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Editor's Note

Greg Mason,
Editor,
Western Economic Review.

All of the articles appearing in this issue of the Western Economic Review were presented at the Transitions to Work Conference, convened by the Institute for Social and Economic Research, held on May 9 and 10, 1985 in Winnipeg.

The sub-themes of the Conference encompassed technological changes, socio-economic and cultural factors, women and transitions to work, the role of business and labour, vocational choice, schools and counselling, special training programs and adult education and research priorities.

The Institute wishes to acknowledge the assistance of the Science Council of Canada in the preparation of the papers, "Education, Social Mobility and the Challenge of Technological Change," and "The Work Force Transition to New Computer Technologies: Changes in Skills and Quality of Work Life."

All of the Conference proceedings, including these articles, will be published in late summer 1985 as a monograph, subject to final revision by the respective authors. For more information, and to place advance orders, contact:

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Can Government-Sponsored Training Reduce Unemployment in Canada?

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2.1 INTRODUCTION

Canada has, at least temporarily, brought inflation to its knees if not delivered a knockout blow. While inflation remained a visibly dangerous foe, high unemployment appeared to be an acceptable temporary price to pay to conquer it. Now that inflation has settled down to a persistent four per cent, however, people have clearly become impatient with the enduring high unemployment rates deemed necessary to keep it there.

Opinion polls keeps reminding us that the historically high rate of unemployment now weighs heaviest on the public mind. Not since the Great Depression, and certainly not since modern unemployment data has been collected, have unemployment rates exceeded 11 percent. Worse, government projections of a rapid decline in the unemployment rate to the five, six, or even seven per cent range are not forthcoming (Department of Finance, 1984). If persistently high unemployment over the next decade is not one of the major questions on the minds of governments and economists these days, it should be.

There are two major views

concerning the cause of the unemployment problem. One view is that the economy is suffering from inadequate aggregate demand and all that is required is a good Keynesian dose of monetary or fiscal stimulus (e.g., Kaliski, 1984). Since the federal deficit is giving some people jitters (most importantly people in the financial community), the preferred course would appear to be a reduction in the deficit and a dramatic lowering of interest rates. If Keynesian macroeconomic management still works, it should be possible by this approach to achieve full employment, or the so-called natural rate of unemployment, fairly quickly (say, within two years given the lags in the transmission of monetary policy). Why then are forecasts of the course of unemployment so pessimistic, since they envisage nine or ten per cent to 1990?

This question brings us to the second proposed cause of higher unemployment, a higher natural rate. If there is a central message in the macroeconomic (or monetarist) revolution of the 1970s, it is that there may be limits to the amount of unemployment that may be eliminated by simply easing interest rates or increasing the federal deficit.

Once the natural rate of unemployment is reached, further stimulus will only reduce unemployment temporarily and at the cost of inflation, unless structural defects in the economy are dealt with or fortuitously disappear on their own. Once the natural rate has been reached, policies aimed at increasing the aggregate supply of goods, or potential G.N.P., are the only policies which can permit the unemployment rate to be lowered without inflationary consequences. From the standpoint of the labour market, this places more emphasis on government training policy to reduce unemployment than has existed heretofore.

The emphasis on training policy to reduce unemployment rests on the contention that there are widespread labour market imbalances in the Canadian economy. In short, this means that there are widespread shortages of skills in demand in various parts of the country amidst obvious surpluses of other skills not in demand. Moreover, the labour market is seen to be sufficiently sluggish that such imbalances are corrected very slowly, if at all, leaving substantial scope for government intervention to improve labour market performance. The Dodge Report on Labour Market Development in the 1980s concludes:

Throughout this Report, we have argued that there is significant potential for Canada to increase output, productivity and employment through selective labour market policies to improve labour market adjustment. We have argued ... that the functioning of the economy could be improved by selective redirection of demand to markets of labour surplus and by a reorientation of federal training efforts to

supply the skills that will be required in the 1980s. Such policies could facilitate adjustment in such a way as to achieve significant increases in output and employment while reducing inflationary pressures[1].

Thus greater emphasis is now being placed on effective training policy to identify and fill labour shortages as they arise. This emphasis probably accounts for what appears to be the sacred budgetary position of training programs while social and other programs come under careful scrutiny. If unemployment is the major public concern, then spending on training programs to lower the attainable or natural rate of unemployment should be increased and not cut.

From this vantage point, it would appear to be useful to try to assess the prospects for training policy to lower the natural rate of unemployment. That is, assuming that the right level of interest rates and deficit spending can be achieved over the next few years, can training policy be expected to lower the unemployment rate significantly? I must admit that I began this assessment with substantially more optimism than its completion now permits me to enjoy. My growing pessimism arises from two major sources. First, I see little evidence that government, or anyone else for that matter, understands the source of labour market imbalances. It is very difficult to devise effective policies to combat an unidentified enemy. Secondly, I see little evidence that steps are being taken to remedy our collective ignorance about labour market imbalances. In particular, I am sceptical of the information base on labour market imbalances that is available to evaluate training programs and to

study the problem.

2.2 WHAT DO WE REALLY KNOW ABOUT IMBALANCES?

The concept of labour market skill imbalances, or structural unemployment, is not a new one. One can trace its roots back as far as Galbraith's ruminations on the problems of effective wage and price control in World War II[2]. Until recently, however, imbalances had not assumed the importance or urgency to economic policy that they now bear. It is perhaps not surprising, therefore, that our thinking on this complex subject remains quite formative and primitive.

What happens if skill imbalances arise in the labour market? One would expect wages to rise for those skills in demand (where there are excess vacancies) relative to those skills in excess supply (where there is high unemployment). Such relative wage changes should continue until workers are encouraged to undertake training in those occupations whose skills are in demand. Such reallocation will likely take time and result in a temporarily higher natural rate of unemployment[3]. The relevant question, then, is whether there are imperfections in this labour market process that can be addressed by training policies. Specifically, are there barriers to training, and thus barriers to entry into skilled jobs in demand, that can be identified and rectified? I want to consider three potential barriers to training commonly mentioned - namely, wage inflexibility, institutional inflexibility, and inadequate information.

First, consider wage inflexibility. What might be the source or sources of this inflexibility? Minimum wage legislation could discourage firms from hiring unskilled

workers, particularly young and inexperienced workers, if the minimum wage exceeded these workers' immediate value to the firm (i.e., before training). Firms would be better off hiring workers that were already trained, if available[4]. Similarly, there is fairly conclusive evidence that collective bargaining has introduced some wage inflexibility. The wages of unskilled union workers are much higher than those of unskilled non-union workers such that the wage differential between unskilled and skilled workers is much smaller in union than non-union firms on average[5]. While this protects the lowest-paid workers in bargaining units, it also increases the cost to firms of training unskilled workers just as the minimum wage does. Firms will want to hire skilled workers, whose wages have fallen relative to unskilