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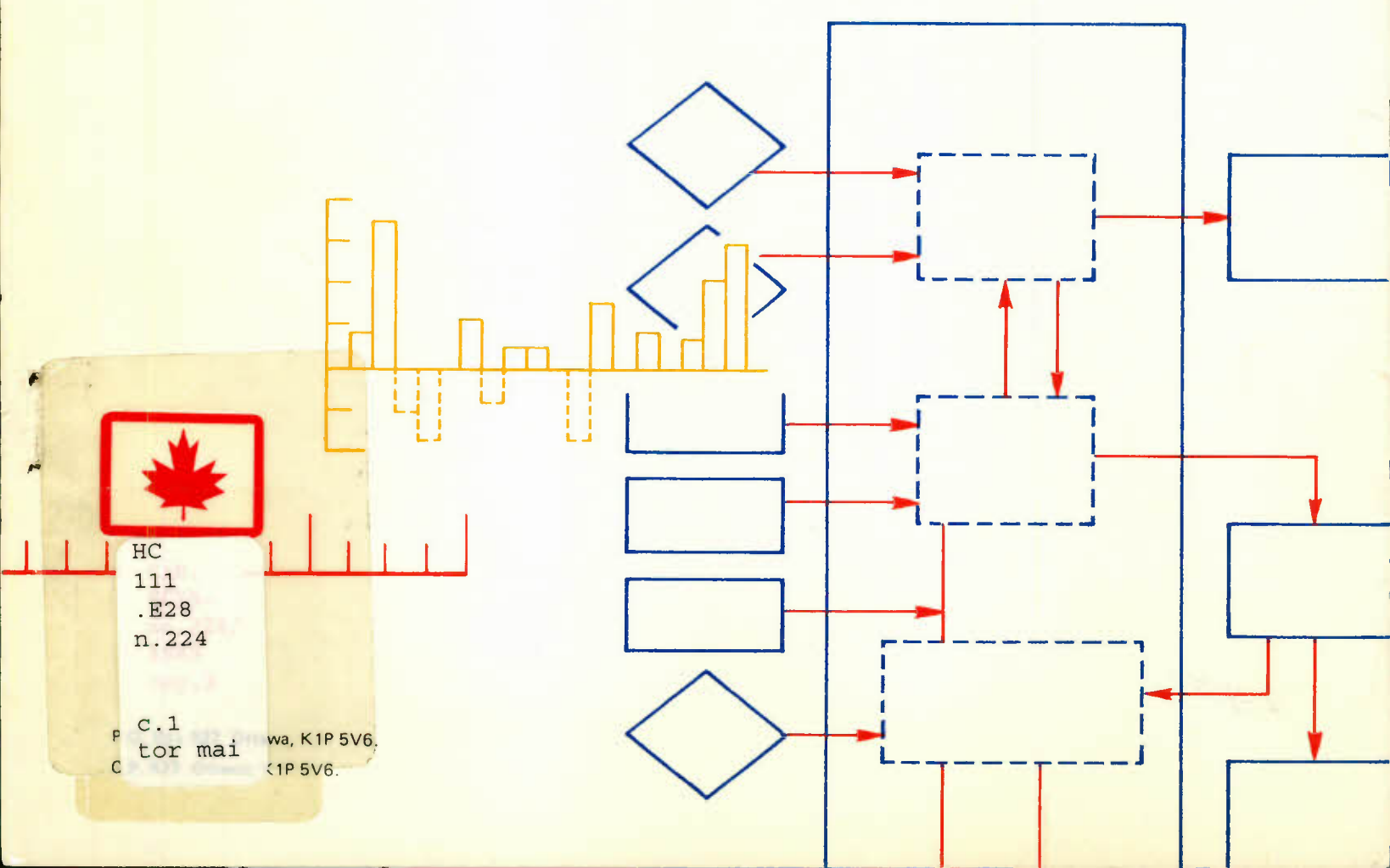

DISCUSSION PAPER NO. 224

An Economic Analysis of Industrial Training in Canada

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The findings of this Discussion Paper are the personal responsibility of the author and, as such, have not been endorsed by Members of the Economic Council of Canada.

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RÉSUMÉ

Les difficultés qu'éprouve actuellement l'économie canadienne -- pénuries de travailleurs qualifiés, faible productivité, inflation et taux de chômage--montrent qu'il est nécessaire d'étudier plus à fond le domaine de la formation de la main-d'oeuvre afin d'en arriver à des politiques plus efficaces. La présente étude porte sur la formation dans l'industrie ou en milieu de travail, qui, selon plusieurs observateurs, a été victime d'une certaine négligence. La principale contribution de l'auteur est la mise au point d'un modèle économétrique exploratoire sur les décisions relatives à la formation en milieu de travail, à partir des progrès théoriques récents déjà mis en évidence dans les écrits sur le sujet, ainsi que des données de l'Enquête sur les ressources humaines de 1979. Celle-ci constitue d'ailleurs une innovation importante par rapport aux enquêtes précédentes au sujet de la formation en milieu de travail, comme le montre le chapitre 2. Toutefois, certaines suggestions sont néanmoins formulées, au chapitre 8, pour l'améliorer encore sur le plan de la recherche économétrique.

Selon le modèle théorique décrit aux chapitres 4 et 5, plus s'accroit la formation en cours d'emploi, plus augmente la productivité des travailleurs, par unité de formation; plus est

forte leur productivité initiale et plus les coûts unitaires de formation baissent; plus bas est le salaire minimum provincial par rapport au taux de salaire payé dans les établissements et plus diminue le degré de syndicalisation des travailleurs. En outre, la formation axée spécifiquement sur les emplois de l'entreprise (c'est-à-dire la formation spécialisée, qui doit être financée conjointement par l'employeur et les employés) durera moins longtemps à mesure que le taux de roulement des employés sera plus élevé.

Le modèle donne de bons résultats dans le cas de la formation en milieu de travail autre que l'apprentissage. À noter que les travailleurs des grandes entreprises, où les coûts unitaires de formation sont plus faibles et la productivité initiale de la main-d'oeuvre plus élevée, participent à des programmes de plus longue durée. L'aide de l'État accroît la durée de la formation, mais les résultats pourraient être trompeurs, car le facteur à utiliser est la disponibilité de l'aide gouvernementale plutôt que le fait de l'avoir effectivement reçue. En outre, celle-ci semble inefficace là où elle est le plus nécessaire, c'est-à-dire sous forme de subventions aux programmes de formation générale. Par conséquent, si l'on en croit l'étude, l'efficacité de ces programmes est contestable. L'un des problèmes vient peut-être de la portée restreinte des programmes actuels d'aide à la formation en milieu de travail, dont il est question au chapitre 3.

D'autre part, comme il fallait s'y attendre, le roulement de personnel défavorise la formation spécialisée par rapport à la formation générale. Comme il accroît aussi la productivité des travailleurs par unité de formation, il favorise la formation générale (mais non spécialisée) financée--on peut le supposer--par le paiement de plus faibles salaires aux apprentis. La législation sur le salaire minimum et le degré de syndicalisation n'influent pas sur les décisions en matière de formation, bien que le rôle de ce dernier facteur soit plutôt complexe. Comme les provinces de l'Atlantique et l'Ontario sont moins engagées dans la formation spécialisée--tous autres facteurs étant constants--l'étude fait valoir que des programmes gouvernementaux plus efficaces pourraient être particulièrement avantageux pour ces régions.

ABSTRACT

The malaise in the Canadian economy - shortages of skilled labour, low productivity, inflation and high unemployment - suggests a need for further study of manpower training to enact more effective policies. This study concentrates on industrial or on-the-job training which, many believe, has not been given sufficient attention. The major contribution of the study is the development of an exploratory econometric model of industrial training decisions, using recent theoretical advancements in the literature and the data gathered by the Human Resources Survey in 1979. This survey represents a substantial improvement over previous surveys of industrial training activity, as discussed in Chapter 2, although some suggestions for its improvement in regard to econometric research are suggested in Chapter 8.

The theoretical model developed in Chapters 4 and 5 argues that more industrial training will be conducted the greater is worker productivity per unit of training, the greater is initial worker productivity, the lower are unit training costs, the lower is the provincial minimum wage relative to the establishment wage rate, and the lower is the degree of unionization of the workers. Furthermore, training in skills specific to the firm (specific training, which must be financed jointly by the employer and employee) will be shorter the higher is the rate of employee turnover.

The model performs well for non-apprenticeship industrial training. In particular, workers in larger firms with lower unit training costs and higher initial worker productivity engage in longer training programs. Government assistance increases training duration, but the results may be misleading because the appropriate factor is the availability of government assistance rather than the actual receipt of government assistance that is used. Furthermore, government assistance appears ineffective where it is most needed, in subsidizing general training programs. Hence the effectiveness of current government training is questionable on the basis of this study. The limited scope of current industrial training assistance programs, discussed in Chapter 3, may be one problem.

Turnover discourages specific training relative to general training as expected. Since turnover also raises worker productivity per unit of training, turnover encourages the provisions of general (but not specific) training financed (presumably) by lower wage payments to trainees. Minimum wage legislation and the degree of unionization do not affect training decisions, although the role of unionization is rather complex. Since less specific training is done in Atlantic Canada and Ontario, other factors held constant, the study suggests that more effective government programs could be particularly beneficial to those regions.

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PART A: INDUSTRIAL TRAINING, PROBLEMS AND POLICIES

CHAPTER ONE: TRAINING, PRODUCTIVITY AND ECONOMIC STABILIZATION

The current economic recession in Canada presents a severe challenge to policy-makers. The record postwar unemployment rate of 1982 must be reduced. Economic contraction and declining productivity must be reversed. The traditional response of expansionary monetary and fiscal policy to recession is inhibited, however, by enduring inflation. The challenge, therefore, is to find non-inflationary solutions to high unemployment and low productivity.[1]

One possible solution is renewed emphasis on manpower training by government.[2] Evidence that this policy option is being seriously pursued may be found in the coincident announcement of record jobless totals and new manpower training initiatives (Winnipeg Free Press, March 12, 1982, page 1, for example.) Additional expenditures on new manpower programs may, however, be less important than evaluation and reorganization of existing programs and expenditures, particularly during the current period of expenditure restraint. Hence there are indications that significant changes in the direction, if not the size, of the manpower training program are imminent (Economic Council of Canada, 1982, page 79). Sketchy details of the proposed National Training Plan, for example, indicate greater emphasis will be placed on industrial, as opposed to institutional, training. This study seeks to evaluate industrial training in Canada and attempts

to model industrial training decisions and thereby measure the impact of government policies on those decisions.

Recent evidence of substantial shortages of various labour skills in industry, despite the high proportion of job seekers in the population, suggests that significant improvements in manpower training are possible. The Human Resources Survey conducted by the Economic Council of Canada found, for example, that about one-half of the establishments in their survey were experiencing difficulty in recruiting workers (Betcherman, 1980). Particularly critical shortages of advanced blue-collar skills in product fabricating, repair and machining occupations were reported across Canada although other skill shortages were also reported, especially in Alberta. Betcherman (1980, page vii) concludes that:

> "While the majority of establishments report some vocational training, only a very small part of this activity is aimed at meeting our most critical shortages through comprehensive, long-term skill development programs."

Shortages of skilled labour constitute a limitation to productivity growth in Canada. Establishments that are unable to fill vacancies for skilled workers will have lower productivity, however measured, than they would have had without labour shortages. Consider, for example, a competitive firm maximizing profits π in the short run. The state of technology is described by a short-run Cobb-Douglas production function

$$(1) \quad Q = A\, L_N^{\alpha} L_S^{\beta}$$

where Q is output, L_S is the input of some particular skill, L_N represents the input of other labour, and A, α, and β are positive constants. We can represent the possibility of a shortage of this labour skill by inserting the inequality constraint

(2) $L_S \leq L_O$

or

(3) $L_S + 1 = L_O$

where L_O is the available supply of skilled workers and $1 \geq 0$ is a "slack" variable such that

(4) $1 = 0$ if $L_S = L_O$

and $1 > 0$ if $L_S < L_O$

The former case (1=0) applies when the establishment is constrained to the available labour supply and may be experiencing shortages while the latter case applies when the establishment is not experiencing a skilled labour shortage. If wages are w_S for the skilled labour and w_N for other labour, and if the product price is p, then the firm's problem is to

$$\text{maximize } \pi = PQ - w_S L_S - w_N L_N$$

(1) subject to $Q = A\, L_N^{\alpha} L_S^{\beta}$

(3) $L_S + 1 = L_O$

(4) and $1 \geq 0$

The solution to this nonlinear programming problem (Intrilligator, 1971, Chapter 4) is given by the first order conditions:

$$(5)\quad p(\alpha+\beta)\, Q/L_S - (w_S + n\, w_N) + \lambda = 0$$

$$(6)\quad p\alpha Q/n - w_N\, L_S = 0$$

$$(7)\quad 1 \gtrless 0$$

$$(8)\quad \lambda \gtrless 0$$

$$(9)\quad \lambda 1 = 0$$

where $n \equiv L_N/L_S > 0$ and λ is the Lagrangian multiplier.

We can now determine the effect of a labour shortage on labour productivity. Combining equations (5) and (6) we have

$$(10)\quad Q/L_S = (w_S-\lambda)/(p\beta) = f(\lambda;\, w_S,\, p,\, \beta)$$

where $\partial f/\partial\lambda < 0$,

from which we can find an expression for labour productivity (output per person-hour), namely

$$(11)\quad Q/(L_N + L_S) = Q/((n+1)L_S)$$

$$= f(\lambda;\, w_S,\, p,\, \beta)\beta w_N/(\alpha w_S+\beta w_N)$$

We can also determine total factor productivity (Kendrick, 1973) to be

$$(12)\quad Q/(\alpha L_N+\beta L_S) = Q/((\alpha n+\beta)L_S)$$

$$= f(\lambda;\, w_S,\, p,\, \beta)\, \beta w_N/(\alpha^2 w_S + \beta^2 w_N)$$

Two cases are possible from conditions (7), (8), and (9). If $l > 0$, then there is no labour shortage and $\lambda = 0$, where λ measures the contribution to profits of one additional trained worker-hour. Since $\partial f/\partial \lambda < 0$, a labour shortage produces lower establishment productivity in (11) or (12) with the productivity loss being either

$$\lambda\beta w_N/((\alpha w_S + \beta w_N)p\beta) > 0 \text{ from (11)}$$

or $$\lambda\beta w_N/((\alpha^2 w_S + \beta^2 w_N)p\beta > 0 \text{ from (12)}.$$

These expressions therefore represent the marginal gain in productivity from training unemployed labour.

As well as retarding productivity, labour shortages may be an important source of inflationary pressure on wages, and hence on prices, because of the asymmetry of wage movements (Lipsey, 1981). Asymmetry means that wages rise more readily in response to excess demand than they fall in response to excess supply. In other words, when skilled labour shortages appear ($l=0$), w_S rises as establishments attempt to fill vacancies and/or prevent the loss of skilled workers to other firms. Other wages w_N decline very slowly, however, in response to competition from unemployed workers such that overall wages rise.[3] That is, if $\dot{w} \equiv \partial w/\partial t$, then

$$\dot{w} \equiv (L_S \dot{w}_S + L_N \dot{w}_N)/(L_S + L_N), \text{ assuming } \dot{L}_S = L_N = 0,$$

$$= (\dot{w}_S + n\,\dot{w}_N)/(1+n) > 0,$$

where $\dot{w}_S > 0$, $\dot{w}_N < 0$, $n \equiv L_N/L_S = (\alpha w_S)/(\beta w_N) > 0$

(13) or $\dot{w}_S > -n\,\dot{w}_N$

This wage asymmetry, if sufficiently strong, would imply that substantial reductions in the rate of increase of labour costs are possible from training to provide unemployed workers with skills that are in demand.

The beneficial effects of scarce skilled workers on productivity and inflation provide an argument for an increased supply of such workers in the Canadian economy, whatever the source. In fact, two sources have been available. Until very recently selective immigration has provided an important source of skilled labour in short supply (Holland and Skolnik, 1975) and has served as a substitute for domestic manpower training. Immigration has been curtailed in recent years, however, presumably to encourage the training of unemployed Canadians. Hence the role of manpower training in overcoming skill shortages has grown in importance.

Reduction of structural unemployment, resulting from imbalance in the supply and demand for different types of workers, has been a basis for advocacy of manpower training programs for many years (Berman, 1965, for example). As we have seen above, however, the motivation for improved manpower training in the current situation

is even stronger than before. Effective training to eliminate observed deficiencies of skilled labour may simultaneously raise productivity, reduce inflation, and lower unemployment. In short, it can help to solve three major problems facing the Canadian economy today.

Before improvements in manpower training programs can be made, however, evaluation of existing programs is necessary. How effective are current training programs? What effect (positive or negative) do other government policies have on manpower training? Are there regions or industries where training is lower than expected and where further government assistance could be directed? This study explores some of these questions with respect to industrial or job training programs in Canada.

Evaluation of job training programs is a complex matter. Training on the job is often difficult to identify and training costs are difficult to measure. The extent of training, however measured, varies according to the circumstances of the firm and the general economic conditions. In order to determine whether too little (or, indeed, too much) training is being conducted and whether government assistance is affecting the amount of training, we must attempt to explain industrial training decisions under different economic and policy circumstances. This study attempts to initiate such an explanation by developing an econometric model of job training decisions, based on the existing literature, and by testing the model on microdata gathered from the Human

Resources Survey. Ultimately, the study seeks to assess the effectiveness of current job training policy and to identify areas where training programs may be needed.

The study is divided into seven additional chapters. Chapter 2 briefly reviews the existing data on the state of industrial training in Canada, providing some perspective for the analysis of the Human Resources Survey in later chapters. Chapter 3 outlines the argument for government intervention in industrial training and critically assesses current Canadian industrial training policy. Chapter 4 reviews the basic economic theory of industrial training, outlining the distinction between general and specific training and illustrating the usefulness of this distinction in examining job training problems. Chapter 5 develops a formal model of general and specific training under different economic and policy circumstances that is suitable for econometric analysis. Chapter 6 discusses the data source and examines the econometric results. Chapter 7 develops a model of turnover behaviour and estimates the training and turnover decisions simultaneously to examine the effect of this potential simultaneity bias on the empirical conclusions drawn in Chapter 6. Chapter 8 summarizes the results of the study and their implications for Canadian training policy. Perhaps of more importance in an exploratory study of this nature, the final chapter also indicates directions for further theoretical and empirical research based on the modelling experience of Chapters 5, 6 and 7.

CHAPTER TWO: INDUSTRIAL TRAINING IN CANADA

Before turning to the economic theory and empirical analysis of job training decisions, it is useful to examine the current state of industrial training in Canada, and the current state of information about industrial training, in this chapter. It will also be useful to consider the role of government in industrial training. This is the subject of Chapter 3. These chapters will provide some background for assessment of the empirical results from the Human Resources Survey in Chapter 6. Chapters 2 and 3 do not attempt to provide a comprehensive review of Canadian manpower policy. Readers interested in such a review are referred to Ostry and Zaidi (1979, Chapter 7) or Gunderson (1977).

How much industrial training is conducted in Canada? What proportion of Canadian resources are devoted to industrial training? Has industrial training been growing in importance? The answers to these and other questions on the state of industrial training are inhibited by both statistical and conceptual factors. Canada lacks a consistent general survey of industrial training, although several different surveys have been conducted since 1963 to provide some idea of the progress in industrial training. Moreover, there are conceptual problems in identifying all the costs associated with training in industry and hence in devising surveys and interpreting the survey results that are available.

Mincer (1962) has argued that the problems involved in measuring the costs of training are so great as to be prohibitive for most firms. Hence attempts to survey firms on industrial training expenditures will be doomed to failure. Specifically, most firms will ignore, or have inaccurate records of, some of the following industrial training expenditures: the cost of substandard workmanship by trainees, the proportion of supervisory labour costs attributable to training, the proportion of personnel expenditures devoted to trainees, and the capital costs of training programs (classrooms, training workshops, etc.).[4]

Because of the difficulty of measuring industrial training costs directly, Mincer turns to indirect measurement of these costs. Using the Current Population Survey of the United States, he estimated the rates of return to college education and to on-the-job training for college-educated males from the wage profiles of college-educated and high-school-educated males. This permitted him to calculate the profile of on-the-job training investments by college graduates and hence estimate annual worker-financed investment in on-the-job training by college-educated males of all ages. Mincer found investment in training to be about 62 per cent of the amount of invesment in schooling was above average due to the baby boom.[5] Hence, he argues that investment in industrial training financed by workers is likely to be close to the same amount as investment in schooling paid for by students.

While Mincer's approach avoids certain measurement problems, it encounters other limitations even if the indirect measurement technique is accurate. It does not permit us to measure the cost of firm-financed industrial training investments. As we shall see in Chapter 3, industrial training costs are often shared between the worker and the firm. Furthermore, it provides only aggregate estimates of investment costs and not investment costs in specific firms and for specific types of workers in those firms. Such disaggregated information, or microdata, is useful to analyze the factors involved in industrial training as the basis for effective evaluation and design of training programs. To obtain such microdata we must resort to surveys and address the problem of the measurement of costs directly.

Turning, then, to survey information on industrial training in Canada, we can identify three different sources of data:

(1) Surveys of employers, based on lists of employers compiled by Statistics Canada. These include Statistics Canada surveys in 1963, 1965, and 1960-70 and the Human Resources Survey conducted by the Economic Council of Canada in 1979.

(2) Records of provincial directors of apprenticeship training, the Canada Manpower Industrial Training Program, and the Ontario Training in Business and Industry Program. These records were compiled by Statistics Canada for 1971-78 inclusive, but were discontinued in 1978.

(3) A special Labour Force Survey of Canadian households in November, 1973, on employer-sponsored training programs.

Of these surveys only the Human Resources Survey attempts to measure industrial training expenditures directly. Each of these sources does, however, provide some information about the incidence and/or duration of industrial training programs in Canada, as well as some indication of its growth since 1963. The incidence and duration of training provides a rough measure of relative training expenditures over time or across firms at some point in time.

Table 1 presents the basic results on the incidence of industrial training by establishment from the four surveys of employers. Comparisons are difficult because of differences in coverage. The first two surveys in 1963 and 1965 covered only four major industry groups, whereas the 1969-70 survey was based on a more comprehensive mailing list of all Canadian establishments. The Human Resources Survey in 1979 was based on a smaller sample, but it extended the definition of training in earlier surveys from formal programs exclusively designed for skill development to any training that improved productivity with the exception of safety and orientation training (Betcherman, 1982, page 49). As a result, more than twice as many establishments report some training in the Human Resources Survey compared to the other surveys. The figures in parentheses for 1979, referring to reported training of at least a year, seem much more consistent with earlier figures.

Table 1 shows a sharp increase in the incidence of training among establishments between 1963 and 1965 and a slight decline after 1965 until 1969-70. Because of the differences in coverage between the 1963-65 surveys and the 1969-70 survey, it is useful to examine the figures for the one industrial group that is common to all three surveys, manufacturing. The incidence of training in manufacturing, reported in the lower half of Table 1, shows a similar sharp increase between 1963 and 1965 but the decline between 1965 and 1969-70 virtually disappears. Insofar as the incidence of training in establishments reflects training expenditures, Canada would appear to have experienced a boom in industrial training in the early 1960s which did not continue to the end of the decade. The provincial pattern is similar to the national pattern with some provinces consistently above the national rate (Alberta) and others consistently below it (Quebec).

Statistics Canada's compilation of government statistics on industrial training program participants provides a look at the extent of apprenticeship and publicly supported non-apprenticeship industrial training between 1971 and 1978. Table 2 shows that new apprenticeship program registrations grew quickly from 1971 to 1974 and more slowly thereafter to 1978. Publicly supported non-apprenticeship training program registrants increased by 51 per cent from the inception of the program in 1974 until 1978. By 1978 about 62 per cent of registrants were in the non-apprenticeship programs. It is difficult to determine whether these statistics are indicative of the growth of industrial

training, since many firms that undertake non-apprenticeship industrial training do not receive government assistance. The Human Resources Survey found, for example, that only 20.2 per cent of the industrial training programs in their sample received government assistance (Betcherman, 1982, page 60). Hence the proportion of industrial training that is in the form of non-apprenticeship programs is likely to be seriously understated above.

Finally, the Labour Force Survey (Statistics Canada 71-001, January, 1975) provides perhaps the best view of the extent of industrial training in Canada at one point in time (November, 1973). The survey estimated that 7.9 per cent of Canadians had attended employer-sponsored training courses during 1973. The figure was above the Canadian average in Western Canada and substantially below it only in Quebec (6.3 per cent). The figure was above the average in primary industries (9.5 per cent) and services (9.2 per cent) and below it in manufacturing (5.8 per cent) and construction (3.2 per cent). The figure was also higher for skilled white-collar workers such as managers (13.3 per cent) and professional and technical workers (14.8 per cent) but not for skilled craftsmen (5.8 per cent). Most courses were of short duration, indicating a preponderance of non-apprenticeship programs. The median course length was under four weeks and the median time spent per week on the course was about fifteen hours. The Human Resources Survey found similarly short average course duration (Betcherman, 1982, page 55).

As was mentioned earlier, only the Human Resources Survey attempted to survey actual expenditures of firms on industrial training. Not surprisingly, they had a very high rate of non-response to these questions (65.9 per cent). Betcherman (1982, page 58) concludes:

> "Indeed, some of the responses to the Human Resources Survey suggest that there are firms that go to great lengths to analyse their expenditures on vocational skills development. On the other hand, it is clear that many establishments do not. . . Moreover, it can be assumed that, in many of these cases, only a very rough estimate was provided."

The Human Resources Survey also asked establishments to identify those categories of expenditures that they included in their estimate of total training expenditures. A wide variety of cost estimation procedures were reported with wages and salaries of trainees and instructors and administrative costs, each reported about 70 per cent of the time but production costs (machinery, power, materials, and wastage) reported less than 20 per cent of the time. Betcherman (1982, pages 59-60) concludes that at least some of the variation in training expenditure estimates reported in the survey is attributable to accounting procedures, since establishments with comprehensive procedures generated expenditure estimates nearly three times the average while establishments with the most incomplete procedures generated estimates consistently below the average.

Since the Human Resources Survey attempted to collect data on both actual expenditures and the duration of training, the relationship between duration and expenditures can be examined. Betcherman (1982, page 58, Table 7-19) clearly shows a positive relationship between training program duration and reported expenditures. This provides cautious support for the use of training duration as a measure of training expenditures due to the extent of non-response and inconsistency in reporting training costs. The incidence of training will then provide an indication of training expenditures as well, provided that the distribution of the duration of training programs is stable.

In summary, existing surveys do not provide a very clear picture of the state of industrial training in Canada. Only the Human Resources Survey of 1979 attempts to measure training expenditures, and the results reflect the conceptual problems mentioned at the outset of this chapter. The cost estimates that are collected suggest that training duration is indicative of the size of establishment expenditures on training. The earlier surveys on the incidence of training suggest exceptionally strong growth in training until 1965, little growth thereafter until 1970, rapid growth in apprenticeship training between 1971 and 1975 but little growth thereafter, and rapid growth in public assistance to non-apprenticeship training from 1974 to 1978. Circa 1975 a majority of firms had some form of industrial training program, but most of them were short, non-apprenticeship programs. About one Canadian in thirteen engaged in employer-sponsored industrial training in 1973.

CHAPTER THREE: THE ROLE OF GOVERNMENT IN INDUSTRIAL TRAINING

One concern of our analysis of industrial training is the efficiency of government assistance. In the previous chapter we noted the increase in participation in publicly assisted non-apprenticeship training in recent years. Yet in Chapter 1 we noted the co-existence of labour shortages and unemployment as evidence that current training, both industrial and institutional, is inadequate and, if improved, could assist in the reduction of inflation and unemployment and in the promotion of productivity growth. By improvements in training policy we mean both finding the correct level of government expenditure on industrial training and finding the most effective programs that public funds will buy. In this chapter this question is examined from two standpoints. First, the chapter considers the economic basis for government assistance in training in general and industrial training in particular. Secondly, government programs currently in place to assist industrial training are critically assessed.

Chapter 1 has already discussed the stabilization and productivity benefits from training to alleviate labour shortages. Identification of these benefits does not, however, define a role for government, although the existence of that role was clearly assumed in Chapter 1. To establish a role for government in manpower training we must identify sources of market failure which render private training decisions socially suboptimal. The existence of labour shortages, for example, only suggests market

failure but does not establish the source of this failure (although some reasons are mentioned in footnote 2 of Chapter 1). Furthermore, training may be suboptimal even during periods of stable prices, full employment and rapid productivity growth.

Several arguments for government intervention to subsidize industrial training may be advanced. First, training may be suboptimal if workers and/or firms are risk averse and training is risky or uncertain due to unpredictable shifts in demand for different skills and the possibility of labour turnover.[6] Government intervention may then be justified to absorb the risk of individual trainees and/or their firms, provided that actual losers are offset sufficiently by winners elsewhere in the program. Intervention need only take the form of loans contingent on the success of training, however, (Gunderson, 1974, page 717) and not actual subsidies. Secondly, the legal prohibition on the provision of labour services as collateral for investment in training may lead to suboptimal investment in industrial training (Lees and Chiplin, 1970; Mehmet, 1970). Again, contingent loans by government may be the best policy to offset this legal constraint (Gunderson, 1974). Thirdly, monopoly, monopsony and such legislated price levels as minimum wages may generate insufficient demand for training. Governments may then be obliged to subsidize training, although more direct measures to counteract monopoly (anti-trust policy), monopsony (policies to encourage labour mobility) and price distortions (relaxation of minimum wages) may be preferable since other problems also arise from these

imperfections and since optimal policy response in imperfectly competitive markets is complex. In the cases of labour monopoly (unions and labour associations) and the minimum wage, however, subsidization of training may be preferred if the other effects of unionization and legislated wage minima are generally supported.

Fourthly, industrial training externalities may exist whether the training is worker-financed or firm-financed (Mehmet, 1970; Gunderson, 1974). The benefits to other individuals who are employed in the same firm or elsewhere as a result of the worker's training decision will be ignored and training will therefore be socially suboptimal, unless government intervenes to subsidize worker training costs. Similarly, firms who finance training will ignore any employment benefits in other firms resulting from the elimination of training bottlenecks. Both workers and firms may also undervalue the future benefits to society of training, either by discounting them too heavily or by underestimating them. Fifthly, training that is informally acquired while working may be difficult to observe or measure and workers and employers may be reluctant to pay for it (Gunderson, 1980, page 104). Sixthly, government intervention to support industrial training may be preferred as a mechanism to redistribute income if society considers earned income to be more valuable than direct transfers of income to the poor (Gunderson, 1974).

This intentionally brief summary of the arguments for government intervention serves two purposes here. First, it suggests the

complexity of modelling and estimating the optimal amount of government intervention in Canadian industrial training. Secondly, even if it is difficult to quantify the role of government in industrial training, there are valid economic reasons for some government involvement to promote industrial training at any time. Hence, when actual training problems, such as the labour shortages outlined in Chapter 1, do occur the government can be expected to take some of the blame and have some role to play in their alleviation and therefore in any resultant alleviation of unemployment, inflation and productivity problems in the economy. In other words, our current economic dilemma does not provide a justification for government intervention in industrial training decisions per se, but it does suggest that, given a role for government in training, better public support for industrial training can be an effective policy response.

Better public support for industrial training need not mean higher expenditures. It may also mean more effective use of existing resources. In any case, since current government anti-inflationary policies include expenditure restraint, reassessment of existing expenditures is likely to be more attractive than reassessment of the size of our industrial training program if the latter review is likely to indicate that more expenditures are required. In subsequent chapters, therefore, current government assistance to industrial training is evaluated according to its impact on training decisions. In the remainder of this chapter, the institutional nature of that assistance is examined.

Canadian Industrial Training Policy

As indicated in Chapter 1, there are strong indications that the federal government is seeking to expand the role of industrial training. This shift in emphasis from institutional training has had many proponents in recent years. (See, for example, Parliamentary Task Force, 1980; and Ostry and Zaidi, 1979, pages 180-1.) Expenditure data from Employment and Immigration Canada in Table 1 indicates, however, that this shift has been occurring in stages ever since the inception of the Adult Occupational Training Act and Employment and Immigration Canada in 1966-67. Expenditures on industrial training jumped from less than 3 per cent of total training expenditures in the years prior to 1972 to about 10 per cent between 1972 and 1977 and to about 18 per cent in 1980-82. The latest increase in the share of expenditures devoted to industrial training coincides with the rapid expansion in 1980-81 of a new program, Critical Trades Skill Training (CTST), begun in 1979-80. Hence recent announcements do not indicate a new trend toward increased emphasis on industrial training but merely the intention to extend the existing trend.

Most of the expenditures on industrial training are devoted to the Canada Manpower Industrial Training Program (CMITP). The program reimburses employers for direct training costs and a portion of trainee wages in approved industrial training programs. Direct costs include those for instructors, training aids and tuition. Programs must not exceed one year.

The CMITP is certainly not a general program. The proportion of trainee wages reimbursed to the employer varies: it is 85 per cent for trainees designated as having unusual problems of finding and retaining jobs, up to 60 per cent for unemployed workers or workers facing layoffs and 40 per cent for other workers. Hence, the program is designed to encourage the training of actual or would-be unemployed, particularly hard core unemployed. No financial assistance, other than trainee wages, is given to firms for on-the-job training as opposed to classroom training in the firm. Programs must be approved by both the province and the federal government, where priority is given to alleviation of unemployment and skill shortages, to support for existing regional development programs, and to new training initiatives rather than expansion of existing ones. By limiting programs to one year, priority is given to the development of lower-level skills.

CTST is specifically addressed to training workers in areas with persistent higher-level skill shortages. Assistance is given for up to two years on a similar basis to the CMITP.

The limited scope of current industrial training assistance may constrain its effectiveness. The criteria for approval under CMITP clearly emphasize short-term skill training in the classroom and stabilization objectives such as alleviation of unemployment and identified labour shortages. These criteria may not encourage the most productive aspects of industrial training. Emphasis on assistance for classroom, or vestibule, training may discourage

direct on-the-job training, for example. Yet one of the strongest arguments for increased assistance to industrial training, at the expense of institutional training, is based on the superiority of an actual work environment, rather than a classroom, for skill training (Ostry and Zaidi, 1979, page 181). Classroom training in industry may avoid the problem of training obsolescent skills that appear to exist in institutional settings (Parliamentary Task Force, 1981, Chapter 3), but concentration on the classroom component to qualify for government assistance could negate one of the most important potential advantages for firms, workers, and society of industrial training.

Another critical constraint on the effectiveness of current industrial training assistance programs may be the limited duration of government support. Indeed, recognition that assistance to short-term skill training may be inadequate has already resulted in the development and rapid expansion of the CTST program. CTST, however, relaxes only one of the potential constraints on the effectiveness of industrial training assistance, and further relaxation beyond the two-year period may still be necessary to capture the most productive industrial training opportunities.

Selective approval for assistance of industrial training programs may be needed to avoid subsidization of programs that would have been created anyway, although many of the arguments for government intervention support general subsidization of industrial training. If selectivity is to be a device to control government

expenditures, on the other hand, the criteria for selection should lead to the choice of assistance for those programs that most effectively promote long-term productivity and employment growth as well as stabilization and equity objectives. The problem is that the theory to establish such criteria, especially those related to long-term growth, has not been developed sufficiently. Another problem is that criteria are only as effective as our ability to implement them. Criteria for approval based on skills shortages, for example, are not very useful if manpower forecasts cannot accurately predict which skills will be in heaviest demand when trainees graduate. Faulty manpower forecasting will inhibit the effectiveness of labour-demand criteria even if the criteria are correct ones. This problem has apparently been recognized in current deliberations over manpower training and will ultimately lead to a new manpower forecasting model (Canadian Occupational Projection System or COPS) at Employment and Immigration Canada. Whether the new model will improve our forecasts of skill shortages remains to be seen.

There are many reasons, therefore, to believe that current industrial training programs may not be as effective as they could be, or even that they are ineffective in promoting training in Canadian industry. Evidence for or against these propositions cannot be assessed, however, until a model of industrial training decisions in the absence of government assistance is developed. Construction and testing of such a model using data on actual training decisions from the Human Resources Survey by the Economic Council of Canada is the task of Part B.

PART B: AN ECONOMETRIC ANALYSIS OF INDUSTRIAL TRAINING DECISIONS

CHAPTER FOUR: THE ECONOMICS OF TRAINING : AN OVERVIEW

From an economic standpoint the distinction between institutional and industrial training is less significant than the distinction between general and specific training made by Becker (1964) in his pioneering work on human capital. This section will outline this latter distinction, indicate why it is important in analyzing job training decisions, and introduce briefly some areas of contention in the literature as background for discussion in subsequent chapters.

Becker's distinction revolves around the question of the portability of skills between firms in the economy. General training refers to skills that are valued by many firms, each of which is therefore willing to pay higher wages after training to reflect the increase in worker productivity. Specific training refers to the acquisition of skills that are valuable only in one firm and therefore do not generate higher wage offers from other firms. Institutional training is primarily general training, whereas job training may be either general or specific.

The distinction between general and specific job training is crucial to understand who incurs the costs of such training, and hence who decides on the optimal amount of training in the absence of government intervention. The costs of general training must be borne by the employee since the benefits upon completion of such

training are fully reflected in his wage potential. Any employer who pays for general training will be unable to recover any of those costs. Any attempt to pay the worker less than the value of his marginal product would encourage the worker to quit and take a higher wage offer from another firm which, since it had incurred no training costs, would be willing to pay the worker the value of his marginal product. Hence, firms often cite the loss of (presumably generally) skilled workers to other firms as a disincentive to train them (Parliamentary Task Force, 1980, Chapter 7). Proposals for a levy-grant system to pool industrial funds to subsidize those firms providing job training (Parliamentary Task Force, Chapter 7) are an attempt to address this problem. Ultimately, however, the important question is why firms cannot get workers to pay for general training in industry. This question will be considered in Chapters 5 and 6.

The usefulness of the distinction between general and specific training is demonstrated by considering the question of the appropriate duration of apprenticeship programs. Those who have called for shorter apprenticeship programs to increase the supply of skilled tradesmen (Parliamentary Task Force, 1980, Chapter 7, for example) have ignored the problem of providing firms with sufficient incentive to supply apprenticeship programs. The apprenticeship period is not only a period for the apprentice to acquire skills but also a period for the firm, the supplier of the apprenticeship program, to recover initial training costs (supervision, instruction, wastage, poor workmanship initially, etc.) by

eventually paying wages below the value of the apprentice's output. If the apprenticeship period is reduced, the demand for apprenticeship programs will rise since trainees will incur a lower training cost. The supply of these programs by firms will fall, however, unless firms are still able to recover training costs during the apprenticeship period (Rottenberg, 1961). After the apprenticeship period firms will be unable to recover training costs without inducing journeymen to quit for higher wage offers elsewhere. Hence it is not clear that reducing the duration of apprenticeship programs will generate more skilled tradesmen unless the programs are subsidized in some manner such as a levy-grant scheme or further government assistance for non-classroom training. Similar arguments regarding military enlistment and professional baseball's reserve clause as arrangements to encourage the supply of general industrial training can also be made (Fleisher and Kniesner, 1980, pp. 315-6).

The costs of specific training, on the other hand, are borne by the firm precisely because the costs of training can be recovered afterward. The firm may pay the worker less than the value of his output to the firm and as much as the value of his output elsewhere since the training received has not raised the worker's wage potential elsewhere. Becker (1964) argues, however, that the costs and benefits of specific training will actually be shared between the firm and the worker rather than assumed entirely by the firm. Sharing the investment would reduce the probability of the worker's quitting during or after training by shifting some of

the training costs and foregone training benefits to the worker from the firm. This sharing hypothesis has been criticized, in particular by Donaldson and Eaton (1976) although apparently unsatisfactorily (Eastman, 1977). Hashimoto (1981) has provided a formal argument for the sharing hypothesis based on the transaction costs of evaluating the worker's productivity after training. The sharing hypothesis is important to the analysis in Chapter 5.

There is also debate concerning the relative importance of specific and general training. The literature on internal labour markets (Doeringer and Piore, 1971, in particular) argues that specific training is a significant aspect of production that is underemphasized by conventional labour economics. This argument, however, also emphasizes the informal nature of most specific training, involving learning by doing the job and making adjustments, often unconsciously, in work processes (Doeringer and Piore, 1971; Myers, 1971, Chapter 1). This means that direct measurement of most specific training is difficult. We will return to this question later in the assessment of the empirical results from the Human Resources Survey.

Although the distinction between general and specific training is useful in the discussion of job training behaviour and problems, the question remains whether actual training is separable into general and specific components. Even informal job training in apparently firm-specific work processes may provide work experience of value to firms elsewhere, while apparently general

training such as apprenticeships will likely include some knowledge or skills useful only in the firm providing the training. In other words, most training may be jointly specific and general, although predominantly one or the other. Having made the theoretical distinction, we still face the problem of finding an operable empirical model.

CHAPTER FIVE: A MODEL OF INDUSTRIAL TRAINING DECISIONS

Hashimoto (1979, 1981) provides a useful two-period model of job training decisions. This chapter will review this model and develop its implications for the empirical analysis in Chapter 6. Hashimoto's notation will be used wherever possible.

Let h be the amount of training, yielding an increase in worker output of m per unit. If H is the worker's output initially, then his output after training is $v = H + mh$. The value of his marginal product elsewhere is $y = H + mh = v$ if training is general and $y = H$ if training is specific. The return on investment for the firm is $R = v - y = 0$ if training is general

$= mh$ if training is specific.

The cost of training to the firm is $C(h, H, z) \geq 0$ where z represents any government subsidy to training, $C_h > 0$, $C_{hh} > 0$, $C_H < 0$, and $C_z < 0$. Hence the present value of the gains to the firm and worker from training are

$$(1) \quad G_e = \frac{(1-\alpha)R}{1+i} - (1-\beta)C$$

and

$$G_w = \frac{\alpha R}{1+i} - \beta C$$

where α is the share of the return to training that accrues to the worker, β is the share of the cost borne by the worker and i is the discount rate.

1. General Training

If R = 0 then $G_e<0$ unless $\beta=1$ or C=0. That is, the worker (or government) must pay the cost of training. Furthermore, $\alpha=1$ since all returns from training must accrue to the worker. His wage profile would be $w_0=H-C$ during training and $w_1=y+mh$ after training (Becker, 1964, Chapter 2). The present value of the worker's gain from training is

$$(2) \quad G_w = \frac{mh}{1+i} - C(h, H, z)$$

Maximization of this gain yields an optimal amount of training

$$(3) \quad h^* = h^*(m, H, z, i) \gtrless 0$$

where $h_m^* \equiv dh^*/dm>0$, $h_H^*>0$, $h_z^*>0$, and $h_i^*<0$. The discount rate i is unobservable and assumed to be constant. (Alternatively, i may be assumed to be uncorrelated with m, H, and z.)

Expression (3) assumes that the optimal amount of training may be chosen by the worker. This will not be the case, however, if the wage profile (w_0, w_1) cannot be realized due to institutional or other factors. In particular, consider the effects of a legal minimum wage and unionization. A minimum wage w_m may require that $w_0 = w_m > H - C$, that is, that $\beta<1$. This would discourage training (Leighton and Mincer, 1981). Similarly, union wage rates

may require that $w_0 \neq H-C$ or $w_1 \neq H+mh$. Some recent evidence suggests that unions compress skill differentials such that $w_1-w_0 < mh+C$ (Simpson, 1980). This implies that $\beta<1$ and/or $\alpha<1$, both of which would discourage training (Rottenberg, 1961). Of course, unions may have other effects on job training decisions, both positive and negative, which may offset or reinforce this prediction. Some offsetting effects will be considered later in this chapter.

To examine the effects of the minimum wage and unionization on job training, modify (3) such that

$$(4) \quad h^* = h^*(m, H, z, p_0, p_1)$$

where p_0 is the probability that $w_0 > H-C(\beta<1)$ and p_1 is the probability that $w_1 < H+mh(\alpha<1)$. It is expected that $h_{p0}^* < 0$ and $h_{p1}^* < 0$. We can then specify

$$(5) \quad p_0 = p_0(w_m/w, H, U)$$

and

$$(6) \quad p_1 = p_1(U)$$

where w is the mean establishment wage rate and U is the indicator of unionization in the firm. It is expected that

$p_{0,wm/w} \equiv \partial p_0/\partial(w_m/w) > 0$, $p_{0,H} < 0$, $p_{0,U} > 0$ and $p_{1,U} > 0$. Combining (4), (5), and (6) yields

$$(7) \quad h_G^* = h_G^*(m, H, z, w_m/w, U)$$

where $h^*_{G,m}>0$, $h^*_{G,H}>0$, $h^*_{G,z}>0$, $h^*_{G,wm/w}<0$, and $h^*_{G,u}\leq 0$. The level of general training will increase with increases in the productivity of the worker per unit of training, his initial productivity, and government subsidization. The level of general training is also expected to increase with decreases in the ratio of the minimum wage to the mean establishment wage and the role of unions in wage determination within the firm.

2. Specific Training

When training is specific, R=mh and y=H. Assume that the benefits and costs of specific training are shared. The worker receives $w_0=H-\beta C$ during training and $w_1=y+\alpha R=y+\alpha mh$ after training (Becker, 1964, Chapter 2). The firm pays $(1-\beta C)$ for training and receives $r=v-w_1=(1-\alpha)R=(1-\alpha)mh$ from training. Then the respective gains of the worker and the firm are

$$M_w = (1-s)\ E(w_1) + s\ E(y \mid y > v)$$

and $M_e = (1-s)\ E(r \mid v \geq y)$, where E denotes expected value and s is the probability of separating (the turnover rate) given by the probability that $v<y$ since $v<y$ is the condition for both quits and dismissals.

The present value of the gain to both parties from training is therefore

$$G = G_w + G_e = \frac{M_w + M_e}{1 + 1} - C(h, H, z)$$

$$= [(1-s)\ [y + \alpha(v-y) + (1-\alpha)(v-y)\ ] + s\ y]/(1+i) - C$$

$$= ((1-s)\ v + s\ y)/(1+i) - C.$$

Maximization of G with respect to α and h yields the first order conditions

$$(8)\quad \partial G/\partial h = \frac{(1-s)m}{1+i} - (C_h + C_H\ H_h) = 0,$$

assuming

$$(9)\quad z_h = 0 \text{ and } \partial G/\partial \alpha = 0.$$

As a result of (8) we have

$$(10)\quad h^* = h^*(m, H, Z, s, i) \geq 0$$

where $h_m^* > 0$, $h_H^* > 0$, $h_z^* > 0$, $h_s^* < 0$ and $h_i < 0$. The only difference between equations (10) and (3) is the appearance of the turnover rate s in the specific training model (10).

The implication of (9) is that α does not matter due to the fact that we have ignored transactions costs in the determination of v and y after training (Hashimoto, 1979 and 1981). This omission simplifies the analysis to this point but it prevents adequate discussion of the effect of wage constraints on specific training decisions. Hashimoto assumes, therefore, that the value of the worker to the firm and to other firms after training, m and y respectively, contains a random component, ε and η respectively, which is too costly to act upon after training. That is,

$$\hat{v} = v + \eta h = (H+mh) + \eta h$$

and $\hat{y} = H + \varepsilon h$.

Hence workers will quit when

$$w = H + \alpha mh \lesssim \hat{y} = H + \varepsilon h$$

or $\varepsilon \gtrsim \alpha m = \varepsilon^*$,

and firms will dismiss workers when

$$\hat{v} = H + mh + \eta h \lesssim w = H + \alpha mh$$

or $\eta \lesssim (\alpha-1)\, m = \eta^*$.

That is, the quit and dismissal decisions are no longer the same and an optimal sharing of costs and benefits (β^*, α^*) is required to minimize the combined losses of quits and layoffs. The expected gross now become

$$M_w = (1-s)\ E(w) + (1-L)Q\ E(\hat{y} \mid \varepsilon > \varepsilon) + L\ E(\hat{y}) - H$$

and $M_e = (1-s)\ E(\hat{r} \mid \eta > \eta^*)$

where Q is the probability of quitting and L is the probability of dismissal such that $s=Q+L-QL$. As before the problem is to maximize $G=(M_w+M_e)/(1+i)-C$ with respect to α and h yielding the first order conditions for an interior maximum solution:

$$(11)\quad \partial G/\partial\alpha = [(1-L)\partial Q/\partial\alpha\ (\eta^*-E(\eta|\eta>\eta^*))-(1-Q)\partial L/\partial\alpha(\varepsilon^*-E(\varepsilon|\varepsilon<\varepsilon^*))]$$

$$\cdot\ h/(1+i) \equiv G\alpha(\alpha^*, h^*, T) = 0$$

where $\partial Q/\partial\alpha<0$ and $\partial L/\partial\alpha>0$, and

$$(12)\quad \partial G/\partial h = [(1-s)(m+E(\eta|\eta>\eta^*)) + (1-L)Q\ E(\varepsilon|\varepsilon>\varepsilon^*)]/(1+i)-\partial C/\partial h$$

$$\equiv G_h\ (\alpha^*, h^*, T) = 0$$

(Hashimoto, 1981, 479), where T represents the exogenous parameters of the problem. Hashimoto then uses the long-run competitive condition that $G=G_w=G_e=0$ to determine $\beta^*=M_w/M$.

The interior solution (α^*, h^*) is assumed to be unique and can be represented by

$$\alpha^* = g_1\ (T) \text{ and}$$

$$h^* = g_2\ (T), \text{ which determines } \beta.$$

Applying the implicit function theorem to equation (12) gives

$$\partial H/\partial\alpha = -\frac{\partial/\partial\alpha(G_h)}{\partial/\partial h(G_h)} = 0 \text{ since } \partial/\partial h(G\alpha) = 0 \text{ from (11)}, h\neq 0.$$

In other words, for any sharing ratio α the maximum gain G^* is at h^*. But if $\alpha\neq\alpha^*$ then $G\leq G^*=0$ by the competitive condition so that training will not be undertaken because it is unprofitable to one

or both parties. Thus, any constraint which requires

$$\alpha = \frac{w_1 - w_0 - \beta C}{mh} \neq \alpha^*$$

will discourage training, other things the same.[7]

As for general training, unionization and minimum wages are two institutional factors that may affect the worker's wage profile (w_0, w_1) and hence force $\alpha \neq \alpha^*$. Hence, as before, we can specify the probability that $\alpha \neq \alpha^*$ to be a function

(13) $p = p\ (w_m/w,\ U)$

where $h_p^* < 0$ and $p_{wm/w} > 0$ such that

(14) $h^* = h^*\ (m,\ H,\ z,\ s,\ w_m/w,\ U)$.

It is expected that all the signs of the first derivatives will be identical to equation (7) for general training with the additional expectation that $h_s^* < 0$; that is, that a higher turnover rate will reduce the amount of specific training conducted, ceteris paribus.

CHAPTER SIX: EMPIRICAL RESULTS FOR THE INDUSTRIAL TRAINING MODEL

Chapter 5 provides equations (7) and (14) for the estimation of general and specific training behaviour, respectively. This chapter discusses the econometric methods used and the results obtained, beginning with a brief discussion of the data base.

1. The Human Resources Survey

The Human Resources Survey collected information from employers across Canada in the fourth quarter of 1979 concerning the nature and extent of skill shortages and employer responses to those shortages. A summary of the results of the Survey (Betcherman, 1980) and a more detailed report of the findings (Betcherman, 1982) have been published. For further information on the survey methodology see Betcherman (1982, Chapter 2).

The survey questionnaire (Betcherman, 1982, Appendix A) requested information on skill shortages in the past two years and company's solution, including training, production cutbacks and capital substitution (question 1). It also gathered information on the extent of job training and government assistance to meet skill shortages and/or to improve future productivity for both apprenticeship (question 3(b)(2)) and non-apprenticeship (question 3(b)(1)) situations. Question 1 data was merged with the data from questions 3(b)(1) and 3(b)(2) by occupational category and establishment to provide information on job training

as a response to manpower shortages and as an opportunity to improve productivity. Situations where opportunities were available to improve productivity through training but where no training was conducted and no shortages were observed were not included in the Survey.

The combined data sets for apprenticeship (questions 1 and 3(b)(2)) and non-apprenticeship (questions 1 and 3(b)(1)) situations were then merged with their corresponding establishment data on deterrents to training (question 5); pay rates, employment growth or decline in the past twelve months, and turnover rates (question 9); coverage by collective agreement (question 10); and gross revenue (question 11). This procedure provided a data set to analyze job training decisions by regression analysis, including the following relevant variables to be discussed in more detail in the next section of this chapter:

DUR - the duration of training programs as a measure of the quantity of training to be explained. Since the duration of apprenticeship and non-apprenticeship training is expressed differently in the Survey (years vs. weeks), separate analyses of apprenticeship and non-apprenticeship training are conducted throughout this study. Question 3 also gathered information on the cost of training, which information has been ignored because there was no uniform procedure for calculating training costs, as discussed in Chapter 2. An alternative measure of training decisions, the incidence

of training, was analyzed in place of DUR. Since the empirical results for that variable were generally inferior, however, they have been relegated to the Appendix.

MANAGE, PROF, OFFICE, FOREMAN - occupational dummy variables representing managerial, professional, and other office workers and foremen/supervisors of non-office workers determined from the occupational codes. The occupational base is non-office workers.

GROWTH - the employment growth rate (positive or negative) in the establishment during the previous twelve months.

GREV - establishment gross revenue in millions of Canadian dollars as a measure of establishment size.

GOVT - dummy variable indicating the presence (1) or absence (0) of government assistance to job training for the specific occupational category and establishment. The appropriate variable, however, is the availability of government assistance, which differs from GOVT in those cases for which DUR = 0, government assistance is available but not taken, and GOVT = 0. The effect of this measurement error is discussed in the next section of the chapter.

W_m/W - the ratio of the provincial minimum wage to the average gross weekly wage of all employees in the establishment.

U - the percentage of office or non-office workers in the establishment covered by a collective agreement.

S - the turnover rate of office or non-office workers in the establishment during the previous twelve months.

SPEC - a dummy variable coded according to whether establishment vacancies can be filled by hiring outside personnel who have the required skills (0) or not (1), based on question 5 in the Survey. This variable is used to try to distinguish general and specific components of training in the next section.

PRIMARY, CONSTN, MFG, TRANSP, TRADE - industrial dummy variables representing primary, construction, manufacturing, trade and transportation industries determined from establishment standard industrial classification codes. The industrial base is private services since public administration was excluded from the Survey (Betcherman, 1982, p. 6).

ATL, QUE, PR, ALTA, BC - regional dummy variables representing the Atlantic provinces, Quebec, Manitoba and Saskatchewan, Alberta, and British Columbia. The regional base is Ontario. This regional division is standard except for the identification of Alberta due to its unique growth experience in the late 1970s and consequently its particularly acute manpower shortages (Betcherman, 1982, Table 3-3).

Perhaps the major problem encountered in the use of the Human Resources Survey for econometric analysis is missing data. Although the Survey consists of 1354 establishments with numerous observations by occupational category within each establishment[8] only 599 non-apprentice observations and 136 apprentice observations were available for regression because the absence of Survey answers to any of the above variables for a particular occupation in an establishment necessitated deletion of the observation. Table 1 presents a comparison of the Survey characteristics and the regression sample characteristics for the variables defined above. Although the regional and occupational distribution in the regression sample is very close to that of the Survey, the regression sample underrepresents primary industries. The growth experience of firms in the regression sample differs substantially from that of the Survey; firms in the non-apprenticeship sample are growing more quickly on average than firms in the Survey as a whole while firms in the apprenticeship sample are declining more quickly. Finally, the mean duration of training is somewhat longer and the frequency of government assistance is somewhat greater in the regression sample. The sampling bias resulting from the deletion of observations due to missing data cannot be determined.

This discussion of missing data problems is not meant to be a criticism of the Human Resources Survey, which attempted to gather as much information as possible on skill shortages and establishment responses and was not specifically designed for regression

analysis. To the extent that regression analysis is useful to analyze training decisions and problems in Canada, however, future surveys of this type might attempt to reduce the missing data problem through redesign of the questionnaire and editing and follow-up procedures. Division of the questionnaire into occupation-specific questions (combining questions 1, 2, 3, and 9(a) for example) and establishment information would facilitate the detection of missing data in returned questionnaires, which could be corrected by appropriate editing of the data or follow-up procedures in many cases.

2. Estimation of the Training Model

The variables h_G and h, s, w_m/w, and U in the training equations (7) and (14) are represented by DUR, S, W_m/W, and U defined in the previous section. The other variables - m, H, and z - require more discussion. The variable m represents the increase in worker output, and hence the value to the firm, of a unit of training in the firm. There is no direct measure of m in the Survey and it is difficult to conceive of an inexpensive method of determining this variable directly for any subsequent survey. Hashimoto's (1979) study of bonus payments in Japan suggests two variables to represent variations in m across firms. First, the greater the establishment growth rate the greater the shortages of skilled workers, particularly specific skills which cannot be acquired by hiring outside the establishment. Growth thereby raises the value of m, particularly for specific training.

Hence the GROWTH variable should be positively related to m and h or h_G, other factors held constant. By this line of reasoning, however, turnover s should also affect m. A high turnover rate will also induce or exacerbate a skill shortage in the firm raising m and hence h or h_G. Note, however, that this effect offsets the effect of s on h discussed in Chapter 5, leaving $\partial h/\partial s$ ambiguos, while $\partial h_G/\partial s > 0$. We will return to this point in some detail in the empirical results in this chapter. Secondly, following Hashimoto (1979) we will include industrial dummy variables to represent differences in m across industries.

Another factor that likely affects m is unionization, which Hashimoto does not consider. The effect of unions in the model in Chapter III is restricted to the effects on training of deviations from the optimal wage profile, ignoring any other factors. The predicted negative impact of unions on specific training may, however, be offset by reduced quit rates in unionized establishments as a result of seniority rules (Addison and Siebert, 1979, p. 152), although this effect should be captured by inclusion of the turnover rate, s, in equation (14). If, however, the extent of unionization in an establishment is the consequence of technological and organizational decisions that encourage specific training and thereby the development of an internal labour market (Doeringer and Piore, 1971) then U may act as a proxy for technological factors that increase m and h. Hence greater unionization may be correlated with greater training (primarily, but not likely exclusively, specific training), although it is not the causal

factor. This effect may offset or dominate the negative effect of unions on training predicted in Chapter 5, particularly for specific training.

From the above discussion we may specify

(15) $m = m(GROWTH,S,PRIMARY,CONSTN,MFG,TRANSP,TRADE,U)$

where $\partial m/\partial GROWTH>0$; $\partial m/\partial S>0$; $m(u=1)>m(U=0)$ especially for specific training; and the effects of the industrial variables on m are not predicted a priori.

The variable H represents worker output prior to training and is hypothesized to increase training by reducing training costs. If this hypothesis is true, then more educated and experienced (and hence better paid) workers should receive more training. Hence managerial and professional workers (represented by occupational dummy variables MANAGE and PROF) should receive more training than other office workers (OFF) and foremen and supervisors (FOREMAN) might be expected to receive more training than other non-office workers. Furthermore, Hashimoto (1979, p. 1098) argues that larger firms hire more able workers by paying higher wages so that GREV should be positively correlated with H, yielding

(16) $H = H(MANAGE,PROF,OFF,FOREMAN,GREV)$

where $H(MANAGE=1)>H(OFF=1)$, $H(PROF=1)>H(OFF=1)$, $H(FOREMAN=1)>H(FOREMAN=0)$ and $\partial H/\partial GREV>0$.

Finally, z represents factors that lower training costs, such as government assistance (GOVT). Hashimoto (1979, p. 1098) also argues, however, that larger firms have lower training costs due to better equipment, management, and access to capital markets. Gunderson (1974, p. 717) adds that large firms benefit from the pooling of individual risks because of their larger portfolio of skills. Another literature which links training to firm size is that concerning internal labour markets (Doeringer and Piore, 1979; Thurow, 1975), where it is argued that large firms can achieve economies of scale through task specialization which requires more specific and general training of the work force. Hence,

(17) $z = z(GOVT, GREV)$

where $z(GOVT=1) > (GOVT=0)$ and $\partial z/\partial GREV > 0$.

To complete the regression model of job training, an error term e and regional dummy variables ATL, QUE, PR, ALTA, and BC are added with no predicted signs to standardize for regional differences such as labour market conditions and government policies not captured elsewhere. Combining either equation (7) or (14) with (15), (16), and (17) plus the error term e and the regional dummy variables yields the basic training equation, which includes the same explanatory variables to explain specific or general training:

$$(18)\quad DUR = a_0 + a_1 GROWTH + a_2 S + a_3 PRIMARY + a_4 CONSTN + a_5 MFG +$$
$$a_6 TRANSP + a_7 TRADE + a_8 MANAGE + a_9 PROF + a_{10} OFF +$$
$$a_{11} FOREMAN + a_{12} GREV + a_{13} GOVT + a_{14} W_m/W + a_{15} U + e$$
$$\equiv \begin{cases} ax + e & \text{if } ax + e > 0 \\ 0 \text{ if } ax + e = 0 \end{cases}$$

where it is anticipated that a_1, a_{11}, a_{12}, $a_{13} > 0$; $a_{14} < 0$; $a_8 > a_{10}$, $a_9 > a_{10}$; $a_{15} \lessgtr 0$ but smaller for specific than general training; and $a_2 > 0$ for general training and $a_2 \lessgtr 0$ for specific training.

As discussed in Section 1 of this chapter, however, GOVT measures the availability of government assistance for job training with error - specifically, when DUR=0, GOVT=0 but the correct variable, call it G*, is 1. Hence, the probability that G*=1 and DUR=0 exceeds the (zero) probability that GOVT=1 and DUR=0. Since DUR=0 always, the impact of G* on DUR (namely, DUR(G*=1)-DUR(G*=0)) is overestimated by the impact of GOVT on DUR (namely, DUR(GOVT=1)-DUR(GOVT=0)). Hence the estimate of a_{13} is biased upward as a measure of the impact of the availability of government assistance programs on DUR.

Ordinary least squares regression estimates will be biased and inconsistent when the dependent variable is limited (to non-negative values in the case of equation (18)) because the

residuals are also limited and therefore not normally distributed; $e \geq -ax$ in equation (18). Hence a superior estimation technique to ordinary least squares is the Tobit method of maximum likelihood. This method applies the assumption of a normal error distribution for the corresponding unlimited (but unobserved) dependent variable to the case of the limited dependent variable actually observed (Tobin, 1958; Amemiya, 1973). The Tobit estimates for the apprenticeship and non-apprenticeship samples are presented in Table 5 along with a summary of the expected signs for each independent variable in equation (18). The absence of office workers or foremen in the apprenticeship sample required omission of the occupational dummy variables for that data.

The non-apprenticeship equation is statistically significant at the 5 per cent level of significance ($\chi^2 = 104.34$) while the apprenticeship equation is not ($\chi^2 = 21.24$).[9] In fact, each variable in the apprenticeship equation is also insignificant with the exception of GREV which inexplicably has a negative sign. The apprenticeship training model is therefore rejected by the data.

