs of skilled training; the denominator, the present value of unskilled earnings, discounted and summed over n^s periods. Now, the indirect (opportunity) cost of skilled training is the present value of unskilled earnings, discounted and summed over d^s periods. Since n^s is surely greater than d^s, the sum contained in the numerator will exceed this latter amount. Therefore, since the direct costs of skilled training are acknowledged to be a small fraction of the indirect cost,[3] the fraction appearing in (6) is likely to be very small indeed. If this argument holds, or if C^s is in fact zero when viewed by the individual, we may ignore it completely.

Having implemented all the preceding assumptions, we may rewrite the indifference condition as

$$(7)\quad I^i = \frac{W^s}{W^u} = \frac{X^u}{X^s} = \frac{e^{-r^i d^u}(1 - e^{-r^i n^u})}{e^{-r^i d^s}(1 - e^{-r^i n^s})} \quad .$$

The critical wage ratio for the ith individual is thus a function of his discount rate, the length of alternative

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[3] See Mincer, op. cit., p. 5.

training periods, and the length of the working life in the skilled and the unskilled occupations. Equation (7) does not, however, exhaust the possibilities for simplification. If the n's are large, or if they are approximately equal,[4] the factors in parentheses, taken together, will be close to unity. As long as this approximation holds, we may employ

$$(8) \quad I^i = e^{r^i(d^s - d^u)} .$$

Finally, if we scale time so that $d^u = 0$, (8) becomes simply

$$(9) \quad I^i = e^{r^i d^s} \quad \text{or}$$
$$\ln I^i = r^i d^s .$$

In order to grasp the meaning of the foregoing expressions more clearly, let us consider Figure 1, which measures discounted earnings on the vertical and time on the horizontal axis. The curves labelled SK and UNSK trace the fall in discounted values of skilled and unskilled earnings as the individual applies r^i to equal amounts obtainable in the future. Accordingly, the vertical intercepts are $h^s W_o^s$ and $h^u W_o^u$. On the assumption that $d^u = 0$, the present value of unskilled earnings PV^u is represented by areas A1 + A2, and the present value of skilled earnings PV^s, by the areas A2 + A3. Indifference exists when A1, the opportunity cost of skilled training,

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[4] Equality may come about because the physical demands of unskilled work force those engaged in it to retire earlier than those engaged in skilled occupations.

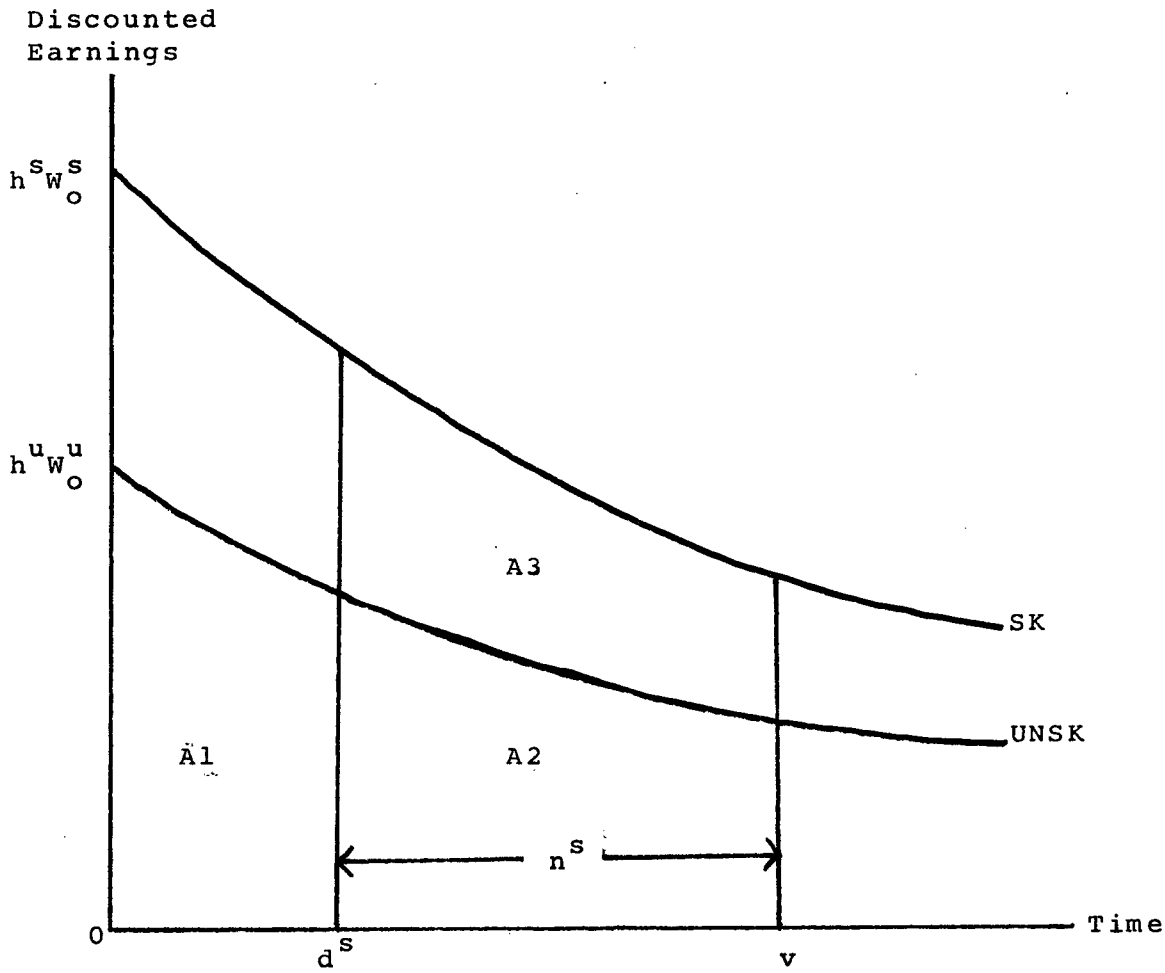

FIGURE 1

DISCOUNTING CURVES FOR SKILLED AND UNSKILLED EARNINGS

equals A3, the net benefit available over n^s periods. Given r^i, d^s, and v, this equality implies a particular value for $h^s W_o^s / h^u W_o^u$, or in the simplified case, W_o^s / W_o^u.

It is clear from the diagram--and it may be proved by differentiation--that W_o^s / W_o^u is related negatively to v and positively to d^s. Since a lengthening of the worker's active lifetime increases the potential net benefit of skilled training (area A3) without altering the cost, SK and UNSK must approach each other--which is to say W_o^s / W_o^u must decline--if the foregoing equality condition is to be satisfied. A lengthening of the required training time d^s increases the cost in terms of foregone earnings (area A1) and decreases the potential benefit both by shortening the working life n^s and by shifting what remains of it into the more distant future. Consequently, W_o^s / W_o^u must rise. Although the influence of r^i is not so obvious as that of the other variables, one may show, by differentiating (7) or (9), that under realistic circumstances its relationship to W_o^s / W_o^u is positive.[5] In diagrammatic terms,

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[5] In the case of (9) this result is immediate:

$$dI^i/dr^i = d^s e^{r^i d^s} > 0$$

In the more general case of (7) note that

$$dI^i/dr^i = \frac{B \cdot dA/dr^i - A \cdot dB/dr^i}{B^2} > 0 \quad \text{if}$$

$$B \cdot dA/dr > A \cdot dB/dr$$

where A and B are, respectively, the numerator and the denominator of the expression under consideration. Now

$$B \cdot dA/dr = -d^u e^{-r^i(d^u+d^s)} + d^u e^{-r^i(v+d^u)} + v e^{-r^i(v+d^s)} - v e^{-2r^i v}$$

an increase in the discount rate causes SK and UNSK to converge more rapidly than would otherwise be the case, shrinking area A3. Although a rise in r^i diminishes somewhat the present value of training costs (both direct and indirect), the impact on net benefits is more pronounced, since the latter accrue farther along in time. The ratio W_o^s/W_o^u must again rise to compensate.

Having thus established the form of the indifference condition, we may complete the model of occupational choice by introducing for individual i an expected wage ratio

$$(1) \quad E^i = (W_o^{s,i}/W_o^{u,i}) \ .$$

The individual will choose to invest in skilled training whenever $E^i > I^i$. Now, in order to aggregate over the entire population of new career entrants, we might assume identical expectations and identical investment criteria. The problem with this device, apart from its basic unrealism, is that it does not admit any intermediate values for q. Either E > I, and all new entrants become skilled (q = 1); or E < I, and all

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and $A \cdot dB/dr = -d^s e^{-r^i(d^u+d^s)} + d^s e^{-r^i(v+d^s)} + ve^{-r^i(v+d^u)} - ve^{-2r^i v}$

To simplify comparison, let $d^u = 0$. Since we may then ignore the first two terms in the top line and eliminate the fourth in both lines, the sign of the derivative will be positive if

$$d^s[e^{-r^i d^s} - e^{-r^i(v+d^s)}] > v[e^{-r^i v} - e^{-r^i(v+d^s)}]$$

and negative if the reverse holds. In general, the result is ambiguous. However, as long as v is large relative to d^s, the expression on the left will exceed the one on the right; and dI^i/dr^j will be positive.

remain unskilled ($q = 0$).

Therefore, if the model is to yield realistic implications, we must take into account differences among individuals. Rather than postulate identical values for the E^i, one may employ some more complicated density function $f_E(E^i)$ to portray the distribution of expectations over the group in question. To the extent that wages within a given skill category reflect the personal qualities of individuals, variations in ability will be one source of dispersion in $f_E(E^i)$. Another, and probably a more important source will be imperfections in the labour market. Since incomplete knowledge, barriers to entry, and differences in the exercise of market power combine in any real setting to permit some disuniformity of wages across firms and across regions, individuals will not generally harbour the notion of a single attainable skill differential, even if each could undertake a thorough census of employment opportunities.[6] Because the collection of labour-market information is costly, individuals will actually form their expectations on

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[6] Since workers cannot be certain that they will ultimately accept a particular job with a particular firm or that wage offers will not change during the interval of job search, each will possess a private distribution function of expected wage rates. Though it is most convenient to assume that individuals are guided by a single parameter of these distributions, namely, their means, one must acknowledge that other descriptive measures may influence decisions. In other words, individuals may be concerned not only with the yield implied by the mean but also with the risk implied by the dispersion (however defined), and they may compare the risk-yield combination available on investments in human capital with those available on alternative investments. Rather than analyse this problem explicitly, we shall assume that it has been accounted for in specifying the aggregate density function $f_E(E^i)$.

the basis of partial samples, the means of which will be distributed around the true mean skill differential offered by firms.

In order to generate $f_E(E^i)$, we may thus write

$$(11) \quad E^i = (\bar{W}^s/\bar{W}^u) + \varepsilon^i,$$

where the $\bar{W}$'s indicate actual mean wage rates and ε^i is a variable relating to individuals. Provided the ε's are independent of $\bar{W}^s/\bar{W}^u$, as seems reasonable, a change in the true skill differential will cause the implied probability density function shown in Figure 2 to migrate left or right without changing its shape. Although the preceding stipulation is not essential for the derivation of a unique relative supply function, its invocation simplifies the diagrammatic argument.[7] If we maintain the assumption of identical indifference wage ratios ($\bar{I}$), it is apparent that q, the proportion of new career entrants investing in skilled training, is just the probability of selecting such an individual from the distribution; accordingly, q is measured by the area of diagonal shading in the diagram.

However, there is no more reason to assume identical indifference ratios than there was to assume identical expecta-

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[7] Nor is it essential to assume that the mean of the ε^i's is zero, as shown in the diagram. Though it seems unlikely that, on the average, expectations would depart very far from reality, a psychological bias prevailing in the population might produce some discrepancy. Unanticipated growth might do the same; however, since growth introduces other interesting problems, discussion on this point will be delayed until the following subsection of this chapter.

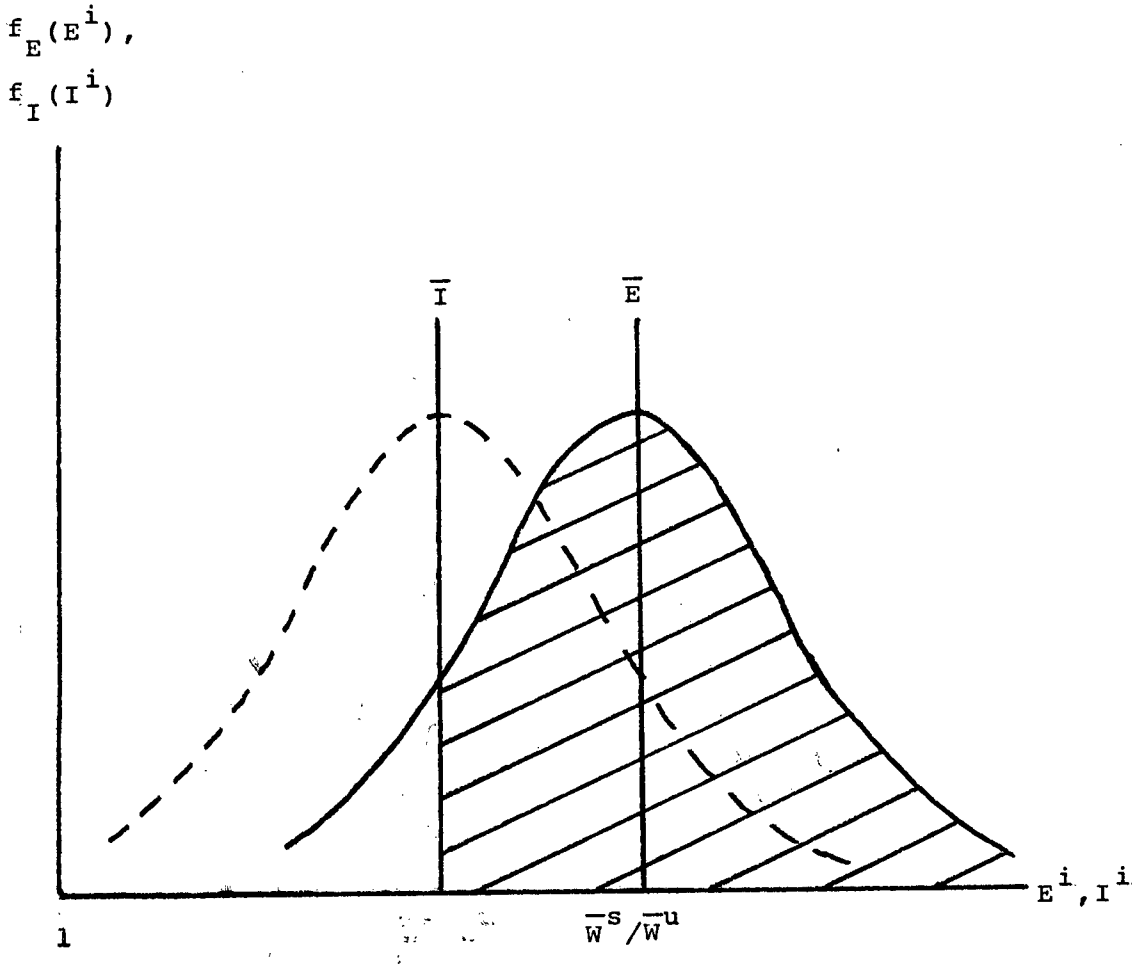

FIGURE 2

DISTRIBUTIONS OF EXPECTED AND INDIFFERENCE WAGE RATIOS

tions. One might logically amend (9) to the form

$$(12) \quad I^i = e^{(\bar{r}+\delta^i)d^s}$$

in order to generate another density function $f_I(I^i)$, which takes into account individual differences in the rate of discount.[8] As one can see, r^i has been replaced by the sum of the population mean $\bar{r}$ and δ^i, a variable relating to the individual. Dispersion in $f_I(I^i)$ arises because of differences in personal rates of time preference and because of differences in rates of return available on alternative investments.

If we now substitute the distribution $f_I(I^i)$, represented in Figure 2 by the dashed line, in place of the single value $\bar{I}$, the shaded area no longer measures the probability of a randomly selected individual investing in training. The new probability must be less than the former one, since, for a number of decision makers, I^i will exceed $\bar{I}$. Formally,[9]

$$(13) \quad \text{Probability } (E^i > I^i) = \text{Probability } (Z^i = E^i/I^i > 1)$$

$$= q$$

$$= \int_1^\infty [\int_1^\infty I^i \cdot f_I(I^i) \cdot f_E(I^i Z^i) \cdot dI^i] dZ^i,$$

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[8] Comments made previously concerning the risk-yield problem apply here as well.

[9] Proof of this formula may be found in Paul G. Hoel, Sydney C. Port, and Charles J. Stone, Introduction to Probability Theory (Boston: Houghton Mifflin Company, 1971), pp. 150-151.

assuming independence. Since it is impossible to observe the empirical form of either density function, one cannot, in practice, use equation (13) to predict the value of q. Nevertheless, it is clear a priori that q will always be negatively related to the mean $\bar{I}$ and positively related to the mean $\bar{E}$, provided both distributions are roughly bell-shaped and stable over time. It is reasonable to assume, in turn, that $\bar{E}$ is stably and positively related to the actual mean skill differential $\bar{w}^s/\bar{w}^u$.

Therefore, suppressing the functional form, we may state q in terms of the observable variables introduced previously; that is,

$$(14) \quad q = q(\bar{w}^s/\bar{w}^u,\ d^u,\ d^s,\ n^u,\ n^s).$$

Although q is also dependent upon r, the discount rate, this variable is unobservable; its mean value would be a product of any attempt to estimate (14) empirically. In any case, by substituting (14) into (3), we obtain the desired long-run relative supply function

$$(15) \quad Q_T = Q_T(q)$$
$$= Q_T(\hat{\bar{w}}^s/\hat{\bar{w}}^u,\ \hat{d}^u,\ \hat{d}^s,\ \hat{n}^u,\ \hat{n}^s),$$

where the circumflexes indicate vectors, the elements of which consist of periodic values for the respective variables, dated over an appropriate interval of the past. Equation (15) differs from a traditional labour supply function mainly in the fact that relative quantities and wage rates replace the

absolute numbers ordinarily employed.

Although the preceding theoretical argument is useful in identifying many important variables, it is somewhat restrictive, in that it applies to a world of only two occupations. One may approach the more complex world of many occupations by means of a framework suggested by Becker.[10] Observe, first of all, that if the expected skill differential is given, (9) may be solved for r^i, which becomes the individual's expected internal rate of return. Stated briefly, then, Becker's argument is that r^i declines as the individual increases his investment in training, or in other words, as he contemplates occupations requiring a longer and, hence, more costly period of preparation. The presumed decline occurs because the addition of training increments to a fixed factor, individual ability, involves diminishing returns in the classic sense. On the other hand, as the individual invests increasing sums in training, he must resort to increasingly expensive sources of financing. Equality between the interest cost of invested capital and the internal rate of return thus determines the optimal amount of training. If occupations are ranked uniquely in order of the amount of training required to obtain the necessary qualifications, and if one postulates distributions of individual cost and benefit functions across the relevant

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[10] Gary S. Becker, Human Capital and the Personal Distribution of Income: An Analytical Approach, Woytinsky Lecture No. 1 (Ann Arbor, Michigan: Institute of Public Administration and the University of Michigan, 1967).

population group, then it is possible to determine the number of career entrants flowing into each occupation during each period and to deduce from this information the skill mix prevailing at any given time.

Though Becker's approach has considerable merit, it has not been adopted here because the present study emphasizes wage ratios and is not explicitly concerned with the rate of return on human capital. Actually, the model developed earlier is also capable of dealing with the multi-occupation case. If one fixes r and allows d^s to vary, the result is a three-dimensional distribution of indifference wage ratios, the additional dimension relating to the continuum of occupations, each indexed by its training time. Combined with a similar three-dimensional distribution of expected wage ratios, this device again permits one to determine the skill mix. Hence, the two approaches are formally equivalent.

Some refinements. Having explored the basic properties of the human capital model, we may now relax certain of its simplifying assumptions in order to treat three factors which were ignored earlier but which appear to be of some significance. Specifically, we shall deal with the reimbursement of trainees, the effect of unemployment, and the problem of growth.

It was assumed throughout the preceding discussion that those who undertake training receive no work-related income during the time they must spend in vocational preparation. In fact, a great many trainees enjoy regular remuneration

either as apprentices or, less formally, as employees of firms offering on-the-job training programmes (in many cases with the assistance of government). Moreover, in Canada and other countries, students enrolled in publicly operated vocational schools frequently obtain monthly training allowances for the support of themselves and their families. The existence of such allowances, of apprenticeship wages, and of on-the-job training requires that some modification be applied to the basic model.

Although the stipends granted trainees may not match the prevailing unskilled wage,or whatever wage constitutes the individual's opportunity cost, such payments restore to some extent the earnings foregone as a result of the decision to devote productive time to learning a trade; and since the amounts in question accrue near the beginning of the individual's working lifetime, they are not heavily eroded by discounting. Because training allowances, apprentices' wages, and the like may thus add significantly to the present value of choosing the skilled occupation, career entrants will experience indifference at a lower wage ratio than would obtain had such sums not been available.[11] The implication is that

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[11] If we let trainees "wages" W^a equal some fraction k of the skilled wage, the amount added to PV^s is

$$kh^s W_o^s \int_0^{d^s} e^{-r^i t}\, dt$$

assuming hours are the same. Equation (9) then becomes

the relative supply of skilled labour will increase. Though we have not yet considered market equilibria, it is convenient at this point to note that the result of the increase in supply will undoubtedly be a fall in the skill premium. This conclusion is obviously important in analysing the decision of governments to institute training allowances and to support private on-the-job training programmes.

Another assumption invoked during the development of the basic model was that hours of work were equal in both occupational categories. This supposition provides a useful point of departure for analysing the effect of unemployment rates on the skill differential. The simplest method of introducing unemployment into the model is to assume that when the unemployment rate is U per cent, workers expect to receive an average of (1 - U)h hours of employment per period. If we insert the usual superscripts, (9) becomes

$$(16) \quad I^i = \frac{(1 - U^u)h^u}{(1 - U^s)h^s} \cdot e^{r^i d^s} .$$

This version of the indifference condition again ignores the

$$I^i = \frac{1}{k(1-e^{-r^i d^s}) + e^{-r^i d^s}}$$

Since $e^{-r^i d^s} < 1$, an increase in W^a, represented by an increase in k, will mean a fall in I^i. The same conclusion holds if W^a is defined in terms of W^u. It may be noted, however, that when wages are rising, payments to trainees must increase proportionally, or I^i will increase. Observe that when $k = 1$, $I^i = 1$, since training requires no sacrifice of earnings.

possibility that increased leisure time may partly compensate workers for the loss of income suffered during unemployment. The U's added here do not, of course, refer to currently measured rates of unemployment, but rather to those thought by individuals to be "normal" in the long run. Since the influence of the current rate on long-run expectations is likely to be considerably diluted through combination with past experience, one could not reasonably undertake a cyclical explanation of movements in the skill differential using (16). As we shall see in the next chapter, authors who have tried to account for alleged cyclical movements have taken a different approach, stressing a direct, Phillips-type relationship between wages and unemployment within respective skill categories.

Looking at (16), one may observe that unemployment disappears from the individual's calculation whenever he expects its incidence among skilled and unskilled to be identical. In the historically more interesting case, when $U^u > U^s$, the wage ratio yielding indifference is lower than that implied by equality of unemployment rates. The reason is simply that opportunity costs are reduced, both during the individual's training and throughout his working life, by the expectation of having to suffer relatively long bouts of idleness as an unskilled worker. Differences in individual estimates of U^s and U^u are a second source of dispersion in $b_I(I^i)$.

The critical wage ratio will also be less than that predicted by equation (9) if wages are expected to benefit from continuing economic growth. No doubt the most artificial assumption used in constructing the model was that indifference calculations depend upon wage rates which do not change over time. In the light of historical experience, workers who make their decisions on this basis must be rare indeed.[12]

Let us therefore replace the unrealistic assumption that $W_t^s = W_o^s$ and $W_t^u = W_o^u$ by specifying

$$(17a) \quad W_t^s = W_o^s \, e^{G^i t} \quad \text{and}$$

$$(17b) \quad W_t^u = W_o^u \, e^{G^i t} \, ,$$

where G^i denotes the underlying growth rate anticipated by individual i. Since the individual's estimate of current wage levels, W_o^s and W_o^u, is already contained in (11), the expected growth path is fully determined. Substituting (17) into (4) ultimately yields

$$(18) \quad I^i = e^{(r^i - G^i) d^s} \, .$$

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[12] In addition to wage increases that come about through overall advances in productivity, workers normally anticipate increases as they acquire experience and seniority. Although increases of the latter variety may be strictly attributable to an accumulation of informal on-the-job training, they usually involve no obvious opportunity costs and may thus be included with the former simply as a source of expected wage growth.

Unequal expected growth rates for skilled and unskilled wages yield an algebraic expression which is slightly more complicated than (18) but which is nevertheless easily soluable for I^i. Variations in G^i introduce a third source of dispersion in $f_I(I^i)$.

By a proof similar to the one used in the case of r^i, it may be shown that dI^i/dG^i is ordinarily negative,[13] that is to say, an increase in the expected rate of growth lowers the wage ratio at which individuals become indifferent. Although the growth of wages increases the income foregone during the training period, its main effect is to swell net benefits. This conclusion is emphasized by Figure 3, which is drawn on the assumption that $G^i > r^i$. Over time the absolute differential for skill rises exponentially, whereas the percentage differential remains constant. Since net benefits are just the sum of n^s terms $(W_t^s - W_t^u)$, $t = d^s, d^s+1, \ldots, v$, exponential growth contributes more heavily to the latter quantity (area A3) than to foregone earnings (area A1), which occur early in the planning interval. For equality between the two areas to be restored, the intercepts of the growth curves must approach one another. The implied fall in I^i will presumably lead to increased entry into the skilled labour force.

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[13] See n. 5 above.