GREV and GOVT have the predicted signs and are significant in the non-apprenticeship model (hereafter NAM). Turnover S has a significant positive sign, presumably due to the dominance of the indirect effect of S on DUR through m rather than the direct effect. Since some of the training is general, in which case no direct effect is expected, the dominance of the indirect effect in the overall sample is not surprising. PROF=1 increases training

in comparison to OFF=1, as expected, although the effect is insignificant. Similarly GROWTH and W_m/W have the correct signs but are insignificant. Unionization has a positive but insignificant effect on training duration, implying that the indirect effect of U on m (equation (15)) offsets the direct effect of U on h discussed in Chapter 6 . Contrary to expectations, MANAGE=1 reduces training in comparison to OFF=1 and foremen receive less training than other non-office workers, although only the last effect is significant. These contradictions to the predicted results would not appear to be serious. Managers and foremen might be expected to receive less formal training once they are officially managers and foremen than those beneath them (some of whom may well be management and foremen trainees). Hence the results seem quite promising for the NAM. The NAM explains about 19 per cent of the variation in training across workers, a fairly respectable figure for regressions using cross-sectional microdata.

The regional variables in the NAM were significant as a group (χ^2 = 12.46) while the industrial variables were not (χ^2 = 3.58). The Atlantic Provinces conducted significantly less training than Ontario, other factors held constant, while the other regions conducted more training than Ontario, although the difference was not significant.[10] None of the industrial variables was individually significant.

Consider again the turnover variable S in the NAM. Firms with higher turnover rates conduct significantly more training, it is

argued, because turnover raises the value of both specific and general training (m) while it deters only specific training (holding m constant). This argument may be examined more closely using the SPEC variable to try to distinguish specific and general training. If firms replied that skills could be acquired by outside hiring then SPEC=0 to denote that training is general; conversely,if this route to skill acquisition were not available then SPEC=1 to denote specific training. The effect of S on DUR should be different depending upon the value of SPEC: if SPEC=0, then a positive indirect effect on DUR through m is expected whereas if SPEC=1 the direct negative effect on DUR is expected to at least partially offset the indirect effect. To investigate this hypothesis, an interaction variable SPEC*S was included in the NAM. In addition separate regressions for SPEC=1 and SPEC=0 were run. These results are presented in Table 6.

As expected the effect of SPEC*S on DUR is negative and significant while the effect of S on DUR continues to be positive and significant. Similarly the effect of S on DUR is negative, although insignificant, for SPEC=1 as the direct and indirect effects offset one another while the effect remains positive and significant for SPEC=0. As a crude measure of the content of training, SPEC performs well in the sense that it confirms our hypothesis regarding the complex effect of turnover on training.

Some interesting changes occur when the NAM is dichotomized according to SPEC. The equation for SPEC=1 appears generally to

perform better. Both equations are significant but the χ^2 value for SPEC=1 is almost double that for SPEC=0 (92.64 vs. 48.20) and the R^2 is considerably higher (0.35 vs. 0.14). Whereas most of the variables that were significant in the overall NAM - GREV, GOVT, MANAGE, OFF, FOREMAN - remain significant for SPEC=1, they are all insignificant for SPEC=0. In fact, the effect of GREV on DUR is negative, albeit insignificant, for SPEC=0. Thus, larger firms conduct more specific training but not general training (including apprenticeship training according to Table 5). This result supports the argument of Doeringer and Piore (1971) that internal labour markets arise in large firms to promote specific training.[11] The effect of unionization on m (equation (15)), however, is unexpectedly stronger when SPEC=0 than when SPEC=1, although both coefficients are insignificant. Other relationships between unionization and training than those considered in this study may be involved.

The regional variables are significant as a group only for SPEC=1. Quebec and British Columbia have significantly greater training than Ontario and Atlantic Canada.

CHAPTER SEVEN: SIMULTANEOUS ESTIMATION OF TRAINING AND TURNOVER BEHAVIOUR

Several authors have argued that turnover depends upon the extent of specific training (Parsons, 1972; Mortensen, 1978; Jovanovic, 1979) as well as vice versa. Hence the estimated effect of turnover S on (specific) training DUR in the previous chapter may be biased because S depends upon DUR and is not independent of the error term in equation (18). In this chapter a simultaneous model of training and turnover will be developed and estimated to determine the importance of this bias.

The turnover equation is based on the model and empirical work of Parsons (1972). From Chapter III we have

$$S = Q + L - QL \simeq Q + L \text{ for small } Q \text{ and } L,$$

where Q and L are the quit and layoff rates, respectively. A linear version of Parson's model is

$$(19)\quad L = a_0 + a_1 K_F + a_2 D$$

$$\text{and}\quad Q = b_0 + b_1 K_W + b_2 D$$

where K_F is firm-financed specific capital, K_W is worker-financed specific capital, and D measures aggregate labour demand conditions. It is expected that a_1, a_2, and b_1 are negative while b_2 should be positive. Then, from (19)

$$(20)\quad S = (a_0+b_0) + a_1(K_F+K_W) + (b_1-a_1)K_W + (a_2+b_2)D$$

$$\equiv c_0 + c_1K + c_2K_W + c_3D$$

where $K \equiv K_W + K_F$ is total specific capital and it is expected that c_1 is negative while c_2 and c_3 are ambiguous, representing the net effect of K_W on quits vs. K_F on layoffs and D on quits vs. D on layoffs, respectively.

Unlike Parsons, we have a direct measure of K, namely DUR. It is, however, only a measure of current training and includes both general and specific job training, although we can try to focus on specific training below by omitting observations for which SPEC=0. Hence, we follow Parson's argument to develop other potential measures of K; that is, we specify

$$(21)\quad K = K(DUR,PAY,MANAGE,FOREMAN,OFF,URBAN,U)$$

where PAY is average gross weekly pay and URBAN represents the size of the urban area (=1 if urban area population exceeds 100,000; =0 otherwise). It is expected that more current training, higher wages, managerial/foreman positions and membership in a union indicate greater total specific capital such that $\partial K/\partial DUR > 0$, $\partial K/\partial PAY > 0$, $K(MANAGE=1)>K(MANAGE=0)$, and $K(U=1)>K(U=0)$. Smaller urban areas, where skills are less easily transferred, and non-urban office jobs are likely indicative of higher specific capital ceteris paribus, so that $K(URBAN=1)<K(URBAN=0)$ and $K(OFF=1)<K(OFF=0)$.

Following Parsons again we can specify

(22) $K_W = PAY/\alpha_2 + K - T$

where T is total (specific plus general) marketable human capital, and

(23) $T = T(DUR,MANAGE,PROF,OFF,FOREMAN,U)$

where all signs are positive except for OFF which is ambiguous. Hence, using (21), (22), and (23) we obtain

(24) $K_W = K_W(DUR,PAY,MANAGE,PROF,OFF,FOREMAN,URBAN,U)$

where $\partial K_W/\partial DUR > 0$, $\partial K_W/\partial PAY > 0$, $K_W(PROF=1) < K_W(PROF=0)$, $K_W(URBAN=1) < K_W(URBAN=0)$, and MANAGE, FOREMAN, OFF, and U have ambiguous effects. Combining (21) and (24) in (20), and using the provincial unemployment rate and the establishment growth rate to measure variations in labour demand D, we have

(25) $S = d_0 + d_1 DUR + d_2 PAY + d_3 MANAGE + d_4 PROF + d_5 OFF +$

$d_6 FOREMAN + d_7 URBAN + d_8 U + d_9 UNEM +$

$d_{10} GROWTH + v$

where v is the residual term and each sign is ambiguous <u>a priori</u> because c_2 and c_3 in equation (20) have ambiguous signs. If, however, we assume that $c_2 = 0 (\partial Q/\partial K_W = \partial L/\partial K_F)$, then we expect that d_1, d_2, d_3, d_4, and d_8 are negative; d_5 and d_7 are positive;

$d_4=0$; and d_9 and d_{10} remain ambiguous. Furthermore, d_1 is more likely to be negative when SPEC=1 since DUR is then a better measure of specific capital K.

Equations (18) and (25) constitute a simultaneous equation system that is estimated by two-stage least squares.[12] The results are presented in Table 4.

The effect of turnover on training is now uniformly positive, although insignificant, for SPEC=1. This suggests that the (weak) negative effect of training on turnover (equation (25)) may have been reflected in the training equations in Table 6. Hence the positive indirect effect of turnover on training through m appears to be stronger than indicated in Table 6, although it would still appear to be offset by a direct negative effect of turnover on specific training (SPEC=1). It is interesting to note that the effect of (general) training on turnover is positive and significant for the SPEC=0 equation although the Parsons' model maintains that general training does not affect turnover since it imposes costs on neither party. The only other significant difference from Table 6 would appear to be that the regional variables are no longer significant as a group or individually.

PART C: SUMMARY AND CONCLUSIONS

CHAPTER EIGHT: A SUMMARY OF THE RESULTS OF THE STUDY

1. Effective manpower training can help to solve three major problems in the Canadian economy -- inflation, unemployment and low productivity (Chapter 1).

2. In order to evaluate training programs, we need to understand the economics of training decisions. This study concentrates on the analysis of industrial training (as opposed to institutional training).

3. Industrial training costs are difficult to measure (Chapter 2). Canadian surveys of industrial training have therefore provided information primarily on the incidence of training. An exception is the Human Resourves Survey to be used in this study, which also collected information on training costs, training cost accounting procedures and training duration. Due to the amount of missing data on costs and the apparent unreliability of that which was collected, training duration and incidence are used as estimators of training expenditures in the remainder of the study.

4. Several arguments may be advanced for government intervention to subsidize industrial training (Chapter 3). Improved public support may mean more effective use of existing training expenditures rather than new expenditures on training.

5. It has been indicated that the federal government is seeking to expand further its role in the promotion of industrial training (Chapter 3). The limited scope of current industrial training assistance programs may not, however, encourage the most productive aspects of industrial training. Criteria for program selection based on long-term productivity and employment growth objectives as well as stabilization and equity goals are needed.

6. In the analysis of industrial or job training it is useful to distinguish between general (or portable) training and specific (or non-portable) training (Chapter 4). Arrangements to induce firms to pay for general training, such as apprenticeship programs, must include either a sufficient period of trainee service to the firm to recover training costs or a training subsidy. Such arrangements are not necessary for specific training.

7. A model of job training derived from Hashimoto (1979, 1981) predicts that both general and specific training will increase with an increase in worker productivity per unit of training, an increase in initial worker productivity, a decrease in training costs, a decrease in the ratio of the minimum wage to the establishment wage rate, and a decrease in unionization (Chapter 5). In addition, specific training will decrease when there is an increase in turnover, since turnover reduces the benefit of firm-financed specific training relative to its cost.

8. The econometric analysis of job training employs the Human Resources Survey conducted by the Economic Council of Canada in 1979. Missing data required numerous observations to be eliminated, leaving a sufficiently large sample but one which may or may not be representative of the entire Survey (Chapter 6, pp. 41-42). Reorganization of the questionnaire (pp. 42-43) and editing and follow-up procedures might reduce this problem in future Surveys if desired.

9. Several theoretical variables have no empirical counterpart in the Survey. Worker productivity per unit of training is therefore represented by the establishment growth rate, the establishment turnover rate (which offsets the direct effect of turnover on specific training), industrial variables, and the extent of unionization in the establishment (which counterbalances the direct effect of unionization on training) (pp. 45-46, equation (15)). Initial worker productivity or human capital is represented by occupational variables and establishment size (p. 45, equation (16)). Training cost differentials among establishments are represented by establishment size and the provision of government assistance rather than its availability, which introduces a positive bias to the effect of government assistance on training (pp. 45-46, equation (17)). Regional variables are added to complete the regression model (p. 47, equation (18)).

10. Tobit estimation of the duration of training yields insignificant results for the apprenticeship equation. The non-

apprenticeship equation is significant with the expected signs on all variables except managerial and supervisory workers. Firm size and government assistance significantly increase training duration, although the latter result is subject to positive bias. Turnover exhibits a significant positive effect on training because, it is argued, it increases the benefits of training to the firm more than it increases the costs, particularly for general components of training. Training is significantly lower in the Atlantic Provinces than elsewhere, other factors held constant. The provincial minimum wage rate relative to the establishment wage rate lowers training duration but not significantly, while unionization has an insignificant positive effect on training. Unionization and potential wage compression may be reducing training duration but this is offset by such factors as the presence of unmeasured technological and organizational factors which encourage both unionization and training. Probit estimation of the incidence of training produced similar, but slightly inferior, econometric results which were therefore relegated to the Appendix.

11. Establishment responses concerning the availability of trained personnel outside the firm are used to try to identify predominantly specific and general training situations. The results confirmed several predictions. As expected, turnover has a negative but insignificant effect on specific training and a positive and significant effect on general training due to its effect on worker productivity per unit of training. Also firm

size encourages specific, but not general, training. The positive effect of unionization is puzzling, however, since it is stronger for general than specific training albeit insignificant in both cases. Government assistance, paradoxically, significantly increases specific training but its effect on general training is insignificant and negative. Given the positive bias associated with the variable used, the effectiveness of government assistance in promoting training is highly questionable. Regional differences appear only for specific training where Ontario and Atlantic Canada are doing significantly less training than Quebec and British Columbia.