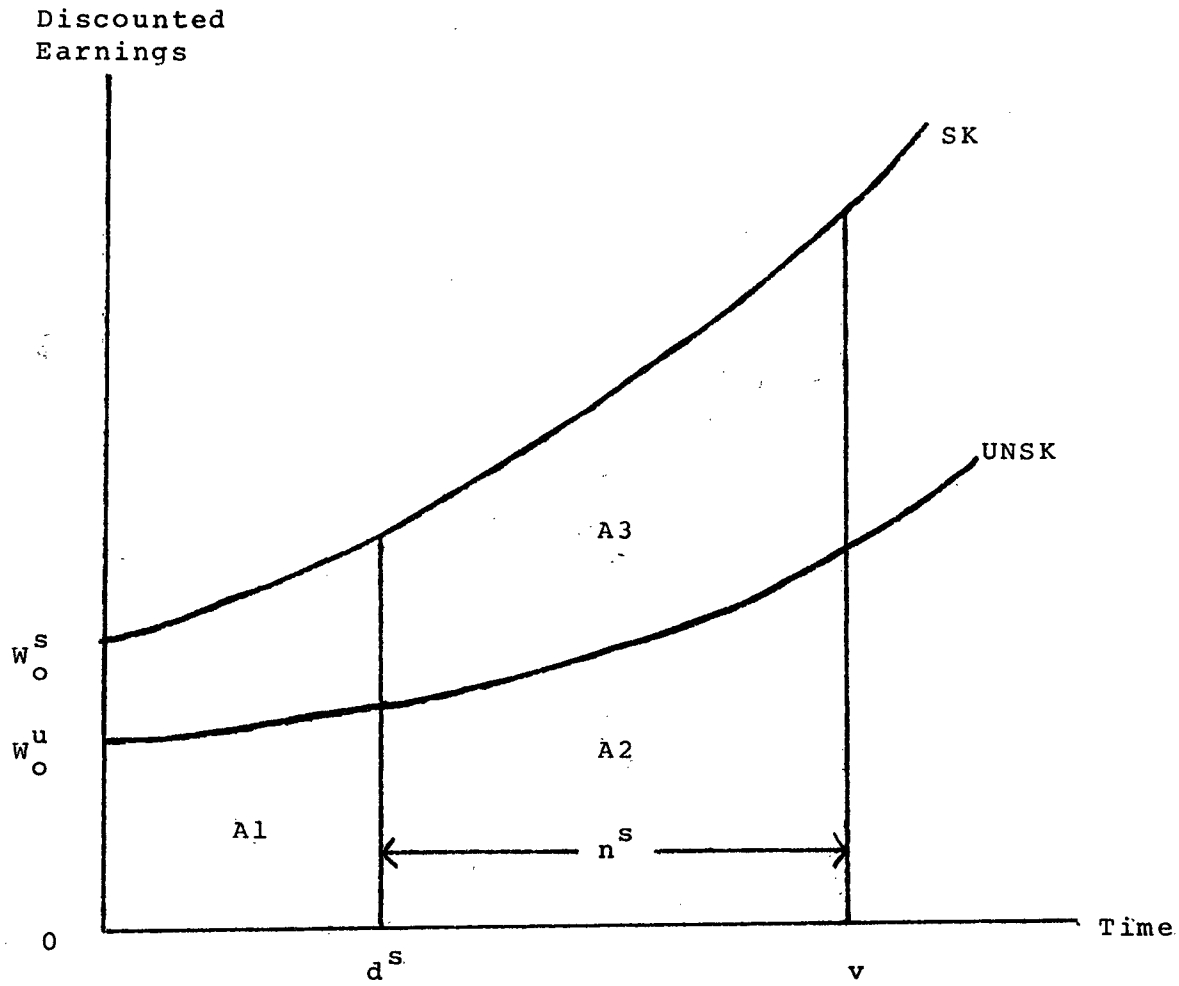

FIGURE 3

DISCOUNTING CURVES FOR SKILLED AND UNSKILLED EARNINGS IN THE PRESENCE OF GROWTH ($G^1 > r^i$)

Whether or not increased entry will also lead, in a given period, to an expansion in the relative supply of skilled workers depends upon the occupational composition of the retiring age cohort. Expansion is more likely when the population is growing than when it is static (since entry will exceed retirement), but the reverse is not inconceivable. This point merely underlines the fact that human capital in the form of skilled training is a relatively durable good. Since optimal adjustments in its stock are likely to be slow and halting, the adaptation of the skill mix to disequilibria will take a long time. In order to discuss the nature of equilibrium and disequilibrium, however, we must first consider relative demand.

The Demand Side

Once we discard the traditional view of labour as a homogeneous input and agree to treat its skilled and unskilled components as separate factors of production, the derivation of a relative demand function follows immediately from standard theorems concerning the behaviour of the firm. In general, one may determine relative demand simply by consulting the first-order conditions for an optimal combination of inputs.

To confirm this point, suppose that all firms in the economy possess the same CES production function[14]

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[14]Note that superscripts on the L's have been replaced by subscripts to avoid confusion with exponents.

$$(19) \quad P = A(\alpha_1 L_s^{-\rho} + \alpha_2 L_u^{-\rho} + \sum_{i=3}^{m} \alpha_i K_i^{-\rho})^{-1/\rho},$$

where $A > 0$, $\alpha_i > 0$ for $i = 1, 2, \ldots, m$, and $\sum_{i=3}^{m} \alpha_i = 1$. Of the m distinct inputs, only L_s and L_u are variable in the short run; the remainder, K_3 through K_m, are assumed fixed. Since the marginal productivities of the former are

$$(20) \quad \partial P/\partial L_s = (\alpha_1/A^{\rho})(P/L_s)^{1+\rho} \text{ and}$$

$$\partial P/\partial L_u = (\alpha_2/A^{\rho})(P/L_u)^{1+\rho},$$

the rate of technical substitution is

$$(21) \quad (\partial P/\partial L_s)/(\partial P/\partial L_u) = (\alpha_1/\alpha_2)(L_u/L_s)^{1+\rho}.$$

Minimizing the cost of producing a given output requires that firms equate the rate of technical substitution and the factor-price ratio W^s/W^u; hence,

$$(22) \quad W^s/W^u = (\alpha_1/\alpha_2)(L_u/L_s)^{1+\rho} \text{ or}$$

$$L_s/L_u = 1/(\alpha_a/\alpha_1)^{\sigma}(W^s/W^u)^{\sigma},$$

inasmuch as the elasticity of substitution σ equals $1/(1 + \rho)$.[15]

Besides stating the familiar condition for equilibrium in production, equation (22) expresses the firm's relative

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[15] See James M. Henderson and Richard E. Quandt, Microeconomic Theory: A Mathematical Approach (second edition; New York: McGraw-Hill Book Company, 1971), p. 86.

demand for skilled and unskilled labour. Although the precise form of (22) depends on the choice of a production function, it should be clear that, in general, the firm's relative demand curve will be negatively sloped as long as the specified isoquants are convex to the origin. In the case of the CES function used in the preceding illustration, convexity is assured whenever $\rho > -1$ or $\sigma > 0$.[16] The advantage of the CES specification is that it demonstrates very simply the role of the parameter σ. It is noteworthy, though not at all surprising, that the elasticity of the relative demand function is nothing more than the negative of the elasticity of substitution. This fact may be derived from equation (22) but is in any case obvious from the definition of σ.

In the long run the derivation of a negatively sloped relative demand curve requires that further restrictions be placed on the form of the production function. In the two-input case applicable to the short run, factors are necessarily "competitive". However, when the number of inputs exceeds two and all are free to vary, factors may be either competitive or "complementary". Thus, if W^s rises while all other factor prices remain constant, it is certain that the employment of skilled labour will fall, both absolutely and in relation to that of all other factors taken as a group; whether the particular employment ratio L^s/L^u will fall is not immediately

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[16] Ibid., p. 87.

predictable. If skilled and unskilled labour happen to be complementary in production, optimal substitution will mean that capital and other factors replace workers in both categories; and the change in L^s/L^u will be indeterminate.

Restrictions on the production function sufficient to ensure negatively sloped relative demand may be expressed in terms of partial elasticities of substitution. It can be shown that[17]

$$(23) \quad \eta_{ij} = \alpha_j(\sigma_{ji} - \eta), \qquad i, j = 1, 2, \ldots, m)$$

where η_{ij} is the elasticity of (absolute) demand for factor i with respect to the price of factor j, α_j is the share of j in total cost, σ_{ji} is the partial elasticity of substitution between i and j, and η is the elasticity of product demand. The firm's relative demand curve will be negatively sloping as long as $\eta_{ss} < \eta_{us}$, since a given percentage increase in W^s (or, ceteris paribus, in W^s/W^u) will then cause a greater percentage fall in L^s than in L^u. Upon simplification this condition reduces to

$$(24) \quad \sigma_{ss} < \sigma_{su} .$$

Since σ_{ss} is always negative, the relative demand curve will

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[17] For proof see R.G.D. Allen, Mathematical Analysis for Economists, London School of Economics and Political Science, Studies in Statistics and Scientific Method No. 3 (London: Macmillan, and New York: St. Martin's Press, 1966) pp. 505 ff.

be positively sloping only if σ_{su} is also negative and greater than σ_{ss} in absolute value. Complementarity alone ($\sigma_{ij} < 0$) is thus not sufficient to yield this result, whereas competitiveness ($\sigma_{ij} > 0$) rules it out completely. Even in the case of complementarity, the likelihood of observing a perverse slope appears faint, inasmuch as one normally expects the direct impact of price changes to be stronger than the accompanying cross effects.

Of course, skilled and unskilled wage rates do not fully determine relative demand in the long run: one must include in the specification the prices of all factors that enter the productive process. Even if changes in wage rates leave W^s/W^u unaffected, price ratios involving labour and other factors will doubtless alter; and substitution will therefore take place. Relative employment L^s/L^u will rise or fall depending on whether this substitution favours skilled or unskilled labour. The appropriate <u>long-run relative demand function</u> is thus

$$(25) \quad R \equiv L^s/L^u = g(W^s/W^u, W^u, W^3, W^4, \ldots, W^m),$$

where W^3 through W^m represent the prices of factors other than skilled and unskilled labour. It may be observed that W^u operates as a kind of numeraire. Given its value, one may determine all the factor-price ratios.

Unfortunately, the substitution process implied by (22) and (25) is sometimes difficult to discern in the real world because firms have at their disposal a number of

indirect means of varying factor proportions. Though one normally associates changes in factor proportions with the introduction of new methods of production, with physical rearrangements of plant and equipment, and with capital investment, other methods of adjustment are often feasible. In many situations firms will be able to reallocate work functions without altering the techniques of production in any meaningful sense. For example, when unskilled wages rise, tradesmen may find themselves doing routine tasks that previously employed their helpers. Firms may also respond by changing the nature of their product or their product mix. Although this course certainly involves technical adjustments, it is to be distinguished from the case of technological change with a constant product definition. Finally, since skill differentials vary across regions, firms may react to wage changes by moving the location of their plant. For example, those that produce a skilled-labour-intensive product may find it profitable to move to regions where skilled labour is relatively cheap.

Changes in technology, product, and plant location are possible, of course, only in the long run. Limitations on substitution in the short run obviously mean that relative demand will be more elastic the longer is the time horizon for which the function is defined.

It remains only to point out that if the assumption of identical production functions is maintained, then the desired aggregative relationships coincide precisely with those derived for individual firms in equations (22) and (25).

If production functions differ, one must apply some weighting procedure in order to obtain the proper result. On the other hand, one may choose to begin by postulating an aggregate production function, which will yield aggregate relative demand directly. The difficulties inherent in both approaches are well known and do not require comment here. It will merely be assumed in what follows that the required aggregation has benn carried out successfully.

Equilibrium

In the classical treatment of the labour market, equilibrium is said to exist when the quantity of labour supplied by individuals equals the quantity demanded by firms at the prevailing wage. In the context of relative supply and demand, it is therefore natural to define equilibrium as the condition that occurs when the skill mix available in the labour market coincides with the skill mix desired by firms at the prevailing wage ratio. Formally, equilibrium exists in the short run when

$$(26) \quad Q_T = R_T \ .$$

The wage ratio that equates Q_T and R_T constitutes the equilibrium value of the skill differential.

Long-run equilibrium poses a more complicated analytical problem, which is best explained with the aid of Figure 4. Initially, let us consider a situation in which the skill mix

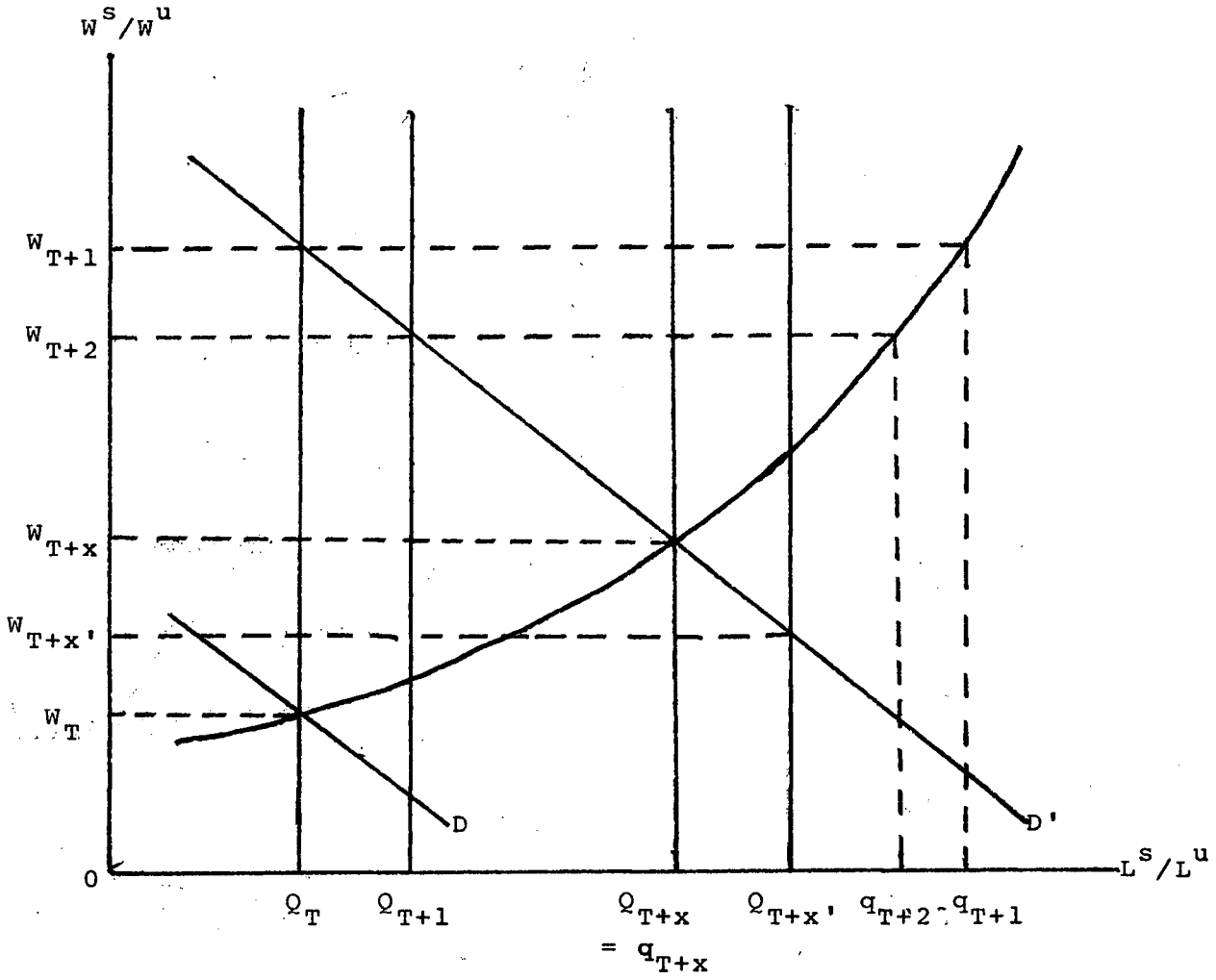

FIGURE 4

SHORT- AND LONG-RUN EQUILIBRIUM

within each age cohort is the same and, therefore, identical to the skill mix Q_T prevailing across the entire labour force. In the diagram the vertical line erected at Q_T represents relative supply in the short run. Relative demand in both the short and the long run is given by D. The distinction between short-run and long-run demand is not of crucial importance to the present discussion and is momentarily ignored. The curve labelled q plots equation (14) in the relative-wage-relative-employment plane. Accordingly, it shows the skill mix arising among new career entrants as a function of the existing wage ratio. Since the situation portrayed by the intersection of Q_T, D, and q will tend to maintain itself period after period, this configuration evidently defines long-run equilibrium.

The nature of this equilibrium is best understood by tracing the process of adjustment. Suppose, therefore, that demand shifts from D to D', perhaps because of technological change favourable to skilled labour. In the short run firms will presumably bid the skilled-unskilled wage ratio up from W_T to W_{T+1}. Among new entrants the skill mix will be q_{T+1}. As a result, the skill mix across the entire labour force will ultimately edge rightward to Q_{T+1}.[18] The distance moved

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[18] Because training takes time, those who choose the skilled occupation enter the labour force with a lag. Although an increase in q will have some immediate effect (simply because a number of retiring unskilled workers will not be replaced by new entrants, who now prefer skilled training), the full impact will not be felt until the end of the training interval. This complication is of no fundamental significance.

obviously depends upon the relationship between the size of the labour force, a stock, and the size of the periodic flows. In any case, the wage differential will recede somewhat, to W_{T+2}, and the skill mix of the next group of entrants will, at q_{T+2}, be somewhat less "rich" than q_{T+1}. This process will continue, with Q approaching Q_{T+x} at a decreasing rate.

Now, it might be supposed that Q_{T+x} and W_{T+x} define the limits of the trend. One may observe, however, that when the skill mix among new entrants is given by q_{T+x}, the skill mix pertaining to the retiring age cohort will necessarily have a lesser value. Hence, the short-run supply curve will continue migrating rightwards, perhaps as far as Q_{T+x}'. The skill premium will continue to fall and so will q. Ultimately, Q will swing back to the left.

The cyclical character of the adjustment process emerges must clearly if one momentarily pretends that the entire labour force retires and is replaced every period. The result, shown in Figure 5, is a version of the familiar cobweb model. Owing again to a shift in relative demand, the skill differential rises from W_T to W_{T+1}, short-run supply migrates to Q_{T+1}, the differential falls to W_{T+2}, supply contracts to Q_{T+2}, and so on through time. Whether the spiral path traced by this sequence of adjustments explodes or converges to a stable equilibrium at E depends, in the present example, upon the elasticities of relative demand and supply. Under realistic circumstances, stability will depend on how expectations react to the disequilibrium adjustments. As already noted in

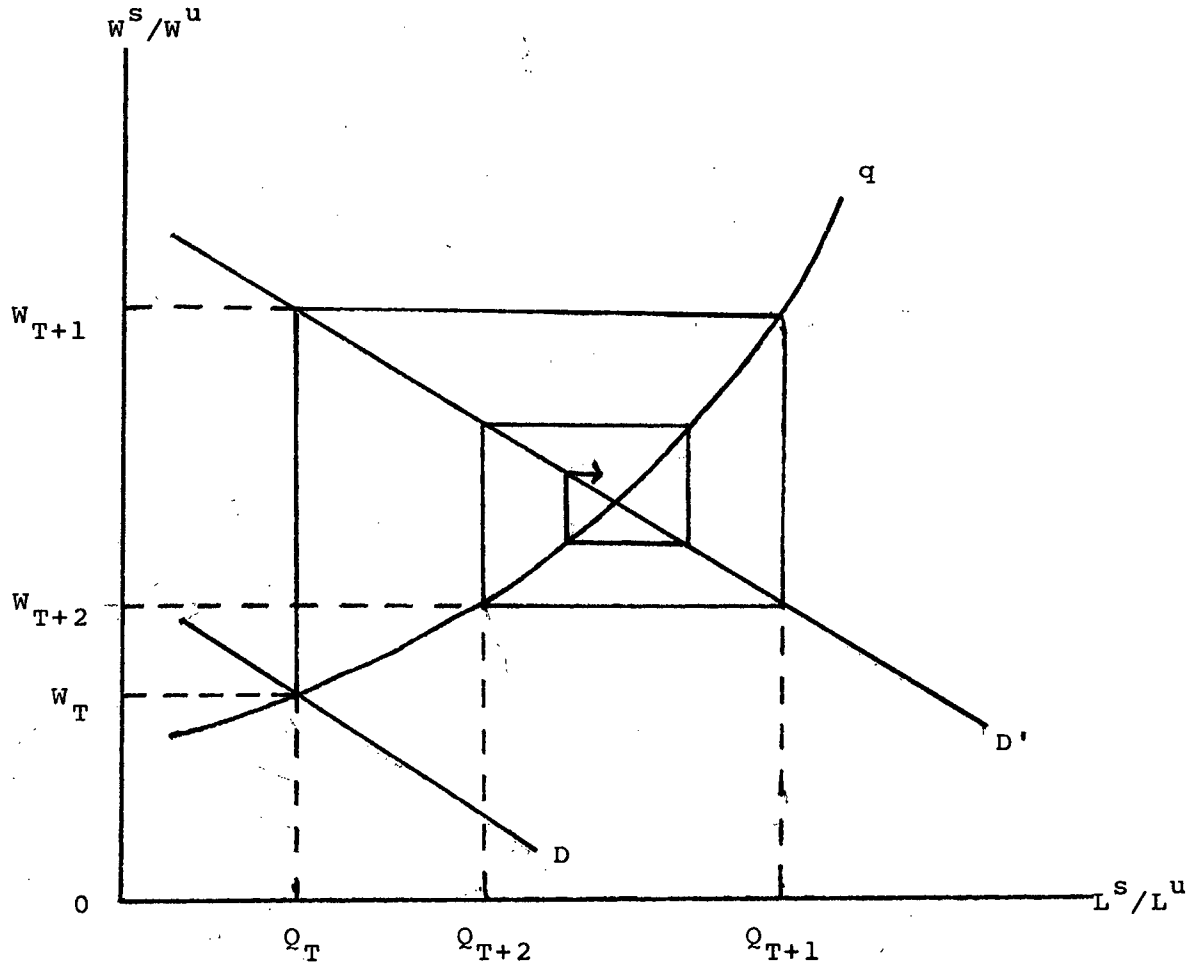

FIGURE 5

A COBWEB ADJUSTMENT PATH

the discussion of relative supply, the fact that periodic flows into and out of the labour force are normally a small fraction of the total stock of workers means that changes in the skill mix and in relative wages evolve rather slowly, whether or not the fluctuations ultimately explode or converge.

The conditions for long-run equilibrium are thus seen to coincide with those specified to begin the analysis. Stated formally, they are as follows:

$$(27) \quad Q_T = R_T \quad \text{and}$$

$$q_T = q_{T-i}, \text{ where } i = 1, 2, \ldots, v.$$

In general, these "proportionality conditions" are necessary but not sufficient for full equilibrium, since they provide no guarantee that <u>total</u> supply within each skill category will equal <u>total</u> demand. Firms may be content with the composition of the labour force but not with its overall size. If there is excess demand (supply), the general level of wages will presumably rise (fall). The behaviour of relative wages will then depend upon the individual or "absolute" elasticities of supply of skilled and unskilled labour. However, the particular assumptions invoked earlier concerning the invariance of hours and of participation rates ensure that supply in both categories will be perfectly inelastic. In this restricted case, or whenever conventional supply elasticities are equal, all wage changes will be proportional. Increases or decreases necessary to satisfy what one might call the "total conditions"

will then leave the equilibrium of relative supply and demand undisturbed.

Needless to say, it is most unlikely that the market will actually reach an equilibrium of the kind described in (27). Demand will surely undergo some disturbance long before homogeneity has been achieved in the skill composition of all age cohorts. As in other fields of analysis, equilibrium must be understood as a limiting case towards which the system is always tending.

Although (27) remains valid as a description of equilibrium, certain complexities have been omitted from the initial outline of the adjustment process. First of all, differences in the elasticity of short- and long-run demand will no doubt be of some significance. Since the immediate decline of the wage ratio from its peak of W_{T+1} (Figure 4) is likely to occur along the relatively inelastic short-run demand function, the fall will initially be more rapid than was earlier supposed. If expectations react quickly, the momentary effect will be to slow the expansion of the skilled labour force. Secondly, the adjustment process may well involve changes in both relative wages and general wage levels. As already noted, the latter occurence will call for substitution of capital and other factors in place of labour. Hence, long- and short-run relative demand functions will shift. This shift will alter the position of long-run equilibrium.

Since the function q has a positive slope, the hypothesized increase in relative demand should lead to an increase

in the skill premium and in the skilled-unskilled employment ratio. Indeed, q may be considered a long-run supply curve, inasmuch as it represents the locus of possible equilibria. This statement needs no qualification unelss one includes in the analysis the direct costs of skilled training. Then, it may occur that an increase in the number of trainees results in a fall in direct costs, either because of economies of scale in the human capital industry or because of falling long-run supply curves for the inputs of that industry. In such cases q will shift outward; and if the shift is sufficiently great, a new equilibrium may be established at a wage ratio lower than existed previously. However, in view of the minor role generally assumed for direct costs, this result appears improbable.

Except for the recognition accorded imperfect knowledge in the treatment of relative supply, the model presented here is obviously cast in a competitive framework. On the demand side the problem of noncompetitive market structures fails to arise. In the case of a firm which enjoys monopoly power in the product market, the fact that it might pay workers less than the value of their marginal product does not have any immediate implications for the analysis of relative demand. As one can see by consulting the derivations, marginal revenue--or price in the competitive case--will always cancel, leaving only parameters of the production function. The only conceivable impact of product-market structure on relative demand occurs when the production function is not homogeneous. In

this situation factor proportions utilized by the monopolist will differ from those utilized by the competitve firm because the profit-maximizing levels of output will differ. The complementary case of the firm which enjoys monopsony power in the labour market was implicitly ruled out in the short run by the assumption of fixed supply. In the long run it would be possible to introduce the monopsony condition into the model simply by constructing a curve q' marginal to q. The intersection of q' and D' would then determine equilibrium factor proportions, while the equilibrium skill differential could be read from q.

On the supply side market imperfections other than incomplete knowledge no doubt deserve some attention. It may well be that barriers to entry exist in the skilled trades, either through direct union control of the labour market or through officially sanctioned occupational licensing regulations. If such barriers exist, relative supply will not expand in the manner assumed. Instead, the skill premium will remain inflated, and there will be either a pool of unemployed tradesmen or a queue of individuals seeking training. Whether one observes unemployment or an apparent shortage of training facilities will depend upon the point at which control is applied.

Collective Bargaining

Though unions occasionally try to advance their interests by asserting control over the volume of employment,

it is more common for them to concede this variable to the discretion of firms and to concentrate whatever bargaining strength they possess in the area of wages. In view of the apparent impact of unions on the wage-setting process, it is obviously important to consider how bargaining behaviour may affect the skill premium. Various informal hypotheses dealing with this problem are surveyed in Chapter III, together with the existing empirical evidence. The present section approaches the issue from the standpoint of formal theory.

To treat collective bargaining within the orthodox framework of a maximization model requires that one specify some sort of objective function for the union, just as one specifies a utility function for the individual or a profit function for the firm. However, unlike the individual or the firm, the union is not an irreducible economic entity, but rather, an assembly of persons, each with his own unique set of preferences, allied through a complex political structure. For this reason it is not at all clear what the union will choose to maximize.

In a recent article Rosen[19] explores the implications of a model which is based on the hypothesis that the union attempts to maximize the total economic rent of its members.

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[19] Sherwin Rosen, "Unionism and Occupational Wage Structure in the United States," International Economic Review, II (June, 1970), 269-286.

Though other assumptions are possible,[20] this one appears well suited to an analysis of relative wages. Stated algebraically, Rosen's objective function is

$$(28) \quad V = \sum_{i=1}^{m} (W^i - \bar{W}^i)L^i ,$$

if there are m skill categories organized by the union. $\bar{W}^i$ denotes the constant wage at which firms may hire workers of the ith skill category had the union not existed. Besides giving the total economic rent of the union membership, V represents the increment in the wage bill attributable to the union's bargaining power. In attempting to maximize V, the union's outermost constraint will be the firm's demand-for-labour function, which in the short run may be written generally as $L^i = h^i(W^s, W^u, \ldots, W^m)$ for all i. Since unions are seldom omnipotent, the solution to the constrained maximization problem cannot be expected to forecase the precise outcome of the bargaining process; but it can give an indication of the direction in which the skill premium is likely to shift under union pressure.

If there are only two groups of workers, skilled and unskilled, and if each is organized by a separate union, maximizing (28) subject to the firm's demand constraint requires that

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[20] For a discussion of the possibilities see John T. Dunlop, Wage Determination under Trade Unions (second edition; New York: Augustus M. Kelly Inc., 1950), ch. 3, or Allan M. Cartter, Theory of Wages and Employment (Homewood, Illinois: Richard D. Irwin Inc., 1959), ch. 7.

$$(29)\quad \partial V/\partial W^s = (W^s - \bar{W}^s)(h^s_s + h^s_u \cdot dW^u/dW^s) + L^s = 0\ ,$$

where h^i_j denotes $\partial L^i/\partial W^j$. Multiplying through by W^s/W^sL^s and rearranging yields

$$(30)\quad \frac{W^s - \bar{W}^s}{W^s} = \frac{-1}{\eta_{ss} + \eta_{su} \cdot dW^u/dW^s}\ .$$

The presence of dW^u/dW^s emphasizes the fact that optimal strategy for one union depends upon its estimate of the other's reaction. In what Rosen terms the Cournot case, unions are oblivious to each other's manoeuvering, and $dW^u/dW^s = 0$. Since an expression analogous to (30) applies to the union of unskilled workers, one may write

$$(31)\quad \frac{(W^s - \bar{W}^s)/W^s}{(W^u - \bar{W}^u)/W^u} = \frac{\eta_{uu}}{\eta_{ss}}\ .$$

As one might guess, the relative impact of collective bargaining on wage rates depends inversely upon the relative elasticity of demand for skilled and unskilled labour, assuming the respective unions to be equally powerful.[21] If, as is frequently argued, the demand for skilled workers is less elastic than the demand for unskilled workers, collective bargaining will tend to inflate the skill premium.

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[21] In a sense, "bargaining power" is itself a function of demand elasticity. The term is used here to refer to the coersive strength that a union may possess regardless of demand conditions.

By negotiating independently, skilled and unskilled groups in effect compete against one another for shares of the wage bill. Not surprisingly, such competition is nonoptimal from the viewpoint of labour as a whole, since it fails to maximize the total value of the payroll. As long as union action can increase the size of the wage bill, it will be possible, at least in principle, to raise the incomes of some union members without decreasing those of the rest.[22] "Pareto optimality" is attainable only through complete collusion, for it will be recalled from discussions of firm oligopoly that this strategy is the only one which extracts the full revenue potential of the market.

If this reasoning is correct, it provides an interesting rationale for the phenomenon of industrial unionism. Though unions of skilled and unskilled workers may co-operate informally at times, merger into a single industrial union represents the surest form of collusion. In this case the union's objective function becomes

$$(32) \quad V = (W^s - \overline{W}^s)L^s + (W^u - \overline{W}^u)L^u.$$

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[22] Whether institutional arrangements exist to provide for the required income redistribution is, however, an important practical question. Since the new settlement will generally involve different levels of employment among both skill categories, the implication is that workers thrown into unemployment receive at least as much as if they had full-time jobs. One does not observe the private or public social welfare schemes that would be needed to effect the necessary compensation.

Because the mathematical argument from this point on is not entirely straightforward, it will be useful to pursue some of its intermediate steps, which Rosen omits from the published text.[23] Maximizing (32) subject to the demand constraint means that

$$(33a)\quad \partial V/\partial W^s = (W^s - \bar{W}^s)h^s_s - L^s + (W^u - \bar{W}^u)h^u_u = 0$$

$$(33b)\quad \partial V/\partial W^u = (W^s - \bar{W}^s)h^s_u - L^u + (W^u - \bar{W}^u)h^u_s = 0\ .$$

Converting to elasticities yields

$$(34a)\quad \eta_{ss}L^s(W^s - \bar{W}^s)/W^s - L^s + \eta_{us}L^s(L^uW^u/L^sW^s)(W^u - \bar{W}^u)/W^u = 0$$

$$(34b)\quad \eta_{su}L^u(L^sW^s/L^uW^u)(W^s - \bar{W}^s)/W^s - L^u + \eta_{uu}L^u(W^u - \bar{W}^u)/W^u = 0.$$

Since the ratio of factor shares α_i/α_j is given by L^iW^i/L^jW^j, we have

$$(35a)\quad \eta_{ss}(W^s - \bar{W}^s)/W^s + \eta_{us}(\alpha_u/\alpha_s)(W^u - \bar{W}^u)/W^u = 1$$

$$(35b)\quad \eta_{su}(\alpha_s/\alpha_u)(W^s - \bar{W}^s)/W^s + \eta_{uu}(W^u - \bar{W}^u)/W^u = 1\ ,$$

a pair of equations which may be routinely solved for $(W^s - W^s)/W^s$ and $(W^u - W^u)/W^u$. It follows that

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[23] I am grateful to Professor Rosen for providing the necessary clarification.

$$(36)\quad \frac{(W^s - \bar{W}^s)/W^s}{(W^u - \bar{W}^u)/W^u} = \frac{\eta_{uu} - \eta_{us}(\alpha_u/\alpha_s)}{\eta_{ss} - \eta_{su}(\alpha_s/\alpha_u)} .$$

The effect of industrial unionism on the skill differential thus appears to depend upon both relative factor shares and the magnitudes of the elasticities and cross elasticities of demand.

Equation (36) may, however, be simplified still further. In light of (23) we know that $\eta_{su} = \alpha_u(\sigma_{su} - \eta)$ and $\eta_{us} = \alpha_s(\sigma_{su} - \eta)$, whence

$$(37)\quad \eta_{su} = (\alpha_u/\alpha_s)\eta_{us} \quad \text{and} \quad \eta_{us} = (\alpha_s/\alpha_u)\eta_{su} .$$

Substituting into (36) and again using (23), one obtains Rosen's result:

$$\frac{(W^s - \bar{W}^s)/W^s}{(W^u - \bar{W}^u)/W^u} = \frac{\eta_{su} - \eta_{ss}}{\eta_{us} - \eta_{uu}} = \frac{\alpha_u(\sigma_{su} - \sigma_{ss})}{\alpha_s(\sigma_{su} - \sigma_{uu})} .$$

Let us now introduce into the argument a third factor of production, "capital", denoted by k. From the fact that factor demands are homogeneous of degree zero in prices, it follows that[24]

$$(39)\quad \alpha_s\sigma_{sj} + \alpha_u\sigma_{uj} + \alpha_k\sigma_{kj} = 0 \quad \text{for } j = s, u, k.$$

Substituting into (38) ultimately yields

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[24] See Allen, op. cit., p. 504.

$$(40) \quad \frac{(W^s - \bar{W}^s)/W^s}{(W^u - \bar{W}^u)/W^u} = \frac{(1 - \alpha_k)\sigma_{su} + \alpha_k\sigma_{uk}}{(1 - \alpha_k)\sigma_{su} + \alpha_k\sigma_{sk}} .$$

According to the foregoing expression, the effect of industrial unionism on the skill differential depends upon a comparison of the elasticity of substitution between capital and skilled labour and between capital and unskilled labour. Rosen argues that $\sigma_{sk} < \sigma_{uk}$. If this guess is correct--and it would appear justified on the basis of casual observation--then industrial unionism tends to increase the skill premium, just as in the case of independent craft negotiation. In view of the arguments surveyed in Chapter III, this conclusion is indeed startling.

Over the years a number of authors have suggested hypotheses to explain the behavior of skill differentials. The next chapter offers a detailed review of these arguments in light of the theoretical demand and supply relationships just discussed. What follows immediately, however, is a survey of the empirical evidence with which theoreticians have had to deal.

Chapter III

REVIEW OF THE LITERATURE

Although this study focuses upon the movement of skill differentials during the last two decades, it is important to consider the time series to be synthesized in Chapter IV in relation to earlier historical data for both Canada and other countries. Besides furnishing some perspective and a starting point for the present study, an examination of the historical record is helpful in understanding the origin of hypotheses offered in explanation. Accordingly, the first section of this review looks at what is known about movements of the skill differential in Great Britain, France, Sweden, the United States, and finally, Canada up to 1950. The final two sections deal at length with long-run and short-run rationalizations for the observed behavior.

Historical Background

Knowles and Robertson[1] penetrate farthest into the past with their study of skill differentials in Great Britain over the period 1880-1950. Taking four industries--building,

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[1] K.G.J.C. Knowles and D.J. Robertson, "Differences between the Wages of Skilled and Unskilled Workers, 1880-1950", Bulletin of the Oxford University Institute of Statistics, XIII (April, 1951), 109-127.

shipbuilding, engineering (metalworking), railways--and the police force, they discover a modest overall decline in the ratios of skilled wages to unskilled wages until the beginning of World War I. As one can see by scanning Table I, which reproduces figures for the building trades, very sharp declines took place during the war and through the brief postwar boom. With the onset of heavy unemployment, the ratio rebounded; but at its peak in 1922 it remained well below prewar levels.

TABLE I

SKILL DIFFERENTIALS IN THE BUILDING TRADES. GREAT BRITAIN, SELECTED YEARS

Year	Mean skilled wage/Mean unskilled wage
1880	1.565
1890	1.524
1900	1.499
1910	1.533
1914	1.503
1917	1.326
1919	1.203
1922	1.337
1924	1.323
1929	1.339
1934	1.328
1939	1.311
1942	1.261
1945	1.238
1947	1.245
1949	1.225
1950	1.189

Source: Knowles and Robertson, op. cit., p. 111. The ratio of unskilled rates to skilled rates provided by the authors has been inverted to accord with majority practice.

Only minor fluctuations occurred until the beginning of World War II. During the war the skill differential again registered a substantial decline. The relatively weak post-war correction having spent itself by 1947, the ratio fell to an extremely low level in 1950. With the exception of the police force, all the industries surveyed exhibited a similar pattern.

Information on the history of skill differentials in France has been summarized by Migué.[2] Selecting the building trades, as did Knowles and Robertson, he demonstrates for the period between 1896 and 1911 a gentle downward trend parallel to the one that took place in Britain. There is a gap in the figures until the year 1929, at which time the statistic for France matches that of Britain almost precisely. A slight rise in the differential until 1935 gave way to a substantial fall by the outbreak of World War II. Further sharp declines occurred during the war and in the immediate postwar period. By 1950 the ratio of skilled wages to unskilled wages had fallen to approximately 1.14. This very low skill premium was reached despite the complex system of wage controls imposed at the end of the war.[3]

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[2]Jean-Luc Migué, "The Theory of Occupational Wage Structure: an Application to the Canadian Experience" (unpublished Ph.D. dissertation, the American University, 1968), Table IV, pp. 30-33.

[3]Lloyd G. Reynolds and Cynthia H. Taft, The Evolution of Wage Structure. (New Haven, Conn.: Yale University Press, 1956), p. 213.

What little information is available on skill differentials in Sweden indicates that a slight narrowing occurred in the interval 1939-1950.[4] Since Reynolds and Taft assert that the differential was already rather small in 1939, a shrinkage as substantial as in the case of Britain and France was probably not to be expected.

A country for which a great deal of information exists is, of course, the United States.[5] The most comprehensive statistics covering the longest span of time are those provided by Ober. He shows that the median ratio of skilled wage rates to unskilled wage rates in manufacturing declined from 2.05 in 1907 to 1.55 in 1947.[6] Regional disaggregation yielded extremes of 1.70 for the South and 1.45 for the Far West in the latter year. Although Ober's study of manufacturing cannot be judged grossly misleading, it must be noted that the list of industries and occupations used for comparison is not consistent from year to year. Fortunately, the article does provide a consistent set of annual figures for the building trades. These are reproduced in Table II.

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[4]Reynolds and Taft, op. cit., pp. 241-242.

[5]See J.T. Dunlop, "Cyclical Variations in Wage Structure," Review of Economics and Statistics, XXI (February, 1939), p. 30-39; S. Lebergott, "Wage Structures," Review of Economics and Statistics, XXIX (November, 1947), pp. 274-285; Harry Ober, "Occupational Wage Differentials, 1907-1947", Monthly Labour Review, LXXI (August, 1948), pp. 127-134; Philip Bell, "Cyclical Variations and Trends in Occupational Wage Differences in American Industry since 1914", Review of Economics and Statistics, XXXIII (November, 1951), pp. 329-337; Toivo Kanninen, "Occupational Wage Relationships in Manufacturing", Monthly Labour Review, LXXVI (November, 1953), pp. 1171-1178; Reynolds and Taft, op. cit., ch. 12.

[6]Ober, op. cit., p. 130.

TABLE II

SKILL DIFFERENTIALS IN THE BUILDING TRADES
UNITED STATES, SELECTED YEARS

Year	Mean skilled wage/Mean unskilled wage
1907	1.85
1910	1.92
1914	1.99
1917	1.91
1919	1.80
1920	1.66
1925	1.81
1929	1.79
1933	1.82
1936	1.75
1939	1.70
1942	1.60
1945	1.54
1947	1.43
1949	1.41
1950	1.39

Source: Reynolds and Taft, op. cit., p. 323. Figures for 1949 and 1950 have been added to Ober's series by the authors.

Tracing the course of this series over the first two decades, one observes three distinct phases in the movement of the ratio. A steady rise[7] lasting until 1914 gives way to an extraordinary plunge, which reaches its low point in 1920. The ensuing correction returns the skill premium in 1925 to a level just short of that exhibited in 1907. After these

[7] Migué (op. cit., pp. 34 ff.) argues that the upward trend began as early as 1875.

major fluctuations there is relative stability for the remainder of the 1920's.

In 1933, the trough of the Great Depression, one may discern, if not a peak, at least a pivotal point for the next important trend. From this year onward, through World War II and the postwar period, the ratio falls continuously and, in most instances, rather sharply. In the terminal year, 1950, it is almost 50 percentage points below its initial level, but still well above comparable figures for Britain and France.

Turning to the Canadian experience, one is struck by the great amplitude of movements in the skill differential. Although fluctuations in the American statistics are wide by European standards, they do not match the swings apparent in the Canadian data. This observation emerges from calculations performed by Migué on wage rates for journeymen and labourers in the building trades of Montreal. Taking a simple average of hourly wages for seven skilled occupations and dividing this figure by the wage for common labour, the author compiles the series of ratios given in Table III.

TABLE III

SKILL DIFFERENTIALS IN THE BUILDING TRADES.
MONTREAL, SELECTED YEARS

Year	Mean skilled wage/Mean unskilled wage
1901	1.31
1907	1.53
1911	1.37
1915	1.39
1919	1.45
1921	2.00
1923	1.80
1927	2.19
1929	2.27
1931	2.45
1933	2.12
1935	1.95
1938	1.84
1942	1.77
1944	1.61
1948	1.68
1951	1.61

Source: Migué, op. cit., Table A-2, pp. 144-145.

Though comparison of absolute magnitudes across countries is rather tenuous, it does appear from this series that the skill differential in Canada stood at a relatively low level around the turn of the century. In any case, there was a sharp rise and fall in the opening decade, succeeded by a mild advance that carried through to the end of World War I. The four years between 1919 and 1923 saw a convulsive movement with its peak in 1921. There followed a spectacular climb, which sent the ratio to a remarkable height of 2.45. From

this peak in the Depression year of 1931, the differential declined through World War II. Nineteen forty-eight illustrates the extent of the postwar reversal, which one will recall, occurred in Britain as well. By 1951 it had been completely erased.

Fortunately--for it would be ludicrous to generalize on the basis of the preceding data along--Migué does present a certain amount of corroborating evidence.[8] The great peak of 1931 is shown to exist in similar series for the iron casting and machine shop industries and for the printing trades. In four other cities besides Montreal, the building trades demonstrate a pattern roughly equivalent to the one outlined.[9]

Indeed, there can be no doubt that skill differentials declined broadly after the early 1930's. Reynolds and Taft select 15 industries and 17 skilled occupations for comparison over two intervals, 1930-1939 and 1943-1952.[10] In all but a few cases the percentage differential over the labourer's rate fell markedly during both periods. Woods and Ostry employ a similar list of industries and, not unexpectedly, come to the same conclusion.[11] Reaching back into the 1920's, they identify the earlier rising trend so prominent in Migue's data.

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[8] Ibid., Table V, p. 41.

[9] Toronto is the exception, displaying a peak in 1941.

[10] Reynolds and Taft, op. cit., Table 11-2a, pp. 294-295, and Table 11-2b, pp. 296-297.

[11] H.D. Woods and Sylvia Ostry, Labour Policy and Labour Economics in Canada (Toronto: MacMillan of Canada, 1962), Table XLVIII, pp. 432-433.

Should any further confirmation be required, it is contained in a descriptive study prepared by the Canada Department of Labour.[12]

In all countries changes in the skill differential may be decomposed, at least conceptually, into short- and long-run movements, or to be more precise, into fluctuations that stem from factors grounded in the business cycle and broad trends that result from structural evolution of the economy in question. The final section of this chapter deals with short-run factors; the following section, with arguments applicable to the long run.

Long-run Hypotheses

Factors that operate in the long run may be grouped under five general headings: (1) education and training, (2) social attitudes and policy, (3) migration flows, (4) technological change, and (5) unionization. These will be discussed in turn.

Education and training. Prior to the acceptance of the "human capital approach" as a tool of orthodox analysis, many writers had identified a link between skill differentials

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[12] Canada Department of Labour, Economics and Research Branch, Wages Research Division, The Behaviour of Canadian Wages and Salaries in the Postwar Period (Ottawa, Queen's Printer, 1967), ch. 10.

and education.[13] Tinbergen asserts: "Statistical data for a number of countries shows that the wage differentials between skilled and unskilled labour in countries with a high level of general eduation are less than in countries with a low level of education."[14] It is clear from the context of this statement that education is being viewed as a commodity served up by governments in autonomous fashion as a response to the general desire for social betterment. In grasping the opportunity for increased schooling, individuals are seen as engaging primarily in consumption and not in any act of investment.

Now, whether the spread of public education has actually been the result of autonomous social forces or the outcome of a multitude of private and collective investment decisions, the effect of this phenomenon on wage differentials has seemed

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[13] One may trace this association back as far as Adam Smith. See An Inquiry into the Nature and Causes of the Wealth of Nations, edited by Edwin Cannan (New York: Modern Library, 1937), p. 101. Two modern examples are: A.G.B. Fisher, "Education and Relative Wage Rates," International Labor Review, XXV (June, 1932), pp. 742-764, and Colin Clark, The Conditions of Economic Progress (3rd ed.; London: Macmillan & Co. Ltd., 1957), p. 525.

[14] Jan Tinbergen, "Some Remarks on the Distribution of Labour Incomes," International Economic Papers, I (1951), p. 207.

indisputable to most authors.[15] From the basic human capital model developed in Chapter II, it is evident that, between any two skill categories, a narrowing of the gap in educational attainments brings about a narrowing of the wage differential. Recall, however, that it is the gap in absolute length of training time that is important, and not some relative standard of inequality. This distinction is crucial in interpreting some of the more casual comments one finds in the literature, for it is by no means self evident that the spread of public education would always have worked towards eliminating educational disparities. If those who eventually become skilled and those who remain unskilled accept equal increases in average amounts of publicly subsidized schooling, our model gives no reason to expect any change in the skill differential.

It must be argued that unskilled workers have increased their attainments more than the skilled. If skilled workers have traditionally received education in excess of the legal minimum, then an increase in the statutory school-leaving age

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[15] See Melvin W. Reder, "The Theory of Occupational Wage Differentials," American Economic Review, XLV (December, 1955), p. 845; Reynolds and Taft, op. cit., p. 184; Woods and Ostry, op. cit., p. 431; Mark W. Leiserson, "Wage Decisions and Wage Structures in the United States," in Wage-Structure in Theory and Practice, edited by E.M. Hugh-Jones (Amsterdam: North-Holland Publishing Company, 1966), p. 53; S.G. Peitchinis, "Occupational Wage Differentials in Canada, 1939-1965," Australian Economic Papers, VIII (June, 1969), p. 21.

might have affected only those destined for unskilled employment, narrowing the disparity between the two classes of workers. Peitchinis seems to suggest that this mechanism has been operative.[16] In any case, if advancement of the school-leaving age, through either custom or statute, has had the effect of keeping a large number of potential unskilled workers off the labour market, one would expect relative wages of the unskilled to benefit.

However, the important point is not that a growing stock of potential unskilled workers has had its entry into the labour market deferred, but rather that a lengthened stay in school has made further training for skilled employment appear more profitable than before. As Keat says, "The increased number of years of school completed may have tended to decrease the number of years required in training, and the additional education may have contributed to lowering the cost of training per year."[17] In other words, the spread of public education has increased the efficiency of specialized vocational training. By remaining in school longer than in the past, the typical individual acquires powers of reasoning and literacy, an inventory of general knowledge, and possibly some elementary work preparation, all of which combine to

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[16] Peitchinis, op. cit., p. 21.

[17] Paul G. Keat, "Long-run Changes in Occupational Wage Structure," Journal of Political Economy, LXVIII (December, 1960), p. 598.

shorten the length of time he must spend learning a skilled trade. Indeed, Keat suggests that the average term of apprenticeship in the United States declined over the first half of this century by as much as one and a half years.[18] A shortened period of training implies decreased cost in terms of foregone earnings and a fall in the wage differential. This fall takes place regardless of whether disparities in the public school component of total training time narrow or remain constant; all that is required is for the general level of public education to rise.

If the general level of education does increase--as it most certainly has over the period surveyed--then an increasing proportion of the labour force may be able to achieve the minimum threshold qualifications that previously constituted a barrier to entry to vocational training. Other things being equal, the skill differential will fall, since the rate of growth of the skilled labour force will increase relative to that of the unskilled labour force.

It remains to point out that if skilled and unskilled labour have become more nearly homogeneous than in the past (owing to a narrowing of differences in training), then they are also likely to be more substitutable in productive processes. One would therefore expect the demand for each class of labour, taken individually, to be more elastic than before.

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[18] Ibid., p. 596.

Social attitudes and policy. It has been argued, notably by Perlman,[19] that the spread of "egalitarian sentiment" has played an important role in the secular decline of skill margins. The precise mechanism by which a general taste for economic equality penetrates the wage-setting process varies, however, from country to country:

> [In Europe] egalitarian sentiment is reflected either in centralized wage determination by government, as in France and Italy, or by union-management agreement, as in Sweden. In France and Italy wage leveling by official bodies may not result so much from pure egalitarian sentiment as from the need to placate strong leftist elements.[20]

Since the influence of unions is discussed fully in a later section, it is unnecessary at this point to do more than acknowledge the possibility that such bodies provide a vehicle for the implementation of changes in the prevailing philosophy of income distribution. As for the influence of government, it strains the economic mind to think that official decree could uphold for very long a system of wage differentials standing in contradiction of market forces. If one is to admit any direct effect of social attitudes on skill differentials, it must be held that rent-producing barriers to entry in the skilled trades are dismantled or that new entrants to these crafts accept lower rates of return than had been "normal" in the past or that the wage-depressing effects of

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[19] Richard Perlman, "Forces Widening Occupational Wage Differentials," Review of Economics and Statistics, XL (May, 1958), pp. 107-115.

[20] Ibid., p. 110.

discrimination against subgroups of unskilled workers diminishes in intensity.[21]

Although the effects of rising egalitarianism are difficult to handle in rigourous fashion, one manifestation of this phenomenon has been subject to a great deal of formal analysis. Increases in the statutory minimum wage have been a controversial tool of wage policy and, according to Perlman, the main resort of governments in North America. Though it would appear that an increase in the minimum wage causes an immediate compression of wage differentials,[22] the long-run impact is uncertain. If the minimum wage constitutes the opportunity cost of skilled training, theory suggests that any increase will lead to a contraction in the rate of growth of the skilled labour force and, in the long run, to a restoration of the original wage differential. This reaction will be speeded in the disequilibrium period by the tendency of firms to substitute highly paid skilled labour for the workers whose wages have risen. However, if the mortality of firms or the substitution of capital for unskilled labour causes unemployment within this category of workers,[23] then their

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[21] On the first point see Tinbergen, op. cit., and on the last, Gary S. Becker, The Economics of Discrimination (Chicago: University of Chicago Press, 1957), ch. I and II.