12. Simultaneous estimation of training and turnover decisions (Chapter 7) indicates that some of the negative correlation of turnover on training previously reported may have been due to the negative effect of training on turnover. Regional differences in training are no longer significant.

13. This study of training has attempted to examine the status of current economic theory to predict training decisions and thereby to identify training problems and to assess the effectiveness of government policies. The results are mixed, in part due to the difficulty in measuring certain theoretically relevant variables and consequently in interpreting the apparently complex effects of variables such as turnover and unionization on training. More consideration of the measurement of these theoretical variables in

subsequent surveys would be useful to assess the predictive content of current job training theory.

14. The study finds some support for the existing theory in the case of non-apprenticeship training. No significant effect of minimum wage rates or unionization on training is found, although the effect of unionization on training is seen to be more complex than that of the minimum wage. Government assistance also has an insignificant effect on (general) training which, given the nature of the variable used, can only suggest that current government assistance to promote non-apprenticeship training is ineffective. Training problems appear to be greater in Atlantic Canada, although not significantly so once turnover behaviour is also explained.

Table 1

Incidence of Industrial Training in Canadian Establishments by Province

A. All Industries Reporting

Province	1963[a] No. Reporting	1963[a] % with Training	1965[b] No.	1965[b] %	1969-70[c] No.	1969-70[c] %	1979[d] No.	1979[d] %	
Nfld.	151	19.2	170	34.1	700	27.1			
P.E.I.	50	12.0	47	23.4	169	21.3	90	60.2	(22.2)
N.S.	361	15.0	388	24.2	1393	23.8			
N.B.	270	14.8	282	20.9	1032	24.2			
Quebec	3485	15.7	3872	25.1	9506	16.6	363	43.0	(6.7)
Ontario	5010	17.2	5450	26.7	15348	25.0	538	67.5	(22.5)
Manitoba	516	13.8	594	22.1	1947	26.2			
Sask.	236	16.5	323	31.0	1483	25.5	363	72.7	(30.3)
Alberta	665	24.4	770	33.8	3139	30.9			
B.C.	1134	16.7	1241	27.8	4138	27.8			
Canada	11879	16.8	13137	26.5	41588	22.9	1354	61.7	(20.3)

Table 1 (cont'd)

B. Manufacturing Industries Only

Province	1963[a] % with Training	1965[b] % with Training	1969-70[c] % with Training	1979[d] % with Training
Nfld.	18.1	35.0	19.7	
P.E.I.	7.7	26.3	16.7	
N.S.	13.6	24.6	21.4	
N.B.	13.9	23.0	31.6	
Quebec	16.2	26.0	36.5	
Ontario	16.8	27.2	29.5	
Manitoba	13.2	22.0	20.9	
Sask.	15.7	27.9	10.6	
Alberta	25.0	34.7	17.6	
B.C.	17.4	28.4	22.9	
Canada	16.6	27.0	26.9	68.1 (27.8)

a "Organized In-Service Training in Four Major Industries, 1963." Statistics Canada 81-525.

b "Organized Training in Four Industry Groups, 1965." Statistics Canada 81-539.

c "Training in Industry 1969-70." Statistics Canada 81-555.

d Betcherman (1982, Chapter 7). Figures in parentheses refer to the incidence of training programs lasting at least one year.

Table 2

Participation in Publicly Sponsored Industrial Training Programs in Canada, by Province 1971-78

Province	New Apprenticeship Registrations			Canada Manpower Industrial Training Program Registrations		Ontario Training in Business and Industry Program	
	No. 1971-2	Growth 1971-2 to 1974-5	Growth 1974-5 to 1977-8	No. 1974-5	Growth 1974-5 to 1977-8	No. 1974-5	Growth 1974-5 to 1977-8
Nfld.	558	75.1%	-16.9%	1634	73.4%		
P.E.I.	88	80.7	- 3.1	428	138.6		
N.S.	906	94.3	-27.4	2238	106.7		
N.B.	1221	49.1	-35.8	1628	199.9		
Quebec	NA	NA	NA	13421	45.2		
Ontario	7045	35.6	2.7	14800	5.4	73551	16.0%
Manitoba	687	45.4	1.7	1534	183.2		
Sask.	731	68.3	53.7	2160	29.8		
Alberta	2981	81.1	27.2	1210	160.5		
B.C.	4013	63.2	NA	6644	51.9		
Yukon/NWT	65	169.2	17.1	468	84.2		
Canada	18295[a]	56.5[a]	5.1[b]	46165	51.0		

NA denotes data not available

a excludes Quebec

b excludes Quebec and B.C.

Table 3

Canada Manpower Training Program Expenditures Devoted to Industrial Training, 1967 to 1982

Year	Total Training Expenditures	Industrial Training Expenditures	% Industrial to Total
1967-8	NA	NA	1%[a]
1968-9	190.0	4.5	2.4%
1969-70	245.1	7.8	3.2%
1970-1	289.6	6.4	2.2%
1971-2	330.8	8.0	2.4%
1972-3	384.8	51.7	13.4%
1973-4	394.2	42.6	10.8%
1974-5	401.2	37.3	9.3%
1975-6	501.5	48.7	9.7%
1976-7	542.4	59.5	11.0%
1980-1	607.6	106.2	17.5%[b]
1981-2	659.3	123.0	18.7%[b,c]

Sources a Gunderson (1977)

b Parliamentary Task Force (1981)

c Budget rather than actual expenditures

All other data from Ostry and Zaidi (1979, p. 176).

Table 4

Human Resources Survey and Regression Sample Characteristics

	Apprentice		Non-Apprentice	
	Survey	Regression Sample	Survey	Regression Sample
Observations	630	136	2333	599
Mean of DUR	0.82	1.24	4.73	5.89
% MANAGE	NAV	0.00	8.47	10.35
% PROF	NAV	0.70	8.75	7.51
% OFFICE	NAV	3.70	63.42	63.94
% FOREMAN	NAV	0.00	4.45	4.51
% NON-OFFICE	NAV	95.60	14.91	13.69
Mean of GROWTH	-0.26	-4.49	7.73	16.84
Mean of GREV	14.97	14.78	14.69	14.02
Mean % GOVT	16.98	31.62	10.22	15.36
Mean U	19.47	40.29	15.84	17.44
Mean W_m/W	0.44	0.36	0.44	0.43
Mean S	20.42	19.85	20.72	22.14
% SPEC=1	0.00	0.00	76.92	64.61
% PRIMARY	34.32	1.47	19.91	2.17
% CONSTN	5.20	16.18	4.66	6.84
% MFG	25.36	46.32	30.22	38.73
% TRANSP	3.80	0.74	3.93	3.01
% TRADE	16.91	30.88	20.62	22.37
% SERVICES	14.41	4.41	20.65	26.88
% ATL	7.31	12.50	6.90	7.68
% QUE	23.42	10.29	22.06	20.53
% PR	6.97	2.94	6.78	4.34
% ALTA	13.91	22.06	12.39	11.52
% BC	10.61	17.65	10.22	11.52
% ONTARIO	37.79	34.56	41.65	44.41

NAV denotes "not available"

Table 5

Tobit Regression Estimates of Equation (18) for the Apprenticeship and Non-Apprenticeship Training Data Samples

Variables	Expected Signs	Apprenticeship Sample	Non-Apprenticeship Sample
MANAGE	⩾ OFF	NAP	-46.242*
			(4.20)
PROF	⩾ OFF	NAP	-14.734
			(1.47)
OFF	?	NAP	-30.188*
			(4.89)
FOREMAN	+	NAP	-76.744*
			(3.58)
GROWTH	+	-.0075	0.0016
		(0.58)	(1.24)
GREV	+	-.0642*	0.1204*
		(2.28)	(3.80)
GOVT	+	-1.1768	13.913*
		(1.13)	(2.11)
W_m/W	-	-6.7304	-21.901
		(1.17)	(0.93)
U	?	-0.0091	0.0219
		(0.82)	(0.30)
S	+ (general)	0.0038	0.0879*
	? (specific)	(0.16)	(1.97)
PRIMARY	?	NAP	-7.1342
			(0.40)
CONSTN	?	-0.5359	-3.5767
		(0.26)	(0.31)
MFG	?	1.8524	7.4960
		(0.96)	(1.11)
TRANSP	?	-14.579	-18.269
		(0.13)	(1.06)
TRADE	?	-0.4036	-4.0319
		(0.21)	(0.50)
ATL	?	0.0039	-24.140*
		(0.00)	(2.00)
QUE	?	-0.5597	10.834
		(0.35)	(1.59)
PR	?	4.2800	3.8179
		(1.92)	(0.32)
ALTA	?	0.5408	14.371
		(0.41)	(1.67)
BC	?	-0.0630	11.999
		(0.05)	(1.43)
CONSTANT	?	1.6501	-18.196
χ^2 ALL VARIABLES		21.24	104.34*
χ^2 INDUSTRY VAR.		5.82	3.58
χ^2 REGIONAL VAR.		4.18	12.46*
R^2		0.13	0.19
number of obs.		136	599
number of limit obs.		90	464

t-values are in parentheses
NAP denotes not applicable (excluded variable)
* denotes significance at the 5% level

Table 6

Tobit Regression Estimates of Equation (18) for the Non-Apprenticeship Training Data Sample

Variables	With SPEC*S	SPEC = 1	SPEC = 0
MANAGE	-46.402*	-35.475*	-380.70
	(4.30)	(3.51)	(0.00)
PROF	-15.099	-7.7919	-27.769
	(1.54)	(0.81)	(0.98)
OFF	-31.482*	-33.418*	-17.742
	(5.16)	(5.05)	(1.18)
FOREMAN	-80.441*	-65.327*	-405.12
	(3.77)	(3.15)	(0.00)
GROWTH	0.0016	0.0134	0.0017
	(1.22)	(0.38)	(0.95)
GREV	0.1206*	0.1152*	-0.4837
	(3.90)	(4.31)	(0.52)
GOVT	13.568*	14.218*	-17.019
	(2.10)	(2.29)	(0.65)
W_m/W	-20.526	11.541	-24.092
	(0.89)	(0.44)	(0.42)
U	0.0267	0.0308	0.3033
	(0.37)	(0.38)	(1.61)
S	0.2016*	-0.0409	0.2836*
	(3.25)	(0.74)	(2.75)
SPEC*S	-0.2013*	NAP	NAP
	(2.50)		
PRIMARY	-2.7288	-5.6154	49.382
	(0.15)	(0.34)	(0.00)
CONSTN	-1.1807	-5.1082	65.927
	(0.10)	(0.46)	(1.74)
MFG	9.2524	6.0850	25.613
	(1.39)	(0.83)	(1.44)
TRANSP	-17.728	-29.441	-18.551
	(1.04)	(1.37)	(0.54)
TRADE	-2.3672	-1.0540	8.4341
	(0.30)	(0.13)	(0.42)
ATL	-23.155*	-18.343	-349.72
	(1.97)	(1.70)	(0.00)
QUE	11.613	19.380*	-6.0493
	(1.74)	(2.69)	(0.36)
PR	4.6971	3.1026	8.6422
	(0.40)	(0.27)	(0.26)
ALTA	14.660	11.155	40.703
	(1.74)	(1.31)	(1.74)
BC	13.614	17.889*	-0.6513
	(1.65)	(2.17)	(0.03)
CONSTANT	-18.802	-23.643	-50.271
χ^2 ALL VAR.	110.58*	92.64*	48.20*
χ^2 IND. VAR.	4.02	4.58	4.68
χ^2 REG. VAR.	13.48*	16.22*	7.46
R^2	0.23	0.35	0.14
no. of obs.	599	387	212
no. of limit obs.	464	288	176

NAP denotes not applicable (excluded variable)
* denotes significance at the 5% level

Table 7

Two-Stage Least Squares Regression Estimates for Training Equation (18) and Turnover Equation (25)