[22] See, for example, George Macesich, "Are Wage Differentials Resilient: an Empirical Test," Southern Economic Journal, XXVII (April, 1961), pp. 348-352.

[23] The effect of the minimum wage on employment has, of course, been the major point of contention in the literature. See Harry Weiss, "Economic Effects of a Nationwide Minimum Wage," and John H. Van Sickle, Lazare Teper, and N.

nominal wages will not, as we have seen, reflect the true change in expected value. On account of the decreased probability of securing unskilled employment, one might observe a fall in the skilled-unskilled wage ratio.

However valid this analysis, it is doubtful that minimum-wage legislation has had much impact on the ratio during the period under consideration. The statutory minimum is an operative constraint for a relatively small number of low-wage industries and for a small minority of workers trapped at the bottom of the productivity scale because of age, sex, immobility, or disability.[24] For most individuals contemplating investments in skilled training, the jobs in question are already dominated by superior opportunities. Moreover, any minimum wage fixed by government in money terms has, in this century, been undermined very quickly by inflation and rendered inoperative through advances in productivity, so that it is unlikely that long-run adjustments of the kind just discussed have been able to work themselves out. At most, the impact of the statutory minimum wage appears scattered

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Arnold Tolles, "Discussion," Industrial Relations Research Association, Proceedings of Ninth Annual Meeting (1956), pp. 154-166 and pp. 184-194 respectively. For a recent theoretical analysis see Harry G. Johnson, "Minimum Wage Laws: a General Equilibrium Analysis," Canadian Journal of Economics, II (November, 1969), pp. 599-603.

[24] See Richard A. Lester, Economics of Labor (New York: Macmillan Co., 1964) pp. 507 ff.

and confined to the short run.

Reder argues that it is not any statutory minimum which is relevant, but rather some sort of cultural subsistence rate, which he terms the "social minimum."[25] This wage rate he describes as "an intellectual construct (not directly observable) whose behavior is reflected in ... shifts of workers between the household and industrial sectors."[26] If one is prepared to accept a concept as vague as this, then one may also concede that its impact may have been broader than that of the legislated minimum wage. The nature of its economic effect should, of course, have been the same. In any case, more will be said about Reder's social minimum in commentary on his short-run analysis of wage differentials.

Migration flows. In discussions pertaining to North America, it is commonly argues that the high skill margins observed during the early years of this century were maintained by heavy migrations of unskilled workers to jobs in the industrial sector.[27] These migration flows, from abroad and from the rural areas of the continent, swelled the supply of

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[25]Reder, op. cit., pp. 839 ff.

[26]Melvin W. Reder, "Wage Structure and Structural Unemployment," Review of Economic Studies, XXXI (October, 1964), p. 313.

[27]See Woods and Ostry, op. cit., p. 431, and Peitchinis, op. cit., p. 29.

unskilled labour and kept the wages of this category of workers depressed.[28] Keat points out, in addition, that recent migrants have been victims of wage discrimination,[29] and Reynolds speculates that these workers and their families, having been accustomed to inferior living standards, may have settled for less than they could have received had they been more agressive and better informed.[30] Although these subsidiary factors affect skilled and unskilled alike, a relative high proportion of recent migrants in the unskilled labour force would mean that average unskilled wages suffer more than average skilled wages.

In any case, it follows that a subsidance of immigration and of rural-to-urban movements could help to explain the secular decline of skill margins. If one is to accept this argument, however, a number of empirical points must be established. What is precisely relevant is not the proportion of unskilled in the total migration flow or the contribution of migration to the total labour force, but rather, the contribution of migration to each skill category. On this matter Keat states: "It would appear that immigration [during

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[28]For a theoretical treatment of the effect of unskilled immigration, see Vera C. Lutz, "Foreign Workers and Domestic Wage Levels with an Illustration from the Swiss Case," Banca Nazionale del Lavoro Quarterly Review, XVI (March, 1963), pp. 3-68.

[29]Keat, op. cit., p. 594.

[30]Lloyd G. Reynolds, Labor Economics and Labor Relations (2nd ed.; New York: Prentice-Hall Inc., 1954) p. 527.

the years preceding World War I] would have affected the supply curve of unskilled workers more than of skilled workers."[31] Looking at Canadian census figures, Migué finds the exact opposite.[32] During the decade 1911-1921 immigration accounted for 25.8% of the growth in the unskilled labour force and 46.3% of the growth in the labour force employed in the skilled occupations selected previously for study. In the interval 1921-1931 the percentages were 23.2 and 37.1 respectively. Between 1941 and 1951 emigration made up 73.6% of the decline in unskilled employment, whereas immigration contributed 5.8% of the increase among skilled occupations.

If one recalls Migue's series on the skill differential, it is evident that international migration could not have been its major determinant; since there is no consistent relationship between the two variables, the most one can say is that immigration may have modified the trend to some degree. In fact, unless one is prepared to specify something about demand elasticities, it is impossible to predict the effect of increments in supply from any source, even if ceteris paribus is invoked. Should the elasticity of demand for unskilled labour be low compared to that for skilled

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[31] Keat, op. cit., p. 594.

[32] Migué, op. cit., Table XVIII, p. 121. Whether Migue's selection of skilled occupations makes his figures unrepresentative is of no importance, provided one relates them solely to the corresponding series on skill differentials.

labour, a relatively small addition to supply in the former category may still effect a decline in the wage rate sufficient to produce a decline in the skill differential, even though skilled wages fall at the same time. Although this ordering of demand elasticities appears contradicted by later arguments, the preceding problem cannot be ignored in a priori discussion.

Whatever the precise impact of immigration on skill differentials in Canada and the United States, the effect must surely have been just the opposite in Europe, since this continent was overwhelmingly the greatest source of migrants to North America. Inasmuch as skill differentials fell more or less simultaneously on both sides of the Atlantic. It is again clear that the flow of migrants could not have been the decisive variable. As for the influence of rural-to-urban migration, none of the authors surveyed furnished any systematic analysis to back up speculation concerning its importance.

Technological change. The development of new products and the discovery of improved industrial processes has led, over the past half century, to significant changes in the production functions to which firms refer in formulating their demands for skilled and unskilled labour. Somewhat surprisingly, a number of writers have contended that these changes have favoured skilled workers less than the unskilled. Although the introduction of complex and sophistocated production methods has undoubtedly given rise to a strong demand

for highly trained manpower, it appears that a large proportion of the jobs created in this way occur in the white-collar-categories.

Among plant workers, there is evidence that tradesmen have not benefited from technological change to the same extent as other groups. The typical "modern" production process involves a few skilled workers, a few unskilled, and a large number of machines tended by semi-skilled operatives. Thus, in comparing Canadian census figures for 1941 and 1951, Scoville[33] found that the number of "unspecialized" jobs in manufacturing grew at a considerably faster rate than the number of "specialized" jobs. The latter category consists mainly of skilled and other highly trained workers, whereas the former includes unskilled and most semi-skilled.[34] Since unskilled employment fell during the period, the growth of the semi-skilled work force was clearly evident. Inasmuch as semi-skilled workers are ordinarily recruited from the ranks of the unskilled, the trend identified by Scoville implies a fall in the supply of

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[33] J.G. Scoville, The Job Content of the Canadian Economy, 1941, 1951, and 1961. Dominion Bureau of Statistics, Special Labour Force Studies, No. 3 (Ottawa: Queen's Printer, 1967), pp. 10-14.

[34] In a certain sense, semi-skilled workers may often appear more highly "specialized" than skilled workers. However, an economic, as opposed to a functional interpretation of the term stresses the time and expense committed to the necessary training, which in the case of the semi-skilled is, by definition, slight. For a comment on this point see Melvin W. Reder, "Gary Becker's Human Capital: a Review Article," Journal of Human Resources, II (Winter, 1967), p. 101.

unskilled labour and, hence, a rise in the relative supply of skilled workers. This movement is obviously consistent with the accompanying decline in the skill premium.

It has also been suggested that technological change has tended over the years to dilute the skill content of many "skilled" jobs. Though occupational titles remain unchanged, work functions have in many cases become less exacting than they once were. As Peitchinis states, "... the invention of a tool which enables a relatively unskilled worker to perform tasks that required the specific knowledge of a craftsman would reduce demand for the latter and increase demand for the former;..."[35] If the development of tools that are simple to operate and yet highly efficient increases the productivity of the unskilled worker in relative terms, the effect in a competitive labour market should be to raise his relative wage. At the same time, the partial "de-skilling" of some jobs may increase the relative supply of skilled labour by shortening the required training time; indeed, we have already noted Keat's assertion that the average period of apprenticeship has shrunk considerably in the United States. According to our model the result should be a narrowing of wage differentials.

In the years immediately after World War II the narrowing process frequently took place under the auspices of

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[35]Peitchinis, op. cit., p. 38.

detailed "job evaluation" programmes designed by firms to rationalize outdated wage structures.[36] By subjecting each occupation to an objective rating procedure, employers sought to remove the inequities and distortions that had accumulated during the war and to substitute in their place a set of wage relationships that accurately reflected postwar technological realities. Though it is unlikely that job evaluation exerted any independent effect on wage differentials, the approach may well have hastened the erosion of wage relationships maintained solely by custom and neglect, in opposition to market forces.

The adoption of increasingly efficient production methods and the implementation of "scientific" management practices such as job evaluation do not, of course, portray the full extent of technological change. As already remarked, advances in technology manifest themselves not only through improvements in the means of production but also through the introduction of new consumer goods. Moreover, the steady growth of income that accompanies technological progress leads to a continuous restructuring of demand for existing products. Since optimal factor proportions will not generally

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[36]The steel industry of the late 1940's represents a classic American case. See Jack Stieber, The Steel Industry Wage Structure (Cambridge, Massachusetts: Harvard University Press, 1959). For a further discussion of job evaluation see E. Robert Livernash, "The Internal Wage Structure," in New Concepts in Wage Determination, edited by George W. Taylor and Frank C. Pierson (New York: McGraw-Hill Book Company, Inc. 1957), pp. 140-172.

be the same for the production of all goods, changes in the output mix demanded by consumers clearly imply changes in relative demand for skilled and unskilled labour. In order to explain the observed decline in the skill premium, one might therefore argue that, on balance, product demand has shifted in the direction of goods for which the production process is relatively intensive in the use of unskilled labour. Migue examines this possibility in as much detail as the scarcity of data permits and comes to the conclusion that the available statistics do not support such a hypothesis.[37]

Peitchinis argues that one very important aspect of technological change--namely, the development and proliferation of modern communications media--is more clearly biased in favour of unskilled workers. He reasons as follows:

> ...other things being equal, the easier it is to acquire adequate and accurate information, the lower is the difference between the current wage and opportunity costs. But the increase in information about job opportunities benefits those who have and are willing to take advantage of alternative opportunities. Many skilled workers have few alternative opportunities, and on the average they are less mobile than the unskilled, both industrially and geographically.[38]

Since it is implied that average unskilled wages rise, the increased flow of information must be presumed to benefit unskilled workers not only more than skilled workers but also more than employers of unskilled labour; otherwise, wage offers

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[37] Migue, op. cit., pp. 60 ff.

[38] Peitchinis, op. cit., p. 30.

might fall to such an extent that average wages would decline. In regard to skilled workers, the important point may be not so much that these individuals possess few alternatives and are less mobile than other workers, but rather that they have always been comparatively well informed and thus experience smaller marginal benefits from the general abundance of market information.

Though it is obvious that technological progress which is biased in favour of unskilled workers will lead, ceteris paribus, to a decline in the skill premium, Becker contends that advances which are completely neutral yield the same result. This rather surprising conclusion stems from an argument that begins as follows:

> If progress were uniform in all industries and neutral with respect to all factors, and if there were constant costs, initially all wages would rise by the same proportion and the prices of all goods, including the output of industries supplying investment in human capital, would be unchanged.[39]

Therefore, the direct costs of education remain constant. Becker continues:

> Since wage ratios would be unchanged, firms would have no incentive initially to alter their factor proportions. Wage differences, on the other hand, would rise at the same rate as wages, and since investment costs would be unchanged, there would be an incentive to invest more in human capital, and thus to increase the relative supply of skilled persons.[40]

The incentive to invest in human capital depends, of course, on a comparison of benefits and costs. Wage differences, or

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[39] Gary S. Becker, Human Capital (New York: Columbia University Press, 1964), p. 53.

[40] Ibid.

to be more explicit, absolute wage differences, determine the total value of net benefits. By again consulting Figure 3, one may verify that proportional growth increases the size of these absolute differences and expands the dollar value of net benefits, represented as before by area A3. If costs are indeed constant, as Becker states, then investment will certainly increase; and the skill premium will ultaimately fall.

Although direct costs are constant, it is not immediately clear that foregone earnings are unchanged. Since unskilled wages rise along with skilled wages, it appears instead that foregone earnings must increase as well. According to Becker, any positive rate of growth should lead to a continuous decline in the wage ratio required for indifference. In equation (18) it was demonstrated, however, that although an increase in the rate of growth leads to a fall in the indifference ratio, a stable growth rate implies a unique and unchanging indifference ratio.

The validity of Becker's argument turns out to depend on a strict application of the definition of neutral technological change. The explanation appears in a footnote:

> Some persons have argued that only direct costs would be unchanged, indirect costs or foregone earnings rising along with wages. Neutral progress implies, however, the same increase in the productivity of a student't time as in his teacher's time or in the use of raw materials, so even foregone earnings would not change.[41]

Becker has found, it seems, a clever, though somewhat circuitous way of saying that technological progress shortens the

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[41] Ibid., n. 27.

training time required to qualify for skilled employment. Because the trainee's time is more productive, he learns more quickly than before and, hence, incurs decreased opportunity costs. This explanation for the observed decline in the length of the apprenticeship period constitutes an alternative to the de-skilling hypothesis mentioned earlier.

Though one may readily concede that improvements in the technology of instruction may have shortened the time needed to train a skilled worker, it is much more difficult to admit the likelihood that significant improvement has occurred in the human raw material which is submitted to the educational process. An improvement in basic human potential, is, after all, what Becker's strict definition of neutral progress requires. It is true that the growth of incomes stemming from technological progress has led to increases in general education and to advances in nutrition and health and that all these factors may be reasonably expected to augment the trainee's learning capacity; but in such instances, the apparent increase in the "productivity" of training time arises simply because of additional investments in human capital made prior to the commencement of training. Though one must agree with Becker's logic, the case he analyses may be empirically irrelevant.

Whether progress is neutral or biased, its income effects may well have an ultimate bearing on the size of the skill premium. As already noted, increased incomes may lead indirectly to increases in learning capacity. When capital

markets are imperfect, the ability to finance investment in human capital from current incomes is also likely to be a significant factor in the expansion of the skilled labour force. Furthermore, increases in taxable capacity undoubtedly result in an increased public contribution to both public and private spheres of direct expenditure on education. Growth may thus be looked upon as a basic factor accounting for the rise of general education noted earlier. Finally, as incsmes grow, tastes change. If individuals have simply become more disposed towards skilled training or skilled work than in the past, they will swell the number seeking skilled employment and thereby compress wage differentials.

Unionization. Of all the factors that might be thought to influence skill differentials, the spread of trade unionism has undoubtedly provoked the greatest interest over the past two decades. As in other discussions of union impact, the problem has been to distinguish substance from appearance. As Reynolds says:

> In the basence of collective bargaining, a wage increase in a firm is attributed to 'market forces' or to a managerial decision more or less strongly influenced by market forces. Under collective bargaining the same increase is announced as a union victory, with an implication that the union was wholly responsible for it....One can be sure, however, that the incremental effect of the trade union will typically be much less than the total change in the wage level, and much less than the union alleges it to have been.[42]

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[42] Lloyd G. Reynolds, "The Impact of Collective Bargaining on the Wage Structure in the United States," in The Theory of Wage Determination, edited by John T. Dunlop (London: Macmillan & Co., 1964), pp. 194-195.

The danger of lapsing into this kind of post hoc argument has rendered direct time-series comparisons thoroughly inadmissible. Accordingly, the empirical work which has been done on the relationship between skill differentials and unionization consists entirely of cross-sectional studies. Though, as we shall see, the cross-sectional approach encounters a somewhat analogous problem, the conclusions reached appear sufficiently firm that one may transfer them with some confidence to the explanation of movements over time.

The hypotheses offered for testing depend, in most cases, upon the type of union organization being considered--whether of the industrial or of the craft variety. Since craft unions were the first to develop in Canada (as in other countries), the rise of skill differentials in the early decades of this century may perhaps be attributed to the establishment of a union-nonunion differential which had not existed previously and which was later erased, at least to some degree, by the organization of the unskilled. In view of the evidence that unions can achieve some wage advantage for their members,[43] this hypothesis cannot be discounted; nevertheless, Keat suggests that, in the case of the United States, its quantitative impact has been slight.[44]

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[43] H.G. Lewis, Unionism and Relative Wages in the United States (Chicago: University of Chicago Press, 1963). For a contrary view of Lewis' evidence, see Melvin W. Reder, "Unions and Wages: the Problem of Measurement," Journal of Political Economy, LXXII (April, 1965), pp. 188-196.

[44] Keat, op. cit., pp. 592-593.

Bronfenbrenner argues that the widening effect of craft unionization on skill differentials operates mainly through the mechanism of unemployment and underemployment:

> In notorious cases, the burden is concentrated on men excluded from the labor market through restrictive union rules of various sorts. The more usual, and less spectacular, method of exclusion is a wage rate held so high as to discourage employment in the craft or industry affected.
>
> In good times, the unemployment is not the visible unemployment of men, but the invisible unemployment of skill...The result of unemployment...is the concentration of labor, and therefore lower wages, in the less desirable occupations.[45]

Although Bronfenbrenner places a great deal of emphasis on this "displaced worker" effect, he comes to the conclusion that it has not been empirically significant.

A more interesting question is what happens to skill differentials when the wages of both categories of workers enjoy the full benefit of collective bargaining. In the event that skilled and unskilled workers are organized by separate unions, it has already been argued on theoretical grounds that skilled workers stand to gain proportionally more than do unskilled workers. This "elasticity hypothesis", given rigourous treatment by Rosen, is actually most closely associated with Friedman,[46] who argued it forcefully during the early fifties.

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[45] Martin Bronfenbrenner, "The Incidence of Collective Bargaining," American Economic Association, Papers and Proceedings, LXIV (May, 1954), p. 321.

[46] Milton Friedman, "Some Comments on the Significance of Labor Unions for Economic Policy," in The Impact of the Union, edited by David McCord Wright (New York: Kelley & Millman, Inc., 1954), pp. 207-208.

Writing in opposition to Friedman at that time, Ulman[47] pointed out the essential indeterminancy of the problem under the realistic assumption that skilled and unskilled groups take into account each other's potential for response. These comments apparently form the basis for Rosen's analysis, outlined in the preceding chapter. One might add that the reputedly conservative craft unions may not have exploited fully their elasticity advantage as general wage levels rose, or may have used their power, to a greater extent than the poorly paid groups, in order to secure nonwage benefits.

Notwithstanding the objections of Rosen, most students of labour economics have found the distinction between craft and industrial unions of extreme importance in dealing with the question of skill differentials. Among specialists, the majority view has been that unions of any kind, and especially industrial unions, are not well portrayed as impersonal, maximizing monopolists and that a more accurate model would picture the union as a complex political body. An organization of the latter kind might well ignore elasticity differentials and Pareto optimality in order to "vote" for an egalitarian wage policy. In the case of an industrial union organized in democratic fashion and dominated numerically by unskilled and semi-skilled workers, such a policy seems intuitively plausible.

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[47] L. Ulman, "Marshall and Friedman on Union Strength," Review of Economics and Statistics, XXXVII (November, 1955), pp. 384-401.

The hypothesis, then, is that the spread of industrial unions has contributed to the decline of skill margins. Searching for the practical mechanism by which this decline took place, Reynolds notes that "From the mid-'thirties through the early 'fifties a large number of unions continued to demand and secure equal cents-per-hour increases for all employees, with the necessary result of reducing occupational differentials on a percentage basis."[48] During this time unions in Britain and Canada followed an identical practice.[49] Although Reynolds goes on to emphasize the political influence of the junior skill categories in the developing industrial unions, he has stated more recently that the democratic model of the union is "simplistic". He writes:

> The skilled men will certainly feel that their 'traditional' differential over the less skilled is right, proper, and should be perpetuated; and since custom has considerable weight in workers' thinking about wages, many of the less skilled will accept this reasoning. The skilled men also, because of their standing in the plant hierarchy and their personal qualities, will usually carry more than proportionate weight in union discussions and furnish more than their share of union leadership. Finally, the skilled men can exert leverage by threatening to form their own union....[50]

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[48] Reynolds, "Impact of Collective Bargaining," p. 201.

[49] See, respectively, Peitchinis, op. cit., p. 24, and Knowles and Robertson, op. cit., p. 121.

[50] Lloyd G. Reynolds, Labor Economics and Labor Relations (5th ed.; 1970), p. 649.

Turner[51] sees the origin of the equal cents-per-hour policy in the desire of industrial unions to appeal to the mass of unorganized workers; consequently, he thinks that the sharpest declines in skill differentials are the product of agressive drives for expansion. At the same time, he contends that a narrowing of wage inequalities constitutes an enduring principle of trade union philosophy. Peitchinis argues that the rise of industrial unionism exposed the monopoly practices of skilled tradesmen and ended their "paternalistic control and exploitation of the unskilled."[52]

Whereas the pattern of union development in Canada is undeniably consistent with the foregoing hypotheses,[53] it is also clear from what has been said that market forces were working in sympathy during the period under discussion. As we have already noted, economists have generally harboured deep suspicions about the effectiveness of "union power." On the particular issue of skill differentials, Reynolds is a good illustration of this unease, inasmuch as he has taken both sides in the debate at different times.[54] Kerr finds no

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[51] H.A. Turner, "Trade Unions, Differentials and the Levelling of Wages," Manchester School of Economics and Social Studies, XX (September, 1952), pp. 244-258.

[52] Peitchinis, op. cit., p. 27.

[53] For a good historical summary see Arthur M. Kruger, "The Direction of Unionism in Canada," in Canadian Labour in Transition, edited by Richard Ulrich Miller and Frank Isbester (Scarborough, Ontario: Prentice-Hall of Canada Ltd., 1971).

[54] Cf. Reynolds, "Impact of Collective Bargaining," p.201 and Labor Economics and Labor Relations (4th ed., 1964) p. 474.

persuasive evidence of an independent union influence in the decline of skill margins, although he thinks it not unlikely that unions may sometimes enforce stability on account of their "penchant for pattern following."[55] Peitchinis, although correct, adds to the confusion by observing: "It is conceivable ...that 'the underlying demand-supply situation' favourable to the decline in the differential emerged after rather than before the narrowing took place."[56]

For a clearer picture one must turn from speculative reasoning to empirical study. In the earliest of the four major pieces of research on the subject, Goldner[57] found that unions tend to raise the wages of unskilled workers by greater absolute amounts than they do the wages of skilled workers, although differences in the incremental effect were small. Applied in a setting of general wage advances, this conclusion implies a concurrent narrowing of percentage differentials. Weiss[58] observed a greater percentage effect on the wages of labourers than on the wages of craftsmen. Cohen[59]

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[55]Clark Kerr, "Wage Relationships--The Comparative Impact of Market and Power Forces," in Theory of Wage Determination, pp. 173-193.

[56]Peitchinis, op. cit., p. 22.

[57]William Goldner, "Labor Market Factors and Skill Differentials in Wage Rates," Industrial Relations Research Association, Proceedings of the Tenth Annual Meeting (1958), pp. 207-216.

[58]Leonard W. Weiss, "Concentration and Labor Earnings," American Economic Review, LVI (March, 1966), pp. 96-117.

[59]Malcolm S. Cohen, "The Determinants of Relative Supply and Demand for Unskilled Workers" (unpublished Ph.D. dissertation, Massachusetts Institute of Technology, 1967) p. 143.

employed different data and found the same result.

Rosen, whose empirical work is quite independent of his theoretical argument, provides what is undoubtedly the most valuable evidence on union impact.[60] He begins by noting that the average wage computed for an industry is really the weighted mean of rates paid to all the various components of the industry labour force. After he removes the effects of factors such as age, sex, and education as well as any industry-specific effects of unionization, it is therefore possible, knowing the relevant weights (i.e., the proportions of various skill categories and the percentage of workers unionized), to infer what must have been the differential impact of unionization. The first set of regression estimates indicates that, on a percentage basis, skilled workers gain substantially more from union membership than all other production workers when the latter are treated as a group. Obviously, this result lends some comfort to proponents of the elasticity hypothesis. Further disaggregation reveals, however, that the effect of unionization is greater upon the wages of the unskilled than upon the wages of the skilled.

Typically, then, collective bargaining appears to have reduced skill margins. In order to investigate the specific

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[60] Rosen, "Wage Structure," pp. 273 ff. Since this survey was written, a fifth study has appeared strongly corroborating the others. See Michael J. Boskin, "Unionism and Relative Real Wages," American Economic Review, LXII (June, 1972), p. 469.

effects attributed to industrial unions, Rosen examines the residuals of his regression estimates for any tendency to underpredict differentials in industries known to operate with this form of union organization. That he finds no such tendency is evidence against the "industrial union hypothesis."

Before accepting these conclusions as final, however, one should beware of at least two difficulties. The cross-sectional studies just reported are by no means immune from their own kind of post hoc fallacy. If it should happen that significant variables omitted by the authors are correlated with unionization, then the results would be biased. Moreover, one can never be completely sure that generalizations based on cross-section study are valid when transferred to the explanation of events taking place earlier, and over an interval of time. These caveats are familiar, but worth repeating.

Having examined the factors linked by various authors to broad movements of the skill premium, we may now consider variables thought by some to impress a cyclical pattern on the underlying secular trend.

Short-run Hypotheses

It has been argued that skill differentials respond to (1) the rate of inflation and (2) the level of unemployment. Though it may prove troublesome to disentangle the independent effects of these variables empirically, the hypotheses that allege their importance are theoretically distinct.

Inflation. It is a commonplace observation that skill differentials have fallen most sharply during periods of rapid price inflation. According to Perlman, the reason for this association is that

> Price increases eat away at the surplus funds of the skilled worker, but prevent the low-wage worker from buying necessities. Thus, the upward pressure on lower wages is more urgent than that on higher wages.
>
> Because of labor's interest in money values and because of egalitarian sentiment fostered by inflation, there is a tendency for the percentage skill differential to narrow.[61]

Now, to probe this reasoning in a manner possible more rigourous than the author used to construct it initially, one might conceive of inflation as a proportional "tax" on consumption. As long as the propensity to consume falls with rising income, this inflation tax will operate regressively. If pressure to increase the wages for any category of workers depends upon the typical individual's sacrifice of utility, then inflation may mean rising wage pressure as one descends the income scale, or it may not, depending on the relationship between the rate of change of the propensity to consume and the slope of the marginal utility-of-income schedule.[62] Still, the question is not whether the burden of inflation is regressive in a welfare sense, but whether one category of workers is likely to

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[61] Perlman, op. cit., p. 111.

[62] For a thorough discussion of the utility arguments that may be applied mutatis mutandis to this case, see Richard A. Musgrave, The Theory of Public Finance (New York: McGraw-Hill Book Company, 1959), pp. 98-102.

be more successful than another in shifting this burden by means of wage demands.

It may be, as Perlman suggests, that public opinion will support the low-wage worker with particular vigour during periods of inflation or that unions implicity accept the welfare argument by reverting to equal-cents-per-hour wage policies; yet, one would like to hear reasons more deeply rooted in economic rationality than these before accepting the hypothesis unconditionally. Reder interprets Perlman as saying that the social minimum wage (Reder's concept) is fixed in real terms,[63] but this rendering is also a little vague. Peitchinis offers the most appealing explanation[64] in noting that an equal cents-per-hour wage increase geared to maintaining the real income of the unskilled worker involves a smaller addition to the wage bill than a policy which simultaneously maintains the percentage differential of skilled workers. Uniform absolute increases for all skill levels are therefore likely to please both the employer and the government seeking to contain inflationary pressure. Although a combination of government coercion, moral suasion,

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[63] Melvin W. Reder, "Wage Structure: Theory and Measurement," in Aspects of Labor Economics, National Bureau of Economic Research, Special Conference Series No. 14 (Princeton: Princeton University Press, 1962), p. 268.

[64] Peitchinis, op. cit., p. 26.

and public sympathy may still be necessary to uphold such a policy in the fact of contradictory market forces, this condition was fulfilled during two World Wars, when a great deal of the narrowing in skill differentials took place. Whether or not market forces were indeed complementary, much of this narrowing occurred under the auspices of wartime control bodies, which Peitchinis contends, were fully aware of the foregoing relationships.

Unemployment. Despite scattered objections[65] the entrenched view has been that skill margins swell during periods of depression and shrink during periods of prosperity. Though evidence of such countercyclical behaviour is not decisive, most authors have accepted it as fact; and a few have ventured explanations. The hypothesis that has received the most widespread support is one first proposed by Reder[66] in the mid 'fifties.

As we shall see, the Reder hypothesis is deceptively simple and may be approached on more than one level of analytical complexity. Its central idea is that firms are likely to respond to the state of excess demand in the labour market by adjusting hiring standards as well as wage offers. In normal times, says Reder, firms will typically enjoy some "labour slack," which he defines as the surplus of job

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[65] See Bell, op. cit.

[66] Reder, "Theory of Occupational Wage Differentials."

applicants willing to work at the current wage rate and able to meet the current minimum hiring standard.[67] A general increase in demand will first eliminate this labour slack and then if the upswing continues, put pressure on wages. Accordingly,

> Competition for workers able to meet current hiring standards on the most skilled jobs would tend to raise their wage rates. However, there would be a brake upon this rise because some workers, previously unable to secure employment in the most highly skilled job categories, would be available at lower rates. Therefore, if the spread between the wage rate of the most skilled and those closest to them in skill should become too large, substitution would tend to occur. This substitution would involve either (1) training the "inferior" workers or (2) altering the productive process (and/or product) somewhat...[68]

This upgrading of workers and downgrading of jobs eventually reaches the very bottom of the skill ladder, where "...employers wishing to use the cheapest grade of labor...have to scramble for a reduced supply, tending to drive up the wage rate." The latter follows on the assumption that the total labour force is fixed by the size of the population.

Now, at first glance this line of argument does not appear very productive. Indeed, Reder admits, "It cannot be deduced from this consideration that, under the specified

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[67] Firms may be compelled, on account of union pressure, to offer wages in excess of those which clear the market, or they may adopt such a "high-wage policy" voluntarily if the existence of labour slack reduces recruitment costs significantly.

[68] Ibid., p. 837.

conditions, wage rates paid on the lowest grade of jobs would rise proportionally more than the rates on others.[69] To discover whether this result is even possible, it will be helpful to interpret Reder's hypothesis in diagrammatic terms.

In Figure 6, which extends a graphical argument originally used by Migue,[70] wage rates for skilled labour are measured on the left vertical axis and those for unskilled labour on the right vertical axis. In order to focus upon percentage changes, these rates have been expressed in logarithmic terms, and the scales so aligned that their initial values W_o^s and W_o^u are opposite one another. The corresponding horizontal axes represent employment, also in logarithmic transformation. SS_o^s and SS_o^u identify the initial supply functions for skilled and unskilled labour respectively. The vertical segments reflect the simplifying assumption that changes in labour input may come about only through adjustments in employment (the availability of workers being fixed in the short run) and not through adjustments in hours; the horizontal segments help to portray Reder's notion of labour slack. Owing partly to the way the horizontal scales have been aligned, $D_o^{s,u}$ serves to represent demand functions for both categories of labour. Though the existence of intermediate skill grades lends plausibility to the original argument, we lose nothing essential by ignoring this complexity in the present discussion.

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[70] Migue, op. cit., pp. 20-26.

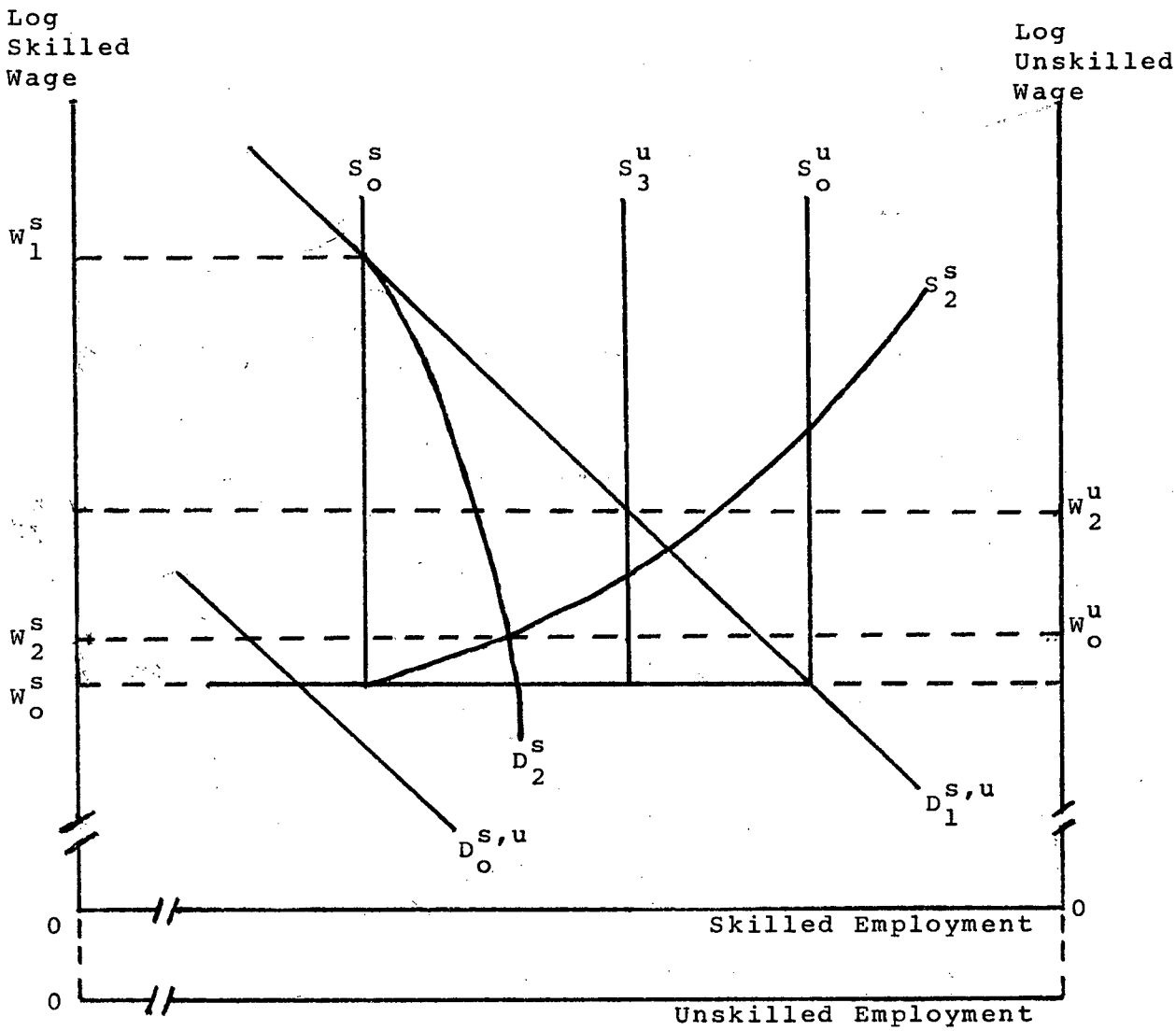

FIGURE 6

GRAPHICAL ANALYSIS OF THE REDER HYPOTHESIS

Suppose, then, that an economic upswing gives rise to a proportionally equal increase in demand for skilled and unskilled workers,[71] shifting the coincident demand functions to $D_1^{s,u}$. Labour slack vanishes in accord with Reder's specification, and skilled wages rise to W_1^s. The accompanying increase in the wage ratio (since W^u has not yet been affected) stimulates firms to begin making adjustments. Note that the ratio rose because of the initial configuration of the diagram. If labour slack had been eliminated simultaneously in both markets, or more generally, if supply elasticities had been everywhere the same, no change would have occurred; and, presumably, firms would detect no incentive to re-organize production. In any case, the standard argument would now predict the traditional sort of factor substitution, leading to a fall in D_1^s, a rise in D_1^u, and some reversal of the increase in the wage ratio. However, with supply unchanged, the substitution process can do no more than moderate this increase.

What Reder must therefore have in mind are opposing shifts in the supply curves, brought about as unskilled labour becomes transformed, albeit imperfectly, into skilled

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[71] Proportionality follows on the assumption of a homogeneous production function. Although Reder himself does not specify anything about the nature of initial shifts in demand, one must suppose that they are proportional; or else any sort of wage behaviour is possible.

labour through a reduction in hiring standards and subsequent training. The possibility of expanding the skilled labour force in this manner suggests a new supply curve such as SS_2^s. Since training is costly to the firm and since the productivity of inferior workers is by definition lower than that of existing employees (and may remain so indefinitely), the demand function D_1^s, which is drawn for labour of homogeneous quality, no longer applies. If individuals previously thought unqualified are hired in descending order of their ability, the relevant demand function, say D_2^s, will be both lower and more inelastic than D_1^s. Hence, for skilled labour the implied equilibrium wage is W_2^s.

The key point is that, as unskilled workers are "converted" into skilled, the number remaining for traditional unskilled employment shrinks; that is, SS^u shifts to the left. If the shift corresponding to the expansion of skilled labour supply is sufficiently strong, say to SS_2^u, we would witness an overall decline in the skill differential, although its value in final equilibrium would not be W_2^s/W_2^u. Presumably, substitution of the orthodox variety would again moderate, though not erase, the tendency to fall.

Since the direction of change in the skill premium depends entirely upon the magnitudes of opposing shifts in supply, Reder's hypothesis is not falsifiable through direct observation of the cyclical behaviour of wage ratios. The strongest statement he can offer is that the inverse relationship is most likely to emerge "only in the really big outbursts

of economic expansion." Even in such cases (during wartime, for example) one would need some independent verification that the postulated mechanism was in fact responsible. As prima facie evidence Reder mentions the shifts of workers from agriculture to industry and from unskilled to semi-skilled jobs--movements that he says intensified during the two World Wars.

There are other problems as well. As Perlman, emphasizes, the supply of unskilled labour cannot be assumed perfectly inelastic owing to the presence of a secondary reserve of unskilled workers (housewives, the young, the aged, and others) who maintain a constant willingness to accept employment at going wage rates.[72] Although the preceding argument remains valid as long as the supply of unskilled labour does not become perfectly elastic, one finds it harder, as a result, to predict that a fall in the skill premium will materialize for any given increase in demand. It is partly in recognition of the existence of a labour reserve that Reder confines his own speculation to periods of extraordinary economic activity, when this pool of workers is substantially absorbed. At such times a reduction in hiring standards presumably applies to skilled and unskilled alike.

Secondly, Reder Acknowledges that his hypothesis "does not seem to be 'reversible'."[73] As one can see by consulting

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[72] Perlman, op. cit., p. 115.

[73] Reder, op. cit., p. 842.

Figure 6, there is no reason to expect a rise in the skill premium to accompany a fall in demand. This problem stems from the author's failure to provide a rigourous analysis of how W^s and W^u are determined and how they react to depressed conditions.

On a more intuitive level,hhowever, Reder's emphasis on hiring standards appears plausible. Oi interprets him as specifying a relationship something like the following:[74]

$$(41) \quad W^i = k^i(D^i - S^i)/S^i \ ;$$

that is, the percentage rate of change of wages in the ith skill category W^i depends on the proportional excess supply and some reaction coefficient k^i. In the expansion phase of the cycle downgrading hiring standards leads to larger proportional shifts in excess supply for unskilled workers than for skilled workers. As long as k for the latter group is equal to or not much greater than k for the former, the wage differential falls. In the contraction phase the upgrading of hiring standards, according to Oi, produces the reverse effect. Yet, if hiring standards are assumed to specify only some minimum level of competence, it is difficult to see why they need change in order for the skill premium to rise. It has often been remarked that in periods of economic slack

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[74] Walter Y. Oi, "Labor as a Quasi-Fixed Factor," Journal of Political Economy, LXX (December, 1962), p. 554.

unemployed tradesmen can compete for unskilled jobs, whereas unemployed labourers cannot compete for skilled positions. This rationale for differential shifts in supply does not depend on any adjustment of hiring standards.

It is well to note, moreover, that the behavioural model specified in equation (41) is, as it stands, a good deal more general than Reder's verbal argument, inasmuch as it applied to all shifts in excess supply regardless of their magnitude. If we take rates of unemployment as satisfactory proxies for excess supply (demand), then we may insert the well known fact that occupational unemployment figures do not manifest equal sensitivity to cyclical variations. Rates for the unskilled fluctuate much more widely than those for the skilled, and under these circumstances the model yields the desired cyclical pattern.

Apart from adjustments in hiring standards, a number of explanations have been offered for unequal movements in unemployment rates.[75] Kaliski mentions "the greater cyclical variability of industires employing, on the average, less skilled labour, and the greater geographic and occupational mobility of the skilled."[76] Oi's own theory stresses

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[75] In addition to those cited below see Barbara R. Bergmann, "Alternative Measures of Structural Unemployment," in Employment Policy and the Labor Market, edited by M.A. Ross (Berkeley: University of California Press, 1965), pp. 256-270.

[76] S.F. Kaliski, "Structural Unemployment in Canada: The Occupational Dimension," Canadian Journal of Economics, II (May, 1969), p. 255.

differences in the nature of labour costs for different classes of workers.[77] He argues that in recruiting and training new workers firms incur fixed costs, which must be amortized over the expected employment period by paying wages that are less than the worker's marginal revenue product. In the short run, however, the recovery of these fixed costs constitutes rent which the firm will forego should it suffer a fall in demand. Consequently, workers in whom the firm has invested will not be dismissed immediately; they will be laid off only when the decline in their marginal revenue product has erased the "periodic rent" and placed them in a position of marginality. It is argued--and the argument is supported by evidence--that skilled workers suffer less than unskilled workers from cyclical swings in employment because labour costs in the case of the former group include a greater proportion of fixed investment than in the case of the latter.

The difficulty with Oi's theory is that it applies only to instances of contraction and recovery; it fails to predict a narrowing of skill differentials once the economy regains its former level. When expansion takes place from a position of long-run equilibrium, all categories of workers are "marginal," regardless of their "degree of fixity;" and the demand curve for each shifts outward in a proportional manner.

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[77] Oi, op. cit.

Perlman contends, without noticeable embarassment, that both depression and full employment tend to promote a widening of skill differentials.[78] For reasons we have already noted (the time and expense required to train journeymen, the existence of a large secondary reserve of unskilled labour, and the downward occupational mobility of skilled workers), he argues that the supply of skilled labour is less elastic at high levels of demand and more elastic at low levels than that of unskilled labour. Given this configuration of supply curves, one would expect a rise in the skill premium for any movement in demand away from some "normal" level. On what constitutes this state of demand, Perlman is unfortunately silent. It is clear that unless his implied zone of normalcy migrates up and down in pursuit of cyclical waves, the hypothesis falters on a difficulty somewhat the reverse of the one encountered by Oi. It can explain, in its own fashion, the effect of once-and-for-all movements of expansion or contraction, but it cannot explain, in a manner consistent with the author's discussion, the effects of retrenchment or recovery over economic ground covered in the preceding phase.

Should the evidence sustain Perlman's dissenting argument that tight labour markets tend to expand rather than shrink the margin for skill, one would then be unable to conclude that government policies designed to secure full

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[78] Perlman, op. cit., pp. 115-116.

employment operate unambiguously in the cause of distributional equality. In contrast, the orthodox view implies that full-employment policies lead not only to increased uniformity of work opportunities but also to smaller wage disparities than would have prevailed in an "unmanaged" economy. Hence, there is no danger that changes in relative wages will offset changes in the distribution of employment.

Should Perlman prove wrong and the majority position hold, one might then cite the adoption of so-called "full-employment policies" as an independent hypothesis to explain declines in the skill premium. This hypothesis would not, of course, apply to the early decades of this century, when such policies were not generally in force. It pertains, rather, to the years between World War II and the present. It is on this period that the empirical investigations of the following two chapters are focused.

Chapter IV

TIME-SERIES EVIDENCE

In order to test generalizations concerning the behaviour of the skill premium, one must first of all acquire a meaningful set of summary statistics with which to trace the movements of this variable over time. Since no statistical agency in Canada furnishes explicit data on skill differentials or on the average wages of "skilled" and "unskilled" workers, the investigator is faced with the immediate task of synthesizing an appropriate time series from the mass of detailed information on occupational wage rates.

To construct a representative set of figures using the available data, one must solve or circumvent a number of formidable problems. The nature of these problems and the statistical procedures adopted in order to deal with them are discussed in the first section of this chapter. In the second, results are set forth and analysed. In the third and final section, these results are employed to test the short-run hypotheses surveyed in the preceding chapter.

Measurement Problems, Data, and Methods

Raw data for the present study has been drawn from Wage Rates, Salaries, and Hours of Labour, a publication compiled and issued annually by the Economics and Research

Branch of the Canada Department of Labour.[1] This source (hereinafter referred to as WRSHL) provides an exceptionally detailed listing of average wage rates by occupations in selected three- and four-digit industries. Devising a summary measure of the skill premium on the basis of these tabulations involves (1) classifying occupations according to skill content, (2) computing a representative statistic for each industry, and (3) aggregating over as many industries as possible. Repeating these steps consistently over successive years furnishes the desired time series.

The difficulties encountered in carrying out such a plan are both practical and conceptual. An obvious conceptual difficulty emerges the moment one attempts to distinguish between skilled and unskilled occupations. Because the boundaries between skill categories are purely conventional, theory offers no guidance on how to proceed. One must rely instead upon common usage.[2] Unfortunately, the test of "common usage" does not apply to many of the specialized production jobs listed in WRSHL. In order to classify these occupations along

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[1] (Ottawa: Queen's Printer, 1921--). Title varies. Most of the information contained in these volumes is based on the results of a mail survey conducted in October of each year. Present coverage includes all establishments employing twenty or more workers.

[2] As a philosopher once reminded his colleagues, "What is a cow is for the public to decide."

with jobs that are more traditional in nature, one must resort to a formal system of job evaluation. Yet, again, if such a scheme is to yield meaningful results, it must implement the unstated criteria upon which common usage rests; otherwise, the conclusions ultimately derived from it will be valid only within an artificial semantic universe.

Job evaluation would be a relatively simple undertaking were it not for the large number of factors that contribute in some way to ordinary notions of skill content. Those that come quickly to mind include the logical complexity of the worker's tasks, the amount of esoteric information required, the degree of manual precision displayed, the importance placed upon personal initiative, the degree of responsibility entrusted to the worker, and the length of the training period. To obtain a one-dimensional measure of skill content, the job evaluator must rate occupations under headings such as these and, having done so, combine the separate scores using a set of weights which reflect the relative importance of each factor in the overall assessment. Whether this process is carried out implicitly or explicitly, it is clear that subjective judgements determine the result. Thus one cannot escape the fact that distinctions between skilled, semi-skilled, and unskilled jobs are essentially arbitrary and imprecise. It is nevertheless impossible to avoid such taxonomy if one is to form even the barest understanding of how labour markets function.

For purposes of the present study, occupations reported in WRSHL were classified using the job evaluation scheme embodied in the U.S. Dictionary of Occupational Titles.[3] Skill content may be ascertained from the Dictionary simply by inspecting an assigned digit of the code number which identifies each occupation. In practice, there was no need to refer directly to the Dictionary in order to perform the work of classification, since titles and code numbers for all occupations appearing in WRSHL were available from sample copies of the wage survey questionnaire issued by the Department of Labour. On the strength of information obtained from this questionnaire, skill labels were attached to almost one thousand jobs.

The next major task was to select, from this number, a satisfactory list of skilled and unskilled occupations upon which to base the ensuing calculations. Because of discontinuities in the published series, many occupations had to be excluded from the sample in order to maintain its consistency throughout the period of study. Occupations which displayed gaps of no more than one year in their wage histories were retained by interpolating the missing data.[4] Occupations

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[3] United States, Department of Labor, Job Analysis and Information Section (Washington: U.S. Government Printing Office, 1939), revised in 1947 and 1965.

[4] The simplest possible method was used--that of taking the mean of rates in the year preceding and the year following.

omitted from WRSHL for two or more consecutive years were rejected.

In addition, certain occupations were excluded from the sample regardless of whether they satisfied the continuity criterion. As explained in the opening chapter, existing research on the topic of skill differentials concentrates its attention upon a relatively small number of traditional craft occupations found in maintenance work and building construction. Since one of the main considerations in undertaking the present study was the need to observe wage relationships outside this narrow sector of the skilled labour force, occupations belonging to the groups mentioned were not treated along with the rest. Construction workers, because of their numbers and because of previous interest shown in them, were dealt with in a separate set of time-series calculations. Maintenance occupations reported in the industry tabulations were simply omitted in order to emphasize the wage structure prevailing among production workers. Finally, all entries in WRSHL pertaining to female workers were excluded from the main industry sample. This rule was adopted in order to abstract from any independent variations in the male-female wage ratio. Because female workers appear in disproportionate numbers among unskilled jobs, such variations could conceivably distort measurements of the skilled-unskilled wage ratio.

Occupations which survived application of all the preceding criteria are listed, by industry, in Appendix A.

In total, there were one hundred forty-nine skilled and seventy-eight unskilled occupations (treating job titles which appear in different industries as occupationally distinct).

Formal economic reasoning suggests that, in treating this sample, one should employ statistics which measure, not just the basic wage received by a worker, but a much broader theoretical concept, namely, the "price" of labour. The latter includes not only straight-time hourly (or weekly or monthly) rates but also the value of fringe benefits, incentive bonuses, overtime payments, shift differentials, seniority increments, cost-of-living allowances, dividends from profit-sharing plans, payments in kind, and all other recognizable forms of remuneration. Unfortunately, it is impossible to portray the variable contemplated in the theoretical argument with complete fidelity, since most items on the foregoing list have been expressly omitted in compiling the published figures.[5] Of course, if fringe benefits and the like happen to be proportional to basic wage rates, their exclusion leaves percentage differentials unaffected. Though one cannot count on strict proportionality, it remains true that measurements of relative earnings are likely to be less distorted by difficiencies in the data than are measurements of absolute earnings.

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[5]Only cost-of-living allowances and seniority pay are included in the averages reported in WRSHL.

The wage rates appearing in WRSHL are of two sorts. Recent issues of the publication--the volumes released since 1956--provide separate tabulations for the average hourly wages of time-rated workers and the average earnings per hour of those on piece rates. Since the number of individuals residing in each pay category is not given, it is impossible to combine these separate figures into an overall occupational average. One has merely to choose between alternatives. It was decided, for purposes of the current investigation, to rely wholly on time rates, except in industries for which only piece rates are reported. Actually, this compromise applied to only two industries, Rubber Footwear and Rubber Tires and Tubes. Although time rates and piece rates were thus intermingled to a certain extent in the ultimate aggregation, they were kept completely apart within particular industries. This procedure was followed consistently from 1956 to 1970, the terminal year of the study. Before 1956 WRSHL failed to distinguish between the two systems of payment. Therefore, if skill differentials among piece workers do not coincide precisely with those observed among time workers, a discontinuity unavoidably occurs at this point. It is important to keep this problem in mind when assessing the results set forth in the next section.

A further problem of continuity arose with regard to the classification of industries. In 1966 WRSHL adopted the 1960 Standard Industrial Classification, whereas previously it had reported data on the basis of the 1948 classification

scheme.[6] This change forced the elimination of some industries from the sample and necessitated special treatment for others. Of the thirty-nine industries retained, nine were affected to some degree.[7]

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[6] A convenient summary of all the changes relevant to the present study may be found in Canada, Dominion Bureau of Statistics, Manufacturing Industries of Canada: Summary for Canada, 1962 (Ottawa: Queen's Printer), catalogue no. 31-203.