Variable	Apprenticeship	Non-Apprenticeship		
		SPEC=0 or 1	SPEC=1	SPEC=0
Equation 18:	DUR			
S	0.0539 (1.42)	0.4161* (2.41)	0.5626 (0.88)	0.3078* (2.02)
MANAGE	NAP	-1.8470 (0.52)	1.3442 (0.23)	-6.2103 (1.22)
PROF	NAP	6.1778 (1.35)	10.663 (1.29)	-0.1796 (0.03)
OFF	NAP	0.7115 (0.16)	0.0757 (0.01)	1.8660 (0.37)
FOREMAN	NAP	-11.904* (2.36)	-2.3570 (0.16)	-20.777* (2.42)
GROWTH	0.0035 (0.48)	0.0002 (0.32)	-0.1195 (0.84)	0.0004 (0.69)
GREV	-0.0183* (2.54)	0.0957* (5.54)	0.1036* (3.76)	0.2130 (1.35)
GOVT	-0.9669 (1.33)	6.5583* (2.17)	9.6056 (1.54)	-5.9972 (0.82)
U	0.0025 (0.49)	0.0605 (1.54)	0.2000 (0.38)	0.1414 (1.75)
W_m/W	-1.9626 (1.08)	3.9115 (0.41)	-5.9610 (0.32)	5.4713 (0.32)
PRIMARY	-1.4372 (0.63)	-13.080 (1.62)	-36.411 (1.09)	9.2655 (0.50)
CONSTN	-0.2316 (0.24)	5.8210 (1.05)	1.4093 (0.20)	10.410 (0.93)
MFG	0.8601 (0.93)	2.3243 (0.80)	-4.1747 (0.61)	6.8971 (1.43)
TRANSP	-3.3340 (1.31)	1.8777 (0.28)	-6.4604 (0.67)	6.6381 (0.67)
TRADE	0.6918 (0.67)	3.8598 (0.93)	0.6331 (0.12)	3.9624 (0.63)
ATL	0.2261 (0.34)	-2.6163 (0.63)	-0.5699 (0.07)	-0.2327 (0.03)
QUE	-0.9576 (1.49)	-1.6203 (0.48)	0.5029 (0.07)	-1.2885 (0.33)
PR	1.8242 (1.69)	3.3855 (0.67)	5.0583 (0.69)	3.3360 (0.38)
ALTA	0.0542 (0.09)	-5.5948 (1.29)	-5.9101 (0.64)	-2.7879 (0.34)
BC	-0.8257 (1.01)	2.5627 (0.75)	1.9517 (0.28)	3.8315 (0.59)
CONSTANT	0.9375	-9.8321	-3.6048	-12.708
F all	1.20	3.34*	2.24*	0.86
F ind. var.	1.29	0.82	0.43	0.50
F reg. var.	1.62	0.82	0.51	0.12
R^2	0.13	0.10	0.11	0.08
Equation 25:	S			
DUR	2.5305 (0.91)	-0.0050 (0.02)	-0.0915 (0.33)	3.7186* (2.16)
MANAGE	NAP	-1.7654 (0.27)	-1.9462 (0.28)	18.807 (0.97)
PROF	NAP	-3.1895 (0.42)	4.3035 (0.53)	0.1771 (0.01)
FOREMAN	NAP	2.1152 (0.20)	-13.517 (1.20)	59.008* (2.11)
OFF	NAP	-17.603* (3.29)	-21.066* (3.56)	5.6869 (0.42)
GROWTH	-0.1486* (2.73)	0.0001 (0.10)	0.2093* (7.37)	-0.0018 (0.92)
UNEM	0.6232 (0.83)	-0.7142 (0.87)	-1.2962 (1.52)	-0.0639 (0.02)
PAY	0.0551* (2.60)	0.0221 (0.93)	0.0063 (0.24)	-0.0537 (0.61)
URBAN	5.7513 (1.44)	10.708* (2.44)	0.9806 (0.21)	-7.9823 (0.50)
U	-0.0692 (1.72)	-0.0929 (1.58)	-0.0316 (0.45)	-0.3739* (2.26)
CONSTANT	-8.1321	27.195	39.513	25.208
F all	2.93*	3.11*	8.56*	1.47
R^2	0.12	0.05	0.19	0.07

NAP denotes "not applicable (excluded variable)
* denotes significance at the 5% level

t-values are in parentheses.

APPENDIX

TO CHAPTER SIX

APPENDIX TO CHAPTER SIX: PROBIT REGRESSION ESTIMATES OF THE INCIDENCE OF INDUSTRIAL TRAINING

In Chapter 6 the duration of training has been used as the dependent variable in equation (18), partly because other measures such as total training costs per worker are not provided on a consistent basis. It is possible, however, that the duration of training is a poor measure of resources devoted to training. Alternatively, it might be argued that the important decision is not whether to increase the amount of training, but whether to do any training at all. If skilled workers can be recruited, no training is done; otherwise a course of predetermined duration must be considered. Hence, it may be argued that the critical question is whether training is done or not and that duration of training is not the appropriate dependent variable even if it accurately reflects training expenditures. In other words, it may be argued in either case above that a binary dependent variable y of the form

$$y = 0 \quad \text{if DUR} = 0$$
$$= 1 \quad \text{if DUR} > 0$$

is preferable to DUR as the dependent variable.

The theoretical argument of Chapters 5 and 6 can be repeated in a probabilistic framework. That is, if it is argued that a variable increases (decreases) the duration of training in those chapters, it would now be argued that the variable increases (decreases) the probability P of training (P(y=1)). Thus,

(1) $P = f(X)$

where $X = a_0 + a_1 GROWTH + a_2 S + a_3 PRIMARY + a_4 CONSTN +$

$a_5 MFG + a_6 TRANSP + a_7 TRADE + a_8 MANAGE + a_9 PROF +$

$a_{10} OFF + a_{11} FOREMAN + a_{12} GREV + a_{13} GOVT +$

$a_{14} W_m/W + a_{15} U$

from equation (18) in Chapter 6.

The problem is that X and P are not observed. We only observe y, the incidence of training. If, however, we assume that there exists some critical or threshold value X* for any firm-worker combination, then the training decision is given by

(2) $y = 1$ if $X > X^*$

$= 0$ if $X \leq X^*$.

Hence, whatever the value of X*, variables that raise (lower) X increase (decrease) the probability that $X > X^*$ and that y=1.

One method of estimating coefficients a_i (i=0, 1, ..., 15) assumes that X* is a normally distributed random variable such that the probability of training, for any value of X, is

$$(3) \quad P = \text{Prob}(y=1)$$

$$= \text{Prob}(X > X^*)$$

$$= (1/\sqrt{2\pi}) \int_{-\infty}^{X} e^{-z^2/2} dz$$

$$= f(X)$$

where z is a normally distributed random variable with zero mean and unit variance, $0 \leq P \leq 1$. Since we can observe y and the determinants of X for individual cases, we can estimate the coefficients a_i (i=0, 1, ..., 15) that are most likely to have generated the set of observations for the model structure represented by equations (1) and (3). The resultant probit model, the counterpart in the case of a dummy dependent variable to the Tobit model used in Chapter 6, was estimated to duplicate each Tobit regression in Tables 5 and 6 of Chapter 6. The results are very similar qualitatively to those in Tables 5 and 6 of Chapter 6, although lower χ^2 statistics and fewer significant t-statistics are obtained, except in the non-apprenticeship sample for SPEC=0 (Table 6, Chapter 6).

In summary, then, using the incidence of training as the dependent variable produces somewhat inferior empirical results while not affecting the conclusions in Chapter 6.

Table A-1

Probit Regression Estimates of Equation (3) and (1) for the Apprenticeship and Non-Apprenticeship Training Data Samples

Variables	Expected Signs	Apprenticeship Sample	Non-Apprenticeship Sample
MANAGE	>OFF	NAP	-1.0732* (4.10)
PROF	>OFF	NAP	-0.3777 (1.52)
OFF	?	NAP	-0.8000* (5.27)
FOREMAN	+	NAP	-1.7332* (3.60)
GROWTH	+	-0.0022 (0.62)	0.00003 (0.87)
GREV	+	-0.0152 (2.03)	0.0012 (1.26)
GOVT	+	-0.3709 (1.28)	0.2956 (1.74)
Wm/W	-	-1.9284 (1.18)	-0.2129 (0.37)
U	?	-0.0030 (0.95)	0.0003 (0.15)
S	+ (general) ? (specific)	0.0003 (0.04)	0.0018 (1.43)
PRIMARY	?	NAP	0.3131 (0.69)
CONSTN	?	-0.1159 (0.20)	-0.0838 (0.29)
MFG	?	0.5877 (1.08)	0.1781 (1.06)
TRANSP	?	-5.4003 (0.00)	-0.4127 (0.98)
TRADE	?	-0.0048 (0.01)	-0.0240 (0.12)
ATL	?	-0.0222 (0.04)	-0.4396 (1.56)
QUE	?	0.0409 (0.09)	0.1708 (0.99)
PR	?	1.4678 (1.82)	0.0983 (0.33)
ALTA	?	0.2287 (0.61)	0.4642* (2.16)
BC	?	0.0107 (0.03)	0.3218 (1.52)
CONSTANT	?	0.3093	-0.4944
χ^2 all variables		20.40	86.22*
Number of obs.		136	599
Number of limit obs.		90	464

NAP denotes not applicable
* denotes significance at the 5% level
R^2, χ^2-statistics for industrial and regional variables not available

t-values in parentheses.

Table A-2

Probit Regression Estimates of Equation (3) and (1) for the Non-Apprenticeship Training Data Sample

Variables	With SPEC*S	SPEC = 1	SPEC = 0
MANAGE	-1.0796*	-0.9128*	-6.3392*
	(4.13)	(3.09)	(0.01)
PROF	-0.3823	-0.2317	-0.5043
	(1.54)	(0.77)	(0.90)
OFF	-0.8180*	-0.8726*	-0.5336
	(5.33)	(4.48)	(1.75)
FOREMAN	-1.7721*	-1.6029*	-6.0805
	(3.66)	(2.89)	(0.01)
GROWTH	0.00003	-0.0003	0.00002
	(0.86)	(0.24)	(0.52)
GREV	0.0012	0.0011	-0.0313
	(1.27)	(1.24)	(1.36)
GOVT	0.3000	0.3199	-0.2649
	(1.76)	(1.65)	(0.48)
Wm/W	-0.1946	0.2763	0.2648
	(0.34)	(0.35)	(0.22)
U	0.0003	-0.0004	0.0067
	(0.17)	(0.16)	(1.68)
S	0.0029	0.0005	0.0048*
	(1.60)	(0.28)	(1.99)
SPEC*S	-0.0020	NAP	NAP
	(0.86)		
PRIMARY	0.3495	0.3254	1.6264
	(0.77)	(0.63)	(0.00)
CONSTN	-0.0632	-0.2640	2.2285
	(0.22)	(0.79)	(2.57)
MFG	0.1954	0.1274	0.6666
	(1.16)	(0.58)	(1.77)
TRANSP	-0.4090	-0.7726	-0.3325
	(0.97)	(1.29)	(0.44)
TRADE	-0.0096	-0.0706	0.5086
	(0.05)	(0.28)	(1.26)
ATL	-0.4349	-0.2672	-5.5753
	(1.54)	(0.86)	(0.01)
QUE	0.1767	0.5294*	-0.2630
	(1.02)	(2.35)	(0.77)
PR	0.1068	0.1320	0.1195
	(0.36)	(0.38)	(0.19)
ALTA	0.4801*	0.3393	1.3852*
	(2.22)	(1.32)	(2.61)
BC	0.3415	0.3746	0.2919
	(1.60)	(1.47)	(0.61)
CONSTANT	-0.5117	-0.6181	-1.2343
χ^2 all var.	86.97*	61.05*	59.26*
No. of obs.	599	387	212
No. limit obs.	464	288	176

t-values are in parentheses
NAP denotes not applicable
* denotes significance at the 5% level
R^2, χ^2 for industries and regions not available

Notes

1 Or hope that inflation will suddenly decline as a result of the recession to the point where economic expansion can be undertaken. More than a few economists and policy advocates have grown either sceptical of, or impatient with, this recipe for recovery.

2 The basis for government intervention in training is discussed in Chapter 3.

3 Reasons for sluggish wage declines are numerous: collective agreements, implicit contracts, imperfect information, etc. (see Santomero and Seater, 1978 for a review). Discussion of this unresolved issue is beyond the scope of this study. We merely use the evidence of wage asymmetry, whatever the reason or reasons, to identify the effects of labour shortages on economic stabilization.

4 These costing problems may not be insurmountable in all cases, permitting analysis of training decisions for certain types of firms. See, for example, Brinley et al (1969) and Schuyff (1980). The argument, however, is that any general analysis or survey will encounter some serious costing problems.

5 Since Mincer analyzes wages, and ignores fringe benefits, it is likely that he further underestimates worker-financed industrial training in the United States.

6 This question of risk in training will be revisited in Chapter 5 when shared investments in training between workers and firms are discussed.

7 See Rottenberg (1961) for a diagrammatic version of essentially the same argument.

8 The number varies according to the part of the Survey questionnaire under consideration; for example, 1573 (question 1), 2210 (question 3(b)(1)), and 362 (question 3 (b)(2)).

9 The χ^2 test replaces the usual F-test for joint significance in ordinary least squares estimation. If L_0 is the value of the log of the likelihood function with the group of k variables excluded and L_1 is the value with the group of k variables included then $-2(L_0-L_1)$ is χ^2 with k degrees of freedom (Pindyck and Rubinfeld, 1981, p. 312).

10 It would have been possible to determine if Ontario conducted significantly less training than the Canadian average by including an Ontario dummy variable and restricting the regional dummies to sum to zero. Such restrictions, however, were not accepted by the Tobit regression package (SHAZAM) used in this study.

11 It should be noted that Doeringer and Piore would include more informal training and orientation and safety programs that are excluded from the Human Resources Survey.

12 A more efficient estimation procedure, considering that the dependent variables are both limited (Amemiya, 1974), could not be undertaken given the time and budget constraints.

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