[7] Five industries underwent relatively minor changes in title and definition: Wooden Furniture became Household Office, and Other Furniture; Iron Castings became Iron Foundaries; Primary Iron and Steel became Iron and Steel Mills; Heavy Electrical Machinery and Equipment became Electrical Industrial Equipment; and Acids, Alkalis, and Salts became Industrial Chemicals. These changes were simply ignored. In two cases, industries which had been reported separately prior to 1966 were coalesced (along with a small number of previously unreported establishments) into one table of averages. Machine Tools and Industrial Machinery were combined into Miscellaneous Machinery and Equipment, and Sheet Metal Products and Brass and Copper Products were combined into Metal Stamping, Pressing, and Coating. Conversely, in another two instances establishments which had been reported as one industry were divided into two. Thus, Radio, Television, and Other Electronic Equipment became Household Radio and Television Receivers and Communications Equipment, and Refrigerators, Vacuum Cleaners, and Miscellaneous Electrical Products became Small Electrical Appliances and Major Appliances. These changes were dealt with by combining separate industry tabulations into one, either before or after 1966 as the situation dictated, using a set of fixed weights. A precise explanation of the methods employed in making this adjustment must, however, await the discussion of other calculations performed on the sample.

The remaining industries, for which no manipulation was necessary, are as follows: Gold Quartz Mines, Other Metal Mines, Biscuits, Bakeries, Confectionery, Breweries, Rubber Footwear, Rubber Tires and Tubes, Other Rubber Products, Cotton Yarn and Cloth, Woolen Yarn and Cloth, Synthetic Textiles, Sawmills and Planing Mills, Veneer and Plywood Mills, Sash, Door, and Flooring Mills, Pulp and Paper, Paper Boxes and Bags, Commercial Printing, Heating Equipment, Machine Shops, Agricultural Implements, Office and Store Machinery, Aircraft and Parts, Motor Vehicles, Motor Vehicle Parts and Accessories, Railroad Rolling Stock, Shipbuilding and Repair, Petroleum Refineries, Pharmaceuticals, Medicines, and Toilet Preparations, Paint and Varnish, Electrical Power. As already mentioned, Building Construction was treated separately.

For all the industries included here, WRSHL reports the wage rates of at least one skilled and one unskilled worker throughout the period of study. Industries which failed to meet this criterion had to be eliminated, since they were incapable of yielding a measure of the skill premium. Because the industry coverage of WRSHL has expanded steadily over the past two decades, it was necessary, in selecting the ultimate list, to trade off sample size against the length of the period to be subjected to scrutiny. It was eventually decided to trace the thirty-nine-industry sample as far as 1953. Beyond this year the number of industries available diminished rapidly. In the case of Building Construction, however, it was possible to survey the entire postwar period, from 1946 to 1970.

Once the composition of the sample and the period of study had been determined, the next step was to consider alternative ways of measuring the skill premium. Although the notion of a summary or aggregative measure seems straightforward, close examination reveals a degree of ambiguity. The nature of the problem is perhaps best explained with the aid of a hypothetical example. Suppose that the economy consists of two industries, A and B, each employing one skilled occupation and one unskilled occupation. The matrix of hourly wage rates might look as follows:

	Industry	
Occupation	A	B
Skilled	$4.00	$3.00
Unskilled	2.00	1.00

Assume for the moment that A and B employ the same number of skilled workers and the same number of unskilled workers. Total employment in the two industries must therefore be the same as well.

Now, in the case of this simple economy, how should one go about constructing a summary measure of the skill premium? An obvious approach would be to take the average skilled wage ($3.50) and the average unskilled wage ($1.50) and then compute their ratio (2.33). However, one might also proceed by calculating the relative wage in A (2.00), the relative wage in B (3.00), and finally, the industry average (2.50). Which of these figures has the better claim to represent the "true" value of the skill premium is not entirely clear. The "ratio-of-averages" method emphasizes percentage differences in the wages of the typical skilled and the typical unskilled worker; the "average-ratio" method attempts to define the typical industrial wage regime. The two measures thus provide answers to slightly different questions.

Although the first measure may appear to be more in keeping with the style of the theoretical argument, the second is by no means invalid. In any case, the figures turn out to be very close when evaluated empirically, and their movements

display a high degree of linear correlation. Owing to the manner in which wage data is normally presented--that is, by industry--most generalizations found in the literature arise from an implicit application of the average-ratio technique. This method will be emphasized here as well, though not wholly for reasons of convenience.

In any real setting, industries such as A and B would utilize several skilled and several unskilled occupations, and they would not employ the same number of workers, either within each job category or in total. Aggregation under these circumstances obviously calls for the use of weighted averages. Ideally, one would compute the average-ratio measure of the skill premium by taking weighted averages of the skilled and unskilled wage rates in each industry, forming the respective ratios, and calculating their weighted average across all industries in the sample. The weights in the first step would be the number employed in each occupation, and in the last, the total number of skilled and unskilled employed in each industry. Unhappily, data limitations render the ideal method infeasible: annual employment figures matching the detail of WRSHL are simply not available.

If one is to proceed, it is therefore necessary to make some rather harsh compromises. A possibility which was carefully investigated was that of using fixed instead of annual employment weights. Although the 1961 Census provides

comparatively rich detail on employment by occupation and industry,[8] the extent of the disaggregation is still insufficient to support the treatment of anything more than a small and perhaps unrepresentative sample. In the end, it was decided to use simple arithmetic averages in computing summary indices of the skilled and unskilled wage rates prevailing within each industry. The weights applied were, in other words, both fixed and arbitrary. Despite the potential biases inherent in this procedure, it was deemed superior to the usual tactic of basing industry wage ratios on an arbitrary selection of one skilled and one unskilled occupation. The approach adopted here is, at the very least, more comprehensive.

At the same time, it does permit some use of employment weights in performing the desired aggregation across industries. As just mentioned, the optimal plan would presumably be to weight industry ratios by the sum of skilled and unskilled employment. However, in the absence of the necessary figures, it seems not unreasonable to substitute total employment (skilled plus unskilled plus semi-skilled). Though strictly speaking, interindustry variations in the composition of the total may distort the results to a certain extent, the

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[8] See Canada, Dominion Bureau of Statistics, 1961 Census of Canada, Volume III, Part 3, Special Labour Force Series, Occupations Classified by Industries (Ottawa: Queen's Printer), catalogue no. 94-552.

overall size of the work force remains an intuitively appealing measure of the impact exerted by any industrial wage regime.

For each industry in the sample of thirty-nine, a series of employment weights was obtained by multiplying together an index of average annual employment and an appropriate base-year value.[9] The latter was taken to be the average number of male "production and related workers" employed by an industry during the base year. Since the index numbers are computed for a somewhat broader total, it was necessary to assume that the proportion of male production workers remained roughly constant in all industries over time.

In general, then, the measure adopted here may be expressed as follows. Let m denote the number of industries in the sample, ns_i, the number of skilled workers, and nu_i, the number of unskilled workers in the ith industry, and E_i, total employment in that industry at time t. The "weighted average ratio" for the t-th year is thus given by

$$(42) \quad WAR^t = \frac{\sum_{i=1}^{m} E_i \left(\sum_{j=1}^{ns_i} W_{ij}^{s,t}/ns_i \right) \Big/ \left(\sum_{j=1}^{nu_i} W_{ij}^{u,t}/nu_i \right)}{\sum_{i=1}^{m} E_i^t}$$

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[9] Index numbers were obtained from Canada, Dominion Bureau of Statistics, Review of Employment and Average Weekly Wages and Salaries, various years (Ottawa: Queen's Printer), catalogue no. 72-201, and base-year figures from idem, Manufacturing Industries of Canada: Summary for Canada, 1961 (Ottawa: Queen's Printer), catalogue no. 31-203, and idem, Mineral Industries: Principal Statistics, 1961 (Ottawa: Queen's Printer), catalogue no. 26-204.

In the case of industries coalesced into one for the reasons explained earlier, weighting became a two-stage operation. Fixed employment weights were first applied to ratios found for each of the constituents, and an average was computed. Then, the figure obtained in this preliminary step was combined in a weighted average with the ratios calculated for the other industries in the sample. The weight applied in the final aggregation was that which would have pertained had the industry not been divided either before or after the change in classification.

Weighting also became a two-stage procedure in the case of Building Construction. Since WRSHL reports the wages of construction tradesmen and labourers only by metropolitan area and not for the country as a whole,[10] the problem was to aggregate across regions rather than across industries. The method followed was to compute a wage ratio for the principal city in each of the five regions of Canada--that is to say, a ratio for Vancouver, Winnipeg, Toronto, Montreal, and Halifax --and then to combine these figures using as weights total construction employment within each region.[11] The ratios entering

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[10] For this industry, wage rates are extracted from collective agreements and are not based on the annual mail survey.

[11] Index numbers were again obtained from the Review of Employment and Average Weekly Wages and Salaries, Base-year figures came from 1961 Census of Canada, Volume III, Part 2, Labour Force: Industries by Sex, catalogue no. 94-518.

into this aggregation were found initially by taking a weighted average of rates reported for seven skilled occupations and dividing this value by the rate reported for a single unskilled occupation, that of labourer. It proved unnecessary to resort to simple averaging, inasmuch as Census data provides an adequate set of fixed (1961) employment weights for the seven-occupation sample.[12] Letting E_{ij}^{t} represent employment of the jth occupation in the ith region at time t, we have for Building Construction

$$(43) \quad WAR_{cons}^{t} = \frac{\sum_{i=1}^{5} E_i^t \left(\sum_{j=1}^{ns} E_{ij}^{61} \cdot W_{ij}^{s,t} / \sum_{j=1}^{ns} E_{ij}^{61} \right) / W_i^{u,t}}{\sum_{i=1}^{5} E_i^t}$$

The results obtained by applying expressions (42) and (43) are set forth in the next section together with the corresponding unweighted series (labelled AR and AR_{cons} respectively). The latter are presented merely to demonstrate the influence of the weighting scheme. It will be observed that weighting has only a moderate impact on the time shape of the computed measures.

In addition, one other series was derived in a manner

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[12] Volume III, Part 2, Labour Force: Detailed Occupations by Industry Groups and Sex, Catalogue no. 94-531.

suggested by Woods and Ostry.[13] To obtain a rough measure of the skill premium, these authors take the median of ratios formed using the highest and the lowest wage rates in each industry.[14] Though a measure of this kind--one might call it a "ratio of extremes" (RE for short)--ignores a good deal of information, it has the virtue of being simple to compute. It is presented here for purposes of comparison.

Descriptive Results

Table IV summarizes results of all the foregoing calculations.[15] Note that horizontal rulings have been inserted between the years 1954 and 1955 and between the years 1965 and 1966 to serve as a reminder of the discontinuities mentioned in the preceding discussion. Though it is not strictly possible to estimate the quantitative significance of these discontinuities, no obvious breaks appear in AR or WAR at the points indicated. However, in the case of RE, there are grounds for suspicion.

Looking at the figures pertaining to the industrial composite, one may make several preliminary observations.

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[13] Labour Policy and Labour Economics in Canada, p. 437.

[14] As a matter of convenience the mean was used here in place of the median.

[15] Time series for individual industries in the sample of thirty-nine may be found in Appendix B.

TABLE IV

COMPUTED TIME SERIES FOR CANADA.
1946-1970

	Industrial Composite			Construction	
Year	AR	WAR	RE	AR_{cons}	WAR_{cons}
1970	1.234	1.265	1.481	1.358	1.356
1969	1.250	1.281	1.502	1.302	1.307
1968	1.256	1.269	1.491	1.334	1.327
1967	1.277	1.291	1.493	1.332	1.323
1966	1.273	1.283	1.505	1.323	1.323
1965	1.263	1.283	1.481	1.399	1.389
1964	1.259	1.279	1.475	1.433	1.427
1963	1.275	1.297	1.491	1.436	1.428
1962	1.278	1.300	1.497	1.455	1.450
1961	1.280	1.298	1.494	1.486	1.476
1960	1.287	1.307	1.495	1.466	1.460
1959	1.287	1.311	1.492	1.509	1.501
1958	1.277	1.311	1.473	1.508	1.504
1957	1.268	1.301	1.482	1.548	1.539
1956	1.274	1.292	1.472	1.584	1.573
1955	1.276	1.295	1.492	1.642	1.641
1954	1.274	1.292	1.484	1.606	1.594
1953	1.275	1.301	1.490	1.650	1.640
1952	--	--	--	1.698	1.698
1951	--	--	--	1.697	1.693
1950	--	--	--	1.765	1.752
1949	--	--	--	1.706	1.698
1948	--	--	--	1.731	1.719
1947	--	--	--	1.773	1.759
1946	--	--	--	1.765	1.759

First, the range of variation exhibited by AR and WAR seems rather small. It would appear that the two decades under consideration constitute a relatively stable period in the history of the skill premium. One must nevertheless exercise some caution in attempting to compare the series reported here with those reproduced or cited in Chapter III. Whereas the latter relate exclusively to individual industries, AR and WAR are aggregates which summarize various conflicting movements among numerous components. It is not therefore surpristhat these series display a degree of inertia. Furthermore, one must bear in mind the likelihood that a change of, say, one percentage point will be more significant when the skill premium is low, as at present, than when it is high, as in the past. In addition to being intuitively sensible, this possibility has considerable theoretical backing, for as we saw in Chapter II, the rate of return to investment in training is a nonlinear (logarithmic, to be precise) function of relative wages. Though it is safe to conclude that in the fifties and sixties skill differentials showed no convulsive movements, the amount of variation which did occur, as expressed by AR and WAR, may well be more important than one might at first think.

The second point to note is that the measure advocated by Woods and Ostry performs rather poorly when judged alongside the other two. Because it uses comparatively little raw data, it is susceptible to discontinuities, as already mentioned; and it signifies fluctuations when, according to the

other series, none of any magnitude are present. Whereas WAR exhibits a net decline of 0.036 between 1953 and 1970, RE falls by only 0.009. On reflection, this outcome seems entirely reasonable. If one considers the complete distribution of occupational wage rates, it appears not unlikely that, in calculating RE, one will select from the tails particular rates which do not move appreciably towards one another as the overall dispersion decreases. Woods and Ostry may therefore have underestimated the degree of narrowing which took place over the interval for which their series was originally computed.

Finally, the fact that values of the weighted series consistently exceed those of the unweighted series implies that, on average, differentials are narrower among the small industries of the sample than among the large ones. It is not clear whether this result emerges because the large industries maintain relatively wide differentials (skill levels held constant) or because they tend to employ the most highly skilled trades (wage differentials per "unit" of skill held constant). This question will be investigated further in Chapter V.

Turning to the construction industry, one encounters a very different picture. It turns out that between 1946 and 1970 the skill premium registers a decline of approximately forty percentage points. Whereas a downward trend is just barely perceptible in the figures for the industrial composite, the shrinkage of skill differentials in the building trades is most striking. In addition, it is worth noting that values of

AR_{cons} generally exceed those of WAR_{cons}. One may therefore conclude that, on average, the skill premium is low in regions where the population of construction workers (in absolute terms) is large. This relationship will also be subjected to closer examination in Chapter V.

Evidence Concerning Cyclical Behaviour

Though it is widely asserted that skill differentials react to cyclical forces, existing empirical studies lend this conclusion only modest support.[16] In the case of the United States, fluctuations associated with the business cycle have been observed under the extreme economic circumstances of two World Wars and the Great Depression, but never with any certainty during what one might call "normal times."[17] In the case of Canada, no published research has dealt specifically with the question of cyclical variations in the skill premium. The figures reported here may thus shed valuable light on a somewhat neglected topic.

To facilitate detailed inspection, Figure 7 portrays

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[16] See Bell, "Cyclical Variations," and Reder, "Theory of Occupational Wage Differentials."

[17] Reder has come ultimately to the same conclusion. See "A Partial Survey of the Theory of Income Size Distribution," in Six Papers on the Size Distribution of Income and Wealth, National Bureau of Economic Research Studies in Income and Wealth, Vol. XXXIII, edited by Lee Soltow (New York: Columbia University Press, 1969), p. 239.

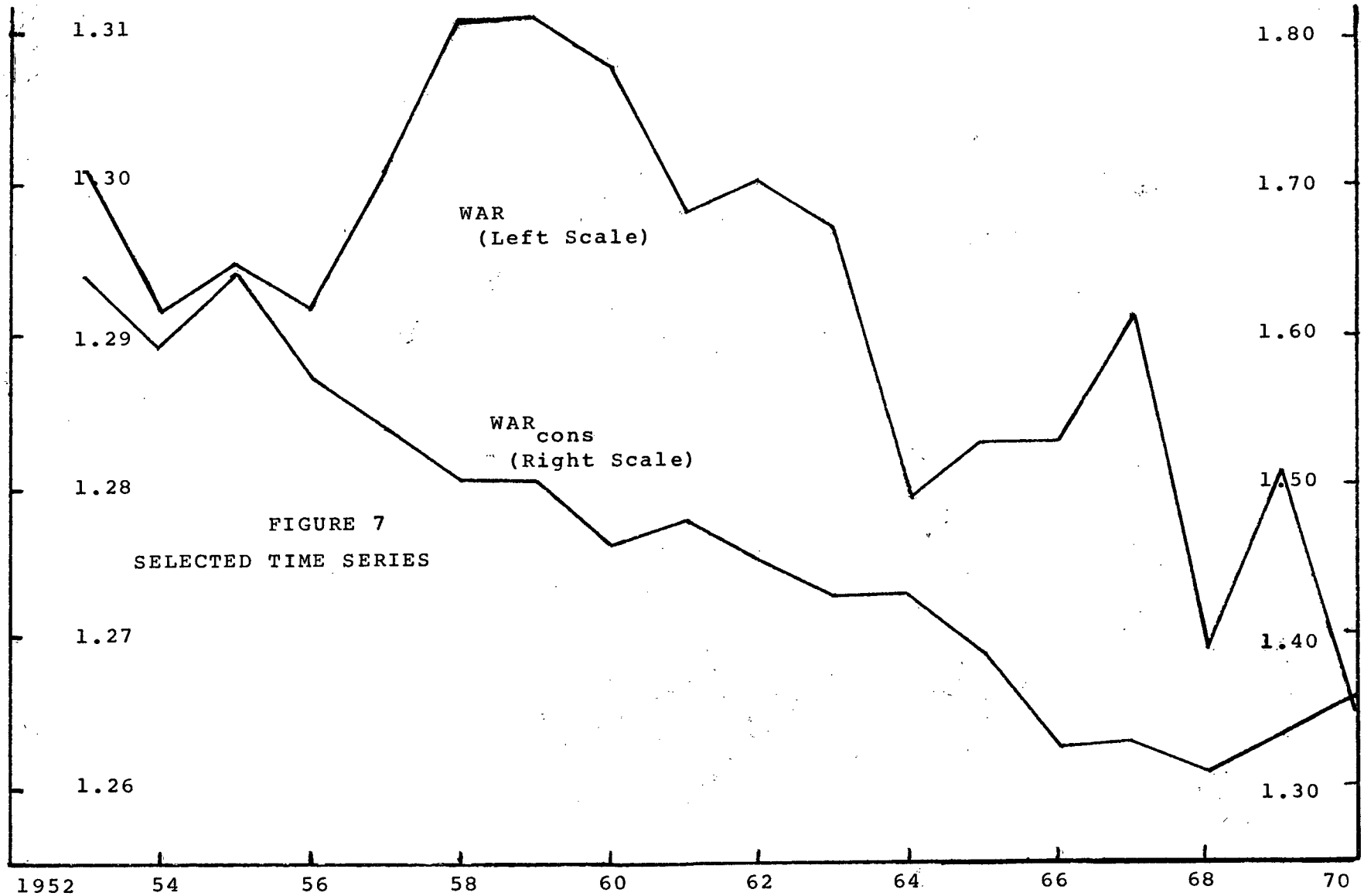

FIGURE 7

SELECTED TIME SERIES

in graphical form the two series of major interest. Though it is difficult and perhaps a little hazardous to abstract visually from the general downward trend, WAR seems to undergo two important short-run disturbances. The first, a conspicuous hump, manifests itself in the late 1950's; the second, a sharp correction, reaches its peak in 1967. The earlier movement coincides with a long episode of severe unemployment, but the later one develops during an expansionary phase. WAR_{cons} appears to depart from its secular trend briefly in 1955 and again after 1966. Both these movements coincide with moderate increases in the rate of unemployment.

Informal inspection thus furnishes some evidence of cyclical response but does not reveal a strong or wholly consistent pattern. Time-series comparisons of an informal nature do not, however, provide a very powerful analytic weapon, particularly when the problem at hand involves several independent variables. In the present case we are concerned not only with the rate of unemployment but also with the rate of change of consumer prices and a whole complex of long-run factors. It was therefore decided to investigate the cyclical behaviour of the computed time series by estimating a multiple regression equation of the following form:

$$(44) \quad DV_t = b_o + b_1 U_{t-1} + b_2 \dot{P}_{t-1} + b_3 T + e_t$$

Here, U_t denotes the average monthly rate of unemployment prevailing in year t, $\dot{P}_t$ stands for the percentage change in the

consumer price index in that year,[18] T represents a linear trend variable, and e_t is a stochastic term. The role of dependent variable (DV) was filled in turn by WAR, WAR_{cons}, and another series, FWAR, to be described in a moment. It will be noted that lags of one period have been assumed. This specification seemed the most plausible, given the use of annual data.

Results are set forth in Table V. They show, with respect to the industrial composite, that the linear time trend postulated on the basis of visual inspection is, in fact, statistically significant.[19] Unemployment turns out to be significant, and its coefficient bears a positive sign, as expected. In equation 1, the price variable is also significant, but the positive sign adhering to its coefficient contradicts the ex ante arguments surveyed in Chapter III.

It would not, of course, be difficult to furnish a convincing ex post rationale for the preceding outcome. One might simply conjecture that skilled workers tend to be more successful than unskilled workers in protecting themselves against inflation. Equation 1 supplies a certain amount of

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[18] Data used in computing U_t and $\dot{P}_t$ were drawn from Canada, Dominion Bureau of Statistics, Canadian Statistical Review (Ottawa: Queen's Printer, 1926--), catalogue no. 11-003, various issues.

[19] Other estimates (not shown) indicate that the long-run factors subsumed under T explain about half the total variance of WAR. The short-run variables U and P, entered alone, acount for about 30%.

TABLE V

TIME-SERIES REGRESSIONS

Dependent Variable	Regression Coefficients b_o	b_1	b_2	b_3	R^2	D.W.
1. WAR	1.299	0.00585** (0.00139)	0.00711* (0.00244)	-0.00342** (0.00061)	0.782**	2.179
2. WAR	1.300	0.00398* (0.00151)		-0.00189** (0.00038)	0.650**	1.719
3. WAR	1.319		0.00237 (0.00314)	-0.00221* (0.00078)	0.507	0.965
4. FWAR	1.309	0.00593** (0.00142)	0.00610* (0.00249)	-0.00392** (0.00062)	0.848**	1.936
5. WAR_{cons}	1.763	-0.00070 (0.00552)	-0.00049 (0.00276)	-0.02050** (0.00105)	0.967**	1.502

Figures in parentheses are standard errors.
*Denotes significance at the 5% level.
**Denotes significance at the 1% level.

prima facie evidence in favour of such speculation but does not test any of the conceivable economic hypotheses that may underlie it. The most that can be said on the basis of the present data is that the inflation hypotheses discussed in Chapter III all appear misdirected.

On the whole, the naive model specified in (44) seems to perform very well. One must nevertheless consider the possibility that the weighting procedure used here introduces a favourable bias into the estimates. If employment in some sample industries is particularly sensitive to cyclical disturbances, and if skill differentials in these industries are typically below the overall average, then one is sure to witness some degree of association between WAR and the rate of unemployment merely through the operation of the weighting scheme. When unemployment is generally high, the industries in question receive relatively light weights; and WAR rises. When it is low, they receive relatively heavy weights; and WAR falls. These movements occur even though wage rates remain constant.

Whether or not the cyclically volatile industries actually display below-average skill differentials is very difficult to ascertain by simple inspection. The question of bias was therefore investigated by indirect means. A new series, FWAR, was computed using fixed rather than annual employment

weights.[20] This series preserves the most important elements of the weighting process but abstracts from cyclical changes in the distribution of employment.

The results obtained by inserting FWAR in place of WAR are displayed in equation 4. If "bias" in the sense just described is of any quantitative importance, this substitution should cause the performance of the unemployment variable to deteriorate considerably. In fact, the t-value associated with its coefficient remains virtually unchanged, while the overall fit of the regression plane appears somewhat improved. Earlier conclusions regarding the significance of unemployment and the rate of inflation are thus sustained.

The final equation reported in Table V presents estimates for the construction industry. As one can see, time is the only significant variable, accounting for almost all the explained variation. Short-run factors, as they have been represented here, exert no measurable influence. These negative findings arise, perhaps, for several reasons. As noted previously, the wage rates which underlie WAR_{cons} are those

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[20] Nineteen sixty-one was selected as the base year. Computed values of FWAR were as follows:

1970 ... 1.258	1964 ... 1.278	1958 ... 1.311
1969 ... 1.275	1963 ... 1.297	1957 ... 1.302
1968 ... 1.270	1962 ... 1.302	1956 ... 1.296
1967 ... 1.289	1961 ... 1.298	1955 ... 1.303
1966 ... 1.279	1960 ... 1.310	1954 ... 1.301
1965 ... 1.281	1959 ... 1.317	1953 ... 1.306

laid down in collective agreements. Wage rates upon which WAR depends are those reported by firms. Consequently, if employers sometimes respond to short-run disturbances in the labour market by paying wages in excess of those dictated by union contracts (the phenomenon of "wage drift"), this method of adjustment will be reflected in WAR but not in WAR_{cons}; and one may well conclude that differentials in the construction industry are completely insensitive to cyclical forces. On the other hand, such insensitivity may in fact be present if strong construction unions act successfully to insulate their members from short-run fluctuations. Though unions connected with the thirty-nine industries aggregated in WAR may harbour similar goals, few would be as strong as those in the construction trades; and, in any case, many of the wage rates entering into the calculation of WAR are determined outside collective bargaining. Finally, it may be that one of the short-run variables appearing in the model, namely, the aggregate rate of unemployment, is simply an inadequate proxy for the state of excess demand in the market for construction workers. On reflection, it appears likely that U will portray conditions facing the "typical" or "average" industry described by WAR better than it will portray conditions facing the construction industry, which characteristically registers turning points that do not match those of the general business cycle.

Notwithstanding the failure of the regression model to rationalize short-term movements in the pattern of construction wages, it seems reasonable to conclude on the basis of

strong evidence obtained from the thirty-nine industry sample that skill differentials in Canada do exhibit a cyclical response which is discernable within the normal range of economic experience. Unemployment appears to be more important than the rate of inflation, but both exert a significant degree of influence, according to the standard statistical tests. Throughout the period of study, this cyclical influence was superimposed upon a general downward trend, which earlier studies trace back as far as the 1930's. Although the striking increase in the skill premium recorded by the construction industry in 1970 may be a hint that the long-run decline is ending, there is really no substantial indication of a reversal.

Chapter V

CROSS-SECTIONAL EVIDENCE

As we have just seen, the information contained in WRSHL may be used to trace the movement of skill differentials over time. Data from this source may, however, be exploited for other purposes as well. Thanks to considerable disaggregation in the reporting of wage rates, it is possible to investigate not only the intertemporal behaviour of skill differentials but also the manner in which they vary across industries and across geographical regions. The regional dimension is explored in the first section of this chapter; the industrial dimension, in the second.

Regional Variation

It has generally been claimed that skill margins on the Pacific Coast tend to be narrower than those prevailing in other parts of North America. Ober[1] reached this conclusion in his early study of United States data; and Reynolds and Taft, commenting in the mid 1950's, agreed.[2] Woods and Ostry, writing about Canada in the early 1960's, made a similar

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[1] "Occupational Wage Differentials, 1907-1947".

[2] Evolution of Wage Structure, p. 295.

assertion but failed to offer any supporting evidence.[3]

The simplest way to investigate their contention and, at the same time, illuminate some other aspects of regional wage structure is to look once more at skill differentials occurring among construction workers. In Chapter IV, statistics computed for metropolitan areas in each of the five regions of Canada were combined to form a national average. The five component series making up this aggregate figure are now displayed separately in Table VI.

According to the measurements performed here, skill differentials among construction workers in the Vancouver area have been considerably narrower than those prevailing in Central Canada--that is to say, in Toronto and Montreal--throughout the postwar period. Yet, Vancouver has seldom occupied the extreme position conventionally ascribed to it. On only three occasions--1949, 1957 and 1958--has its wage structure yielded the lowest average among the metropolitan areas surveyed. Over the rest of the period, the distinction of harbouring the most compressed wage scale has been shared almost equally by Winnipeg, in the Prairie region, and Halifax, in the Atlantic. The widest differentials have always occurred in either Toronto or Montreal.

In general, then, the construction industry does not seem to bear out the conventional view, as expressed by Woods

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[3] Labour Economics and Labour Policy, p. 434.

TABLE VI

SKILL DIFFERENTIALS IN THE CONSTRUCTION INDUSTRY, BY METROPOLITAN AREA. 1946-1970.

Year	Skill Differential					
	Van.	Win.	Tor.	Mon.	Hal.	Can.
1970	1.279	1.264	1.422	1.348	1.398	1.356
1969	1.340	1.166	1.381	1.359	1.218	1.307
1968	1.343	1.286	1.350	1.397	1.182	1.327
1967	1.308	1.284	1.320	1.407	1.269	1.323
1966	1.344	1.153	1.396	1.464	1.279	1.323
1965	1.351	1.286	1.470	1.468	1.317	1.389
1964	1.354	1.335	1.447	1.633	1.365	1.427
1963	1.357	1.331	1.476	1.590	1.345	1.428
1962	1.374	1.335	1.504	1.598	1.405	1.450
1961	1.409	1.387	1.558	1.550	1.385	1.476
1960	1.405	1.380	1.512	1.544	1.387	1.460
1959	1.383	1.415	1.593	1.581	1.371	1.501
1958	1.380	1.438	1.553	1.623	1.401	1.504
1957	1.379	1.462	1.621	1.689	1.398	1.539
1956	1.401	1.504	1.659	1.737	1.395	1.573
1955	1.428	1.473	1.781	1.883	1.392	1.641
1954	1.459	1.481	1.807	1.850	1.409	1.653
1953	1.421	1.477	1.829	1.811	1.401	1.640
1952	1.399	1.510	1.913	1.907	1.383	1.698
1951	1.464	1.595	1.811	1.863	1.415	1.693
1950	1.522	1.705	1.871	1.870	1.416	1.752
1949	1.522	1.682	1.711	1.875	1.616	1.698
1948	1.648	1.636	1.817	1.798	1.576	1.719
1947	1.742	1.640	1.854	1.933	1.570	1.759
1946	1.758	1.600	1.840	1.839	1.790	1.759

and Ostry. Unfortunately, when we turn to other industries, empirical inquiry becomes more difficult. Although WRSHL provides a comparatively large amount of regional detail, it does not furnish enough data for one to trace a consistent regional cross section over a long period of time, as in Table VI. One must instead be content to look at regional differences frozen in a single year.

The method adopted was to select, from the 1969 volume, one skilled and one unskilled occupation per industry, according to certain criteria. The first was that an occupation be reported in more than one region. Those occupations ultimately retained were ones which allowed the widest possible comparison. For example, occupations reported in four of the five regions were selected in preference to those reported in only three. If more than one skilled and one unskilled occupation remained after the application of the preceding criteria, the pair chosen were those which had the highest and the lowest wage rates, respectively, among the occupations considered. Naturally, the selection process was also constrained by the simultaneous availability of a skilled and an unskilled occupation within a particular region.

Since wage rates are reported by province, and not by major geographical region, it sometimes happened in the case of the Prairie and Atlantic Provinces that more than one rate appeared for a given occupation. When this situation occurred, it was dealt with by taking a weighted average, the weights

being total industry employment in the provinces concerned.[4] The final step was to compute wage ratios, by region, for each industry.

In order to summarize the results, Table VII sets forth mean values for these ratios, calculated across various industry samples.[5] The composition of each sample is determined by the availability of data, which in turn depends roughly on the industrial mix of the least industrialized region entering into the comparison in question.

TABLE VII

MEAN SKILL DIFFERENTIALS, BY REGION, SELECTED INDUSTRIES AND OCCUPATIONS,* 1969

Sample No.	No. of Indust.	Mean Differential				
		B.C.	Prs.	Ont.	Que.	Atl.
1.	32	--	--	1.352	1.393	--
2.	19	1.361	--	1.407	1.397	--
3.	11	1.318	1.386	1.369	1.383	--
4.	10	1.410	--	1.474	1.468	1.583

*See Appendix A

[4] Most of the employment data was obtained from Canada, Dominion Bureau of Statistics, Manufacturing Industries of Canada, 1969, and from idem., General Review of the Mineral Industries, 1969. In a few cases D.B.S. publications for specific industries were consulted.

[5] The industries and occupations from which each sample is formed are denoted in Appendix A.

As one can see by examining the table, British Columbia exhibits the lowest mean differential in all three of the cross sections in which it appears. The Prairie region exhibits the highest figure when it is included, and the same is true for the Atlantic region when it is present in the comparison. Ontario and Quebec interchange rankings as the sample varies; however, in the broadest cross section, which contains thirty-two industries, Quebec turns out to possess the higher mean figure.

Since averages can sometimes be misleading, Table VIII summarizes results of the present investigation in an alternative manner, that is, by counting the number of industries in which a particular region displays the lowest wage ratio observed. It will be seen that Table VII and Table VIII portray much the same pattern of regional variation. Low differentials tend to be concentrated in British Columbia; seldom do they appear on the Prairies or in the Atlantic region.

TABLE VIII

NUMBER OF INDUSTRIES IN WHICH REGIONS RANK LOWEST, 1969

Sample No.*	Total	Number of Industries				
		B.C.	Prs.	Ont.	Que.	Atl.
1.	32	--	--	19	13	--
2.	19	8	--	5	6	--
3.	11	4	-1	4	2	--
4.	10	6	--	1	2	1

*See Appendix A.

Thus it seems that, outside the construction industry, the evidence collected here supports the conventional position. It will be noted that this general conclusion bears a close resemblance to one reached in connection with the time-series study of Chapter IV. There, the composite sample of industries displayed something of the expected cyclical pattern, whereas the construction industry did not. These behavioural differences undoubtedly reflect the special characteristics of wage determination in the construction trades. They emphasize, at the same time, the dangers of attempting to generalize about skill differentials on the basis of the latter group of occupations.

Interindustry Variation

Sectioning the data across industries rather than across geographical space reveals a further pattern of variation. As one may confirm by looking at Appendix B, the average skill margins derived for constituents of the thirty-nine-industry sample span a range of more than eighty percentage points. Of course, much of this variation, perhaps the greatest part of it, is simply the result of differences in the composition of employment. Industries which yield the widest mean differentials are, quite obviously, those which utilize the most skilled occupations. Hence, the interesting question--and the one which occupies the rest of this chapter--is whether any of the variation observed in cross section can be attributed to other well defined sources besides differences in the occupational

mix. Likely candidates for testing are variables which seek to represent technological factors, industry organization, and the impact of collective bargaining.

In order to determine what influence, if any, such variables exert, one must first remove that component which is due to the occupational mix. According to the theory of human capital, equilibrium skill differentials depend primarily upon the amount of time individuals must spend in training for particular jobs. Training time would thus seem to be the economically relevant variable with which to distinguish one occupation from another.

The only convenient source of detailed information on training times is a United States publication entitled Estimates of Worker Trait Requirements for 4000 Jobs.[6] Issued in 1956, this volume was designed for use in conjunction with the Dictionary of Occupational Titles. For all listed occupations, it supplies ratings covering general educational development (GED) and specific vocational preparation (SVP). Although these ratings are based on an arbitrary scale of numbered levels, Eckaus has provided equivalents measured in years of training.[7]

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[6]Department of Labor, Bureau of Employment Security (Washington: U.S. GOvernment Printing Office, 1956).

[7]Richard S. Eckaus, "Economic Criteria for Education and Training," Review of Economics and Statistics, XLVI (May, 1964), pp. 181-190.

Estimates was found to contain sufficient data for a cross-section sample of thirty-two industries.[8] Training times for the skilled occupations in each industry were evaluated by adding together the figures for GED and SVP. This sum does not, of course, match precisely the variable contemplated in the theoretical argument. Strictly speaking, it is not training time that counts, but the sacrifice of potential earning time. The initial years of GED probably involve no earnings sacrifice and, therefore, no opportunity cost. Moreover, in some occupations, but not in others, individuals undertaking SVP receive wages or allowances which serve to defray opportunity costs. Though GED and SVP may yet act as respectable proxies for the concept of training time outlined in the theory of human capital, it is sufficient for purposes of this study to interpret them merely as variables which capture the wage-related attributes of the sample occupations.[9]

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[8]The sample consisted of: Metal Mining (except gold and iron); Biscuits; Bakeries; Confectionery; Rubber Footwear; Rubber Tires and Tubes; Leather Tanneries; Cotton Yarn and Cloth; Synthetic Textiles; Sawmills; Plywood and Veneer Mills; Sash, Door, and Flooring Mills; Household, Office, and Other Furniture; Paper Boxes and Bags; Commercial Printing; Iron Foundaries; Metal Stamping, Pressing, and Coating; Heating Equipment; Machine Shops; Agricultural Implements; Miscellaneous Machinery and Equipment; Aircraft and Parts; Motor Vehicles; Motor Vehicle Parts and Accessories; Railroad Rolling Stock; Shipbuilding and Repair; Small Appliances; Electrical Industrial Equipment; Petroleum Refineries; Pharmaceutical and Toilet Preparations; Paint and Varnish; Industrial Chemicals.

[9]For some criticisms of the data see Sidney A. Fine, "The Uses of the Dictionary of Occupational Titles as a Source of Estimates of Education and Training Requirements," Journal of Human Resources, III (Summer, 1968), pp. 363-374. Since the present aim is not to test human capital theory or to do manpower forecasting, it cannot be considered a disadvantage that

Inasmuch as the industry wage ratios were calculated by first averaging the skilled wage rates, the variable describing the occupational mix was constructed by averaging the corresponding training times. This procedure was followed despite certain complications.[10] Since training times turned out to be completely uniform for all the unskilled occupations in the sample, there was no need to make any adjustments for heterogeneity within the unskilled category.[11] The required

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extraneous elements may have crept into the GED and SVP ratings, provided these elements help to differentiate in a meaningful way among occupations.

[10] The fundamental problem, noted again in the next paragraph, is that theory predicts a nonlinear relationship between training times and the equilibrium wage rates of skilled workers. Averaging, on the other hand, is a linear operation. If the functional relationship is as shown in the accompanying diagram, taking an average of the wage rates W and W' and of corresponding training periods d and d' yields the point $(\bar{d}, \bar{W})$, which is not on the curve, as one would hope. Under the present circumstances, therefore, averaging furnishes only an approximation for the desired value d*. The closeness of this approximation depends on the degree of nonlinearity, which, according to the theory outlined in Chapter II, depends in turn upon the size of the discount rate.

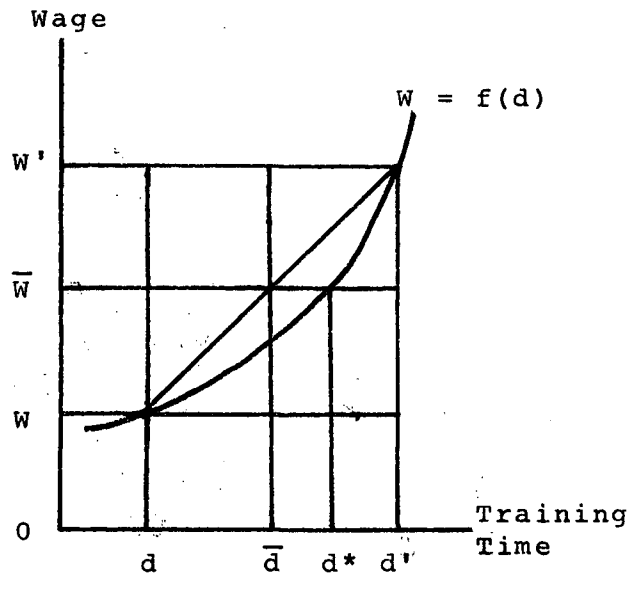

FIGURE 8

ERRORS INTRODUCED IN AVERAGING TRAINING TIMES

[11] If one were attempting to maintain an analogy with the human capital model, the proper procedure would be to take the differences in training times between skilled and "unskilled" workers. The estimated training times for the latter were not

standardization was accomplished by inserting the occupational mix variable (MX) into all the regression estimates.

Unfortunately, theoretical reasoning provides only modest help in seeking a functional form to relate skill differentials and the occupational mix, as they have been depicted here. Human capital arguments are inoperative not only because of the data but also because of the way it is sectioned. In order to apply human capital theory to the present problem, one would have to assume that the unskilled wage in a given industry constitutes the opportunity cost of the skilled workers employed in that industry. Since labour markets are seldom bounded in this manner, such an assumption is clearly untenable. Nevertheless, it does seem likely that some of the nonlinearity predicted by the human capital model will survive in the statistics that have been constructed for this study. Experimentation with nonlinear forms thus became necessary.

The best results were obtained using the general quadratic form reported in equation 2 of Table IX.[12] Logarithmic

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subtracted out here, since to do so would merely have been to change the location of the origin for the occupational mix variable.

[12]Note that the dependent variable in all seven regressions was the set of industry skill differentials obtained for the year 1968. At the time this research was begun, this year was the latest for which most of the other data were available.

TABLE IX

REGRESSION RESULTS FOR THE INDUSTRIAL CROSS SECTION, 1968

Eq. No.	Regression Coefficients					R^2
1.	0.877**	+0.028 MX*				0.144
	(0.172)	(0.013				
2.	2.810**	-0.280 MX**	+0.012 MX^2**			0.549**
	(0.399)	(0.061)	(0.002)			
3.	2.787**	-0.276 MX**	+0.012 MX^2**	-0.042 SCAL	-0.003 LINT	0.552**
	(0.386)	(0.065)	(0.002)	(0.102)	(0.190)	
4.	2.773**	-0.255 MX**	+0.011 MX^2**	-0.160 UZ		0.589**
	(0.391)	(0.062)	(0.002)	(0.107)		
5.	2.735**	-0.251 MX**	+0.011 MX^2**	-0.229 UZ	+0.096 CON	0.595**
	(0.395)	(0.063)	(0.002)	(0.131)	(0.105)	
6.	2.730**	-0.246 MX**	+0.011 MX^2**	-0.232 UZ	+0.076 FSCAL	0.615**
	(0.384)	(0.061)	(0.002)	(0.115)	(0.050)	
7.	2.787**	-0.276 MX**	+0.012 MX^2**	-0.001 EMP		0.554**
	(0.390)	(0.062)	(0.002)	(0.597)		

Figures in parentheses are standard errors.
*Denotes significance at the 5% level.
**Denotes significance at the 1% level.

and exponential forms (not shown) were grossly inferior, as was the simple linear specification set forth in equation 1. Although the quadratic has a minimum in the vicinity of MX = 2.3, this point lies well outside the meaningful range of the variable and, therefore, is not a source of great discomfort. It will be observed that MX, by itself, explains more than half of the total interindustry variation.

The problem, then, is to account for what is left. Since theoretical arguments are, at this point, rather remote, an experimental approach seems justified. The first question to explore is whether any part of the interindustry variation is systematically related to technological characteristics. The two variables which are most often used to describe the technology of an industry are plant scale and factor intensity. Plant scale is measured here by taking the quotient (SCAL) of total employment (EMP) divided by the number of separate establishments. Factor intensity, or to be precise, total labour intensity (LINT), is portrayed by calculating the share of wages and salaries in value added.[13] According to equation 3, however, both SCAL and LINT are resoundingly insignificant as determinants of industry skill differentials. Technology thus seems to be important only insofar as it dictates the occupational mix.

Another possibility is that skill differentials are affected by the degree of competition prevailing within

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[13] Except for the year, 1968, statistical sources for SCAL and LINT were the same as those given in n. 4.

industrial labour markets. As noted in Chapter III, the dominant view (particularly with regard to the "industrial unions" which dominate the present sample) has been that the exercise of monopoly power by unions tends to cause a narrowing of differentials. On the other hand, there has been little speculation concerning the potential effects of monopsony power exercised by firms.[14] Both points seem worth investigating. Accordingly, an attempt was made to quantify the impact of unionization by selecting as an independent variable (UZ) the fraction of the labour force in each sample industry covered by a collective agreement.[15] Although this variable does not distinguish between craft and industrial unions, as does the literature, and does not allow for differences in militancy or bargaining strength, it constitutes the only measure readily available on a detailed industry basis. On the other side of the labour market, monopsony power was portrayed alternately by two variables. The first was a four-firm concentration

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[14] Presumably, firms desire an occupational wage structure which generates optimal flows of new hires and separations at all levels. Peitchinis contends, however, that even if firms could use some of their monopsony power to dictate relative wages, in practice they tend to display indifference over wide ranges, preferring to respond by altering factor proportions in whatever way is necessary to minimize cost for a given wage structure. See "Occupational Wage Differentials in Canada," pp. 38-39.

[15] Figures were taken from Canada, Department of Labour, Working Conditions in Canadian Industry, 1968 (Ottawa: Queen's Printer, 19--).

coefficient (CON) measured in terms of employment.[16] The second was average firm scale (FSCAL), the quotient of total employment divided by the number of firms.[17]

The foregoing variables appear in equations 4, 5, and 6. It will be observed that the coefficient of UZ is, on the one hand, negative, and on the other, insignificant, in all three cases.[18] From this result one may conclude that the most heavily unionized industries in the sample tend, on average, to be those with the narrowest skill differentials (other things being equal), but that the association does not display enough

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[16] In the case of the manufacturing industries, the percentage of industry employment residing in the four largest firms was determined after they had been ranked according to the value of outgoing shipments. The figures, which were for 1965, came from Canada, Department of Consumer and Corporate Affairs, Concentration in the Manufacturing Industries of Canada (Ottawa: Information Canada, 1971), Table A-2. In the case of Metal Mining, concentration had to be measured in terms of sales. This piece of data (which was for 1964) came from Max D. Stewart, Concentration in Canadian Manufacturing and Mining Industries, Background Study to the Interim Report on Competition Policy (n.p.: Economic Council of Canada, 1970), mimeographed, Table 3.1).

[17] For manufacturing, data on employment and on the number of firms were extracted from Canada, Department of Consumer and Corporate Affairs, op. cit. For Metal Mining, data came from the source cited in n. 4 (the year being 1965) in the case of employment, and from Canada, Dominion Bureau of Statistics, Corporation Financial Statistics, 1965 (Ottawa: Queen's Printer, 1965--), catalogue no. 61-207, in the case of the number of firms.

[18] Although the t statistic in equation 6 exceeds 2.0, the traditional rule-of-thumb value, it falls short of 2.059, the precise critical value for a two-tail test at the 5% level of significance, given 27 degrees of freedom.

consistency for one to postulate a functional relationship, according to standard research criteria. Nevertheless, unionization does show a certain amount of promise as an explanatory variable; and future inquiry, aimed at refining the measurement of union power and at delineating more appropriately than here the boundaries of the relevant labour markets, might well demonstrate the existence of a significant association. The regression results also indicate that CON and FCAL, the variables representing the demand side of the market, are insignificant. Moreover, the combinations of UZ plus either CON or FSCAL turn out to be insignificant in F tests at the five-percent level.

Finally, it will be recalled that in Chapter IV comparison of the weighted and unweighted time series revealed that the largest industries (in terms of total employment) tended to have the widest skill differentials. It was not clear whether this relationship arose as an effect of industry size or merely as the result of a correlation between industry size and the "richness" of the skill mix. Without attempting to compare the industry sample used in Chapter IV with that used here, one may observe that in equation 7 EMP is thoroughly insignificant. In view of this outcome, and the fact that EMP along yields an R^2 of only 0.004, the second of the two preceding explanations now appears the more reasonable.

On the whole, however, attempts to explain interindustry variations in the skill premium produced negative results.

When one considers the complex overlapping of occupational, regional, and industrial labour markets, and the crudeness of the measurements allowed by the available data, this general outcome is not altogether surprising.

Chapter VI

SUMMARY AND CONCLUSIONS

This study has considered skill differentials in the Canadian economy, first from a theoretical, and then from an empirical standpoint. Unfortunately, it has not established many firm links between these two phases of inquiry, owing to the fact that the key relationships encountered in the theoretical discussion proved largely inaccessible to statistical probing.

If neoclassical theory fails, in the present case, as in others, to yield an abundance of testable propositions, it serves, at least, to clarify a number of issues raised in the literature. The analysis conducted here proceeds in a somewhat novel fashion by deriving short- and long-run supply and demand curves drawn in relative-price-relative-quantity space. This device allows one to deal with the markets for skilled and unskilled labour simultaneously and to extract results measured directly in terms of relative wages.

On the supply side of the merged skilled-unskilled labour market, human capital theory, as expounded by Jacob Mincer and Gary Becker, bears the major analytical burden. Together with certain distributional assumptions describing the population of prospective trainees, it generates the conclusion that flows into skilled training, and ultimately into the skilled labour force, depend positively on the level of

apprenticeship wages, the expected growth rate of all wages, and the average length of an individual's working life, and negatively on the discount rate, the length of the training period, the supply price of capital to the individual, and the skilled-unskilled ratio of expected unemployment rates. On the demand side, the conventional theory of the firm provides all the relevant arguments. One need only refer to the familiar theorem which states that factor input ratios depend on relative factor prices. In the terminology adopted earlier, the skill mix demanded by firms depends on the prevailing skill differential (given the prices of nonlabour inputs). The form of this demand relationship follows, in turn, from the parameters of the production function, notably, the partial elasticities of substitution.

Market equilibrium occurs when the relative wage is such that firms aggregately choose to employ the available skill mix. In the short run the skill mix is given, but in the long run it changes in response to flows into and out of the labour force. Because these flows are typically a rather small proportion of the total stock in any occupational category, such changes proceed very slowly but, at the same time, possess a kind of momentum which is likely to cause market adjustments in the skill premium to "overshoot" long-run equilibrium. Theory thus implies the possibility of cycles.

Whether or not the historical record fulfills this prediction is, however, debatable. In the case of Canada, the long-run studies consulted in Chapter III identify broad

increases in skill differentials until the 1930's, followed by substantial declines. To say that these movements confirm the existence of long cycles would require both bravery and imagination.

The trends and minor fluctuations observed during the first half of this century did, of course, provoke a wide array of explanatory efforts. Hypotheses pertaining to the long run emphasized the spread and development of public education, the effects of social attitudes and policy, the subsidance of international and of rural-to-urban migration, the influence of technological change, and the growth of unionization. The latter phenomenon has unquestionably received the most thorough discussion in the literature. In Chapter II we reviewed in detail Rosen's elasticity model, which predicts that unionization, whether of the industrial or of the craft variety, will lead to a widening of skill differentials. In Chapter III, however, we found that the weight of speculative opinion, as well as the results of the empirical work which has been undertaken (including some by Rosen himself), tend to contradict such a priori reasoning.

Hypotheses pertaining to the short run link skill differentials with the rate of unemployment and the rate of inflation. The best known of these--the hypothesis propounded by Melvin Reder--was subjected in Chapter III to particularly careful scrutiny.

Chapter IV presented the outcome of attempts to describe and explain the time-series behaviour of skill differ-

entials in Canada over the postwar period. Samples of skilled and unskilled occupations, collected on the one hand from a group of thirty-nine mining and manufacturing industries, and on the other, from the large and important construction sector, were found to yield very different results. Although summary statistics designed to measure the average skill premium signalled a narrowing of differentials in both samples during the period of study, the downward trend exhibited by the industrial composite was only just perceptible among the short-run fluctuations, whereas the trend displayed by the construction industry was steep and unmistakable. Only in the terminal year of the investigation, 1970, did construction differentials manifest signs of rebounding to former levels.

The two samples also behaved somewhat differently in response to cyclical forces, that is to say, the rate of unemployment and the rate of inflation. Whereas construction differentials appeared completely insensitive to these variables, differentials computed for the industrial composite turned out to be significantly related to both. According to the regression results, unemployment exerted a positive effect, as hypothesized earlier. The fact that inflation <u>also</u> exerted a positive effect came, however, as a surprise, inasmuch as the majority view has been that the relationship is negative. Contrary to previous observation, skilled workers employed during the 1950's and the 1960's within the broad sample of occupations considered here seem to have gained in relative terms from periods of inflation.

Conclusions with regard to the influence of unemployment and inflation cannot, however, be stated with complete confidence, in view of the disparity in the results obtained using the two occupational samples. It may be that no universal statement is possible. As noted in Chapter IV, there are sound reasons for thinking that wages in construction and those in the other industries surveyed require separate analyses. If this suspicion is valid, the positive results derived in connection with the industrial composite sample may be accepted on their merits. In any event, the disparity in findings tends to vindicate a criticism directed earlier against existing research; namely, that generalizations based on the construction trades may be misleading.

To the extent that increases in unemployment and inflation precipitate a widening of skill differentials (relative to trend) among blue-collar workers, it is clear that distributional equality suffers. Although the secondary impact on distribution via wage structure is probably much less important than the direct effect of these two economic evils on earning opportunity and purchasing power, all factors deserve recognition by the policy authorities. As long as equality remains a policy goal, planners must take wage effects at least into theoretical account in establishing policy targets for unemployment and inflation.

Chapter V reports on two cross-sectionsl studies of skill differentials. The first, a regional cross section, again reveals differences between construction and other indus-

tries. Contrary to popular assertion, construction differentials in British were seldom the narrowest in the country during the postwar years; on the average, however, the conventional view of how skill differentials are ranked across regions appeared justified with regard to industries other than construction.

The second study was an attempt to explain variations in skill differentials, not across regions, but across industries. In terms of positive results, this effort proved relatively unsuccessful. Among all the variables tested, only unionization showed any promise (although, strictly speaking, it was not statistically significant). Specifically, there was some evidence that skill differentials in the sample industries were inversely related to the level of union organization. Plant scale, labour intensity, firm scale, industry concentration, and total industry employment were rejected as explanatory variables. Differences in the skill mix accounted for slightly more than half the observed variation; the remainder was, for the most part, unexplained.

It is worth noting, parenthetically, that all three of the preceding empirical studies were hampered to a considerable degree by a lack of detailed statistics on occupational employment. Although the required information is gathered annually by the Department of Labour and is routinely used in computing average wage rates, it has never been published. In view of the many valuable uses to which such data could be put, as well as the probable ease with which publication could be accomplished, it is to be hoped that the Department will soon decide to make the employment figures available.

At this point it is perhaps in order, as a final comment, to indulge in some discrete speculation as to the probable course of skill differentials in Canada during the coming years. As we have seen, short-run movements are likely to depend on the general level of economic activity and on the kind of inflation-unemployment trade-off that can be achieved. What will happen to the underlying trend, which has been consistently downward since the 1930's, is somewhat more difficult to forecast. Although the skill premium stood at an historical low in 1970, European experience suggests that further declines are within the realm of economic feasibility. Whether such declines will materialize depends, presumably, on the long-run factors enumerated in Chapter III. Let us consider these in turn.

The first was the spread of public education, or more properly, the lessening of educational disparities. Though a continued lessening is probable (if only because of the retirement of the oldest and most poorly educated worker age cohorts), the major impact of this factor has likely been spent. Second was the influence of social attitudes and policy. It would appear that these forces, for what they are worth, remain strongly in favour of equality in wage structure. Whatever has been the effect of the third factor, migration, it is unlikely to exert much influence in the future. Technological change, the fourth factor mentioned, is difficult to predict; but if it has contributed to the declines of the past, there is little reason to suppose that it will have a reverse effect

on skill differentials in the coming years. The fifth and last factor was the spread of unionization. Since unionism in Canada would appear to have passed through its phase of greatest militancy and most rapid growth, it is unlikely that further declines in skill differentials will stem from this source.

Nevertheless, further declines do seem probable as the net effect of all the preceding factors. Since some have become inoperative and others have weakened, what is unlikely is that the declines will be as dramatic as those of the past.

One factor which has not been previously considered but which will undoubtedly generate continuing social and economic repurcussions is the increase in labour-force participation, first among women, and second among young people. Until barriers to the entry of women into high-level occupations are broken down, it is clear that most will be competing for jobs in the unskilled category. Young people, who typically possess little specialized training, similarly gravitate towards unskilled jobs. Therefore, to the extent that unskilled wages respond to market forces, these wages may not rise as rapidly as would have been the case had labour force participation remained constant. Apart from an unforeseeable technological shift, this change in participation rates is the most obvious factor which might upset the foregoing prediction.

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APPENDIX A

INDUSTRIES AND OCCUPATIONS SELECTED FOR USE IN EMPIRICAL INVESTIGATIONS

The following occupations, listed by industry, form the basis for the composite time series discussed in Chapter IV. Those which also appear in the regional cross-sections of Chapter V are denoted by an asterisk. Figures preceding the industry titles signify inclusion in the particular cross-sectional comparisons assigned corresponding numbers in the text.

	Industry	Skilled Occupations	Unskilled Occupations
	Gold Quartz Mines	-hoistman -miner -timberman	-deckman -labourer, underground -labourer, surface -mucker and trammer -trackman -tradesman's helper
(1,2,4)	Metal Mining (except gold and iron)*	-hoistman -miner* -timberman	-deckman -labourer, underground -labourer, surface* -mucker and trammer -trackman -tradesman's helper
(1)	Biscuits*	-dough mixer -ovenman*	-general helper*
(1,2,3,4)	Bakeries*	-baker, bread -baker, cake -doughman* -ovenman	-general helper*
(1)	Confectionery*	-candymaker*	-packer*
(1,2,3)	Breweries*	-bottle shop worker, skilled -brewhouse worker, skilled*	-bottle shop worker, unskilled -brewhouse worker, unskilled -labourer* -loader and unloader

	Industry	Skilled Occupations	Unskilled Occupations
	Rubber Footwear	-shoemaker	-packer
	Rubber Tires and Tubes	-tire builder, passenger -tire builder, heavy service -inspector, final, tire	-labourer
(1)	Other Rubber Products*	-inspector, finished goods*	-packer*
	Leather Tanneries	-dyer -sorter, finished leather -tanning drum operator	-labourer
(1)	Cotton Yarn and Cloth*	-card grinder -fixer, spinning -loomfixer* -weaver	-battery hand -warp hanger*
	Synthetic	-loom fixer -weaver	-battery hand -warp hanger
(1,2,4)	Sawmills*	-band head sawyer* -circular head sawyer -grader -shingle sawyer	-labourer -loader -piler* -tail sawyer
(1,2)	Veneer and Plywood Mills*	-lathe operator*	-labourer* -off-bearer -press loader

	Industry	Skilled Occupations	Unskilled Occupations
(1,2,3,4)	Sash, Door, and Flooring Mills*	-cabinetmaker, millwork* -grader -planer operator -woodworking machine operator	-labourer* -loader -piler
(1,2,3)	Household, Office, and Other Furniture*	-cabinetmaker, class A* -planer operator -upholsterer -veneer cutter and matcher	-labourer -packer* -yardman
(1,2,4)	Pulp and Paper*	-digester cook -machine tender, cylinder* -machine tender, fourdrinier	-blow pit man -chipperman -digester cook helper* -oiler -roll finisher -wood handler -third hand -fourth hand -fifth hand -sixth hand
	Paper Boxes and Bags	-die maker -pressman, cylinder, printing -printer-slotter operator	-bundler -labourer -sticher operator -stripper, folding carton
(1,2,3,4)	Commercial Printing*	-compositer, hand -linotype operator -pressman, cylinder -pressman, platen -pressman, offset*	-bindery hand*

	Industry	Skilled Occupations	Unskilled Occupations
(1,2,3)	Iron Foundaries*	-coremaker -cupola charger -machinist -moulder, bench -moulder, floor* -patternmaker -pourer, metal -sand cutter -welder	-labourer*
(1)	Metal Stamping, Pressing, and Coating*	-machinist -plater -tool and die maker -welder*	-labourer* -metalworker's helper
(1)	Heating Equipment*	-machinist -tool and die* maker -welder	-labourer*
(1,2,3,4)	Machine Shops*	-fitter -lathe operator -machinist* -tool and die maker	-labourer*
	Agricultural Implements	-inspector -lathe operator -machinist -set-up man -tool and die maker -welder	-labourer

	Industry	Skilled Occupations	Unskilled Occupations
(1,2,3)	Miscellaneous Machinery and Equipment*	-fitter -lathe operator -machinist* -milling machine operator -moulder, bench -moulder, floor -sheet metal worker -tool and die maker -welder	-labourer*
	Office and Store Machinery	-tool and die maker -welder	-labourer
(1)	Aircraft and Parts*	-aircraft electrical mechanic -aircraft engine mechanic -inspector -lathe operator -machinist -milling machine operator -sheet metal worker -subassembler -tool and die maker* -welder	-labourer*
(1)	Motor Vehicles*	-inspector -sheet metal worker -tool and die maker* -welder	-labourer*

	Industry	Skilled Occupations	Unskilled Occupations
(1)	Motor Vehicle Parts and Accessories*	-heat treater -lathe operator -set-up man -sheet metal worker -tool and die maker -welder	-labourer*
(1,2,4)	Railroad Rooling Stock*	-crane operator -lathe operator -tool and die maker* -welder	-labourer*
(1,2,4)	Shipbuilding and Repair*	-blacksmith -boilermaker -electrician, ship -engine fitter -joiner -machinist* -pipefitter -plater -ship rigger -shipwright -welder	-labourer*
(1)	Household Electrical Appliances - Small and Major*	-plater -tool and die maker* -welder	-labourer*
(1)	Radio and Television Receivers - Communications Equipment*	-fitter -inspector, electrical -technician, production* -tool and die maker -trouble shooter	-labourer* -packer

	Industry	Skilled Occupations	Unskilled Occupations
(1)	Electrical Industrial Equipment*	-lathe operator -milling machine operator -tool and die maker*	-labourer*
(1,2,3)	Petroleum Refining and Products*	-instrument repairman -still operator*	-labourer*
(1)	Pharmaceuticals, Medicines, and Toilet Preparations*	-mixer, hand*	-filler and packager*
(1,2)	Paint and Varnish*	-kettleman -mixer, paste -tinter*	-labourer* -wharehouseman
(1)	Industrial Chemicals*	-operator, chemical*	-labourer*
(1,2,3,4)	Electric Power*	-electrician -floorman -lineman* -meter repairman -operator, generating station -troubleman	-labourer*

The following were used in both time-series and cross-sectional analyses of Building Construction. Wage rates included were those for Vancouver, Winnipeg, Toronto, Montreal, and Halifax.

Skilled Occupations	Unskilled Occupations
-bricklayer	-labourer
-brush painter	
-carpenter	
-electrician	
-plasterer	
-plumber	
-sheet metal worker	

APPENDIX B

TIME SERIES FOR INDIVIDUAL SAMPLE INDUSTRIES

3. Gold Quartz Mines

Year	Wage Ratio	Year	Wage Ratio
1970	1.060	1961	1.096
1969	1.085	1960	1.097
1968	1.093	1959	1.094
1967	1.105	1958	1.096
1966	1.107	1957	1.094
1965	1.109	1956	1.111
1964	1.107	1955	1.111
1963	1.106	1954	1.092
1962	1.103	1953	1.103

5. Other Metal Mines

Year	Wage Ratio	Year	Wage Ratio
1970	1.081	1961	1.088
1969	1.107	1960	1.088
1968	1.121	1959	1.118
1967	1.089	1958	1.148
1966	1.098	1957	1.121
1965	1.090	1956	1.101
1964	1.116	1955	1.055
1963	1.086	1954	1.115
1962	1.100	1953	1.111

11. Biscuits

Wage	Wage Ratio	Year	Wage Ratio
1970	1.200	1961	1.277
1969	1.170	1960	1.207
1968	1.208	1959	1.233
1967	1.186	1958	1.200
1966	1.217	1957	1.211
1965	1.218	1956	1.241
1964	1.176	1955	1.245
1963	1.228	1954	1.214
1962	1.247	1953	1.263

12. Bakeries

Year	Wage Ratio	Year	Wage Ratio
1970	1.281	1961	1.245
1969	1.304	1960	1.189
1968	1.263	1959	1.223
1967	1.245	1958	1.208
1966	1.263	1957	1.229
1965	1.174	1956	1.204
1964	1.243	1955	1.272
1963	1.231	1954	1.242
1962	1.283	1953	1.274

13. Confectionery

Year	Wage Ratio	Year	Wage Ratio
1970	1.123	1961	1.227
1969	1.095	1960	1.231
1968	1.110	1959	1.208
1967	1.151	1958	1.197
1966	1.226	1957	1.217
1965	1.205	1956	1.248
1964	1.223	1955	1.232
1963	1.229	1954	1.263
1962	1.238	1953	1.094

15. Breweries

Year	Wage Ratio	Year	Wage Ratio
1970	1.009	1961	1.046
1969	1.027	1960	1.089
1968	1.035	1959	1.119
1967	1.019	1958	1.029
1966	1.034	1957	1.036
1965	1.036	1956	1.057
1964	1.033	1955	1.062
1963	1.048	1954	1.107
1962	1.056	1953	1.059

17. Rubber Footwear

Year	Wage Ratio	Year	Wage Ratio
1970	0.749	1961	1.080
1969	0.989	1960	1.088
1968	0.977	1959	1.091
1967	1.058	1958	1.101
1966	1.000	1957	1.029
1965	0.975	1956	1.019
1964	1.030	1955	1.030
1963	1.003	1954	1.161
1962	1.029	1953	1.124

18. Rubber Tires and Tubes

Year	Wage Ratio	Year	Wage Ratio
1970	1.534	1961	1.692
1969	1.481	1960	1.635
1968	1.620	1959	1.610
1967	1.658	1958	1.662
1966	1.747	1957	1.656
1965	1.659	1956	1.648
1964	1.675	1955	1.353
1963	1.619	1954	1.524
1962	1.688	1953	1.601

19. Other Rubber Products

Year	Wage Ratio	Year	Wage Ratio
1970	0.996	1961	1.199
1969	0.953	1960	1.108
1968	1.060	1959	1.200
1967	1.178	1958	1.101
1966	1.183	1957	1.035
1965	1.136	1956	1.094
1964	1.102	1955	1.092
1963	1.163	1954	1.128
1962	1.201	1953	1.137

21. Leather Tanneries

Year	Wage Ratio	Year	Wage Ratio
1970	0.991	1961	1.092
1969	1.004	1960	1.046
1968	1.091	1959	1.094
1967	1.102	1958	1.065
1966	1.105	1957	1.068
1965	1.135	1956	1.081
1964	1.082	1955	1.051
1963	1.106	1954	1.153
1962	1.073	1953	1.157

23. Cotton Yarn and Cloth

Year	Wage Ratio	Year	Wage Ratio
1970	1.240	1961	1.215
1969	1.240	1960	1.212
1968	1.258	1959	1.172
1967	1.252	1958	1.245
1966	1.255	1957	1.184
1965	1.212	1956	1.177
1964	1.207	1955	1.207
1963	1.253	1954	1.174
1962	1.241	1953	1.249

25. Synthetic Textiles

Year	Wage Ratio	Year	Wage Ratio
1970	1.099	1961	1.355
1969	1.170	1960	1.431
1968	1.107	1959	1.283
1967	1.072	1958	1.324
1966	1.114	1957	1.311
1965	1.140	1956	1.283
1964	1.164	1955	1.321
1963	1.232	1954	1.290
1962	1.237	1953	1.296

31. Sawmills and Planing Mills

Year	Wage Ratio	Year	Wage Ratio
1970	1.479	1961	1.526
1969	1.464	1960	1.544
1968	1.497	1959	1.560
1967	1.494	1958	1.557
1966	1.499	1957	1.541
1965	1.464	1956	1.525
1964	1.425	1955	1.526
1963	1.552	1954	1.481
1962	1.539	1953	1.484

32. Veneer and Plywwod Mills

Year	Wage Ratio	Year	Wage Ratio
1970	1.160	1961	1.264
1969	1.192	1960	1.225
1968	1.190	1959	1.216
1967	1.190	1958	1.232
1966	1.186	1957	1.178
1965	1.169	1956	1.191
1964	1.155	1955	1.231
1963	1.174	1954	1.207
1962	1.252	1953	1.223

33. Sash, Door, and Flooring Mills

Year	Wage Ratio	Year	Wage Ratio
1970	1.121	1961	1.239
1969	1.096	1960	1.238
1968	1.154	1959	1.221
1967	1.253	1958	1.213
1966	1.220	1957	1.234
1965	1.186	1956	1.271
1964	1.144	1955	1.233
1963	1.226	1954	1.187
1962	1.160	1953	1.197

34. Household, Office, and Other Furniture

Year	Wage Ratio	Year	Wage Ratio
1970	1.242	1961	1.307
1969	1.243	1960	1.292
1968	1.251	1959	1.263
1967	1.255	1958	1.244
1966	1.273	1957	1.277
1965	1.298	1956	1.233
1964	1.296	1955	1.254
1963	1.311	1954	1.279
1962	1.332	1953	1.348

35. Pulp and Paper

Year	Wage Ratio	Year	Wage Ratio
1970	1.285	1961	1.526
1969	1.302	1960	1.369
1968	1.305	1959	1.452
1967	1.311	1958	1.463
1966	1.331	1957	1.441
1965	1.355	1956	1.449
1964	1.357	1955	1.467
1963	1.367	1954	1.450
1962	1.359	1953	1.474

39. Paper Boxes and Bags

Year	Wage Ratio	Year	Wage Ratio
1970	1.213	1961	1.264
1969	1.245	1960	1.300
1968	1.257	1959	1.278
1967	1.250	1958	1.283
1966	1.253	1957	1.293
1965	1.281	1956	1.307
1964	1.351	1955	1.314
1963	1.312	1954	1.316
1962	1.290	1953	1.288

40. Commercial Printing

Year	Wage Ratio	Year	Wage Ratio
1970	1.760	1961	1.239
1969	1.905	1960	1.902
1968	1.869	1959	1.909
1967	1.811	1958	1.895
1966	1.827	1957	1.921
1965	1.837	1956	1.906
1964	1.852	1955	1.912
1963	1.881	1954	1.881
1962	1.917	1953	1.909

43. Iron Foundaries

Year	Wage Ratio	Year	Wage Ratio
1970	1.094	1961	1.307
1969	1.096	1960	1.116
1968	1.092	1959	1.125
1967	1.161	1958	1.114
1966	1.093	1957	1.106
1965	1.124	1956	1.132
1964	1.120	1955	1.109
1963	1.133	1954	1.105
1962	1.108	1953	1.125

47. Metal Stamping, Pressing and Coating

Year	Wage Ratio	Year	Wage Ratio
1970	1.302	1961	1.362
1969	1.286	1960	1.288
1968	1.241	1959	1.201
1967	1.292	1958	1.245
1966	1.330	1957	1.263
1965	1.294	1956	1.288
1964	1.255	1955	1.275
1963	1.265	1954	1.228
1962	1.248	1953	1.287

49. Heating Equipment

Year	Wage Ratio	Year	Wage Ratio
1970	1.339	1961	1.327
1969	1.373	1960	1.300
1968	1.422	1959	1.302
1967	1.377	1958	1.241
1966	1.374	1957	1.236
1965	1.268	1956	1.339
1964	1.213	1955	1.299
1963	1.266	1954	1.267
1962	1.256	1953	1.282

50. Machine Shops

Year	Wage Ratio	Year	Wage Ratio
1970	1.416	1961	1.905
1969	1.395	1960	1.369
1968	1.458	1959	1.319
1967	1.503	1958	1.374
1966	1.495	1957	1.378
1965	1.513	1956	1.373
1964	1.499	1955	1.409
1963	1.416	1954	1.346
1962	1.408	1953	1.271

51. Agricultural Implements

Year	Wage Ratio	Year	Wage Ratio
1970	1.216	1961	1.117
1969	1.206	1960	1.228
1968	1.249	1959	1.319
1967	1.187	1958	1.362
1966	1.170	1957	1.334
1965	1.146	1956	1.296
1964	1.140	1955	1.224
1963	1.118	1954	1.267
1962	1.163	1953	1.281

52. Miscellaneous Machinery and Equipment

Year	Wage Ratio	Year	Wage Ratio
1970	1.287	1961	1.282
1969	1.351	1960	1.315
1968	1.115	1959	1.309
1967	1.362	1958	1.308
1966	1.288	1957	1.305
1965	1.307	1956	1.302
1964	1.303	1955	1.377
1963	1.328	1954	1.325
1962	1.313	1953	1.337

53. Office and Store Machinery

Year	Wage Ratio	Year	Wage Ratio
1970	1.475	1961	1.304
1969	1.449	1960	1.346
1968	1.363	1959	1.389
1967	1.421	1958	1.308
1966	1.667	1957	1.313
1965	1.350	1956	1.496
1964	1.379	1955	1.536
1963	1.420	1954	1.300
1962	1.329	1953	1.300

54. Aircraft and Parts

Year	Wage Ratio	Year	Wage Ratio
1970	1.202	1961	1.410
1969	1.238	1960	1.285
1968	1.232	1959	1.310
1967	1.357	1958	1.299
1966	1.260	1957	1.356
1965	1.227	1956	1.257
1964	1.242	1955	1.273
1963	1.268	1954	1.307
1962	1.272	1953	1.277

55. Motor Vehicles

Year	Wage Ratio	Year	Wage Ratio
1970	1.253	1961	1.154
1969	1.200	1960	1.114
1968	1.173	1959	1.102
1967	1.123	1958	1.126
1966	1.146	1957	1.134
1965	1.223	1956	1.138
1964	1.149	1955	1.158
1963	1.126	1954	1.187
1962	1.123	1953	1.127

56. Motor Vehicle Parts and Accessories

Year	Wage Ratio	Year	Wage Ratio
1970	1.138	1961	1.196
1969	1.216	1960	1.291
1968	1.080	1959	1.277
1967	1.242	1958	1.218
1966	1.135	1957	1.143
1965	1.190	1956	1.225
1964	1.148	1955	1.050
1963	1.167	1954	1.166
1962	1.214	1953	1.176

57. Railroad Rolling Stock

Year	Wage Ratio	Year	Wage Ratio
1970	1.254	1961	1.312
1969	1.236	1960	1.220
1968	1.301	1959	1.290
1967	1.297	1958	1.253
1966	1.266	1957	1.269
1965	1.251	1956	1.260
1964	1.256	1955	1.256
1963	1.300	1954	1.328
1962	1.250	1953	1.368

58. Shipbuilding and Repair

Year	Wage Ratio	Year	Wage Ratio
1970	1.242	1961	1.239
1969	1.262	1960	1.258
1968	1.228	1959	1.282
1967	1.187	1958	1.287
1966	1.240	1957	1.285
1965	1.230	1956	1.243
1964	1.246	1955	1.276
1963	1.295	1954	1.273
1962	1.242	1953	1.302

59. Small Electrical and Major (Electric and Non-electric) Appliances

Year	Wage Ratio	Year	Wage Ratio
1970	1.277	1961	1.158
1969	1.336	1960	1.453
1968	1.332	1959	1.346
1967	1.322	1958	1.339
1966	1.351	1957	1.200
1965	1.331	1956	1.213
1964	1.290	1955	1.200
1963	1.291	1954	1.179
1962	1.339	1953	1.193

61. Household Radio and Television Receivers and Communications Equipment

Year	Wage Ratio	Year	Wage Ratio
1970	1.312	1961	1.226
1969	1.355	1960	1.320
1968	1.457	1959	1.398
1967	1.408	1958	1.329
1966	1.275	1957	1.276
1965	1.365	1956	1.262
1964	1.354	1955	1.440
1963	1.303	1954	1.437
1962	1.278	1953	1.218

63. Electrical Industrial Equipment

Year	Wage Ratio	Year	Wage Ratio
1970	1.273	1961	1.268
1969	1.298	1960	1.272
1968	1.271	1959	1.272
1967	1.356	1958	1.278
1966	1.288	1957	1.223
1965	1.320	1956	1.244
1964	1.333	1955	1.286
1963	1.328	1954	1.215
1962	1.320	1953	1.333

65. Pharmaceutical, Medicines, and Toilet Preparations

Year	Wage Ratio	Year	Wage Ratio
1970	1.196	1961	1.323
1969	1.178	1960	1.321
1968	1.266	1959	1.206
1967	1.233	1958	1.254
1966	1.166	1957	1.203
1965	1.195	1956	1.220
1964	1.194	1955	1.327
1963	1.280	1954	-.000
1962	1.271	1953	1.147

66. Paint and Varnish

Year	Wage Ratio	Year	Wage Ratio
1970	1.130	1961	1.292
1969	1.162	1960	1.190
1968	1.182	1959	1.184
1967	1.169	1958	1.169
1966	1.172	1957	1.290
1965	1.215	1956	1.259
1964	1.207	1955	1.173
1963	1.209	1954	1.167
1962	1.190	1953	1.290

67. Industrial Chemicals

Year	Wage Ratio	Year	Wage Ratio
1970	1.206	1961	1.268
1969	1.193	1960	1.185
1968	1.168	1959	1.166
1967	1.142	1958	1.112
1966	1.191	1957	1.128
1965	1.152	1956	1.064
1964	1.150	1955	1.126
1963	1.160	1954	1.134
1962	1.160	1953	1.116

70. Electric Power

Year	Wage Ratio	Year	Wage Ratio
1970	1.483	1961	1.464
1969	1.478	1960	1.545
1968	1.484	1959	1.554
1967	1.498	1958	1.472
1966	1.389	1957	1.455
1965	1.468	1956	1.439
1964	1.463	1955	1.506
1963	1.493	1954	1.501
1962	1.544	1953	1.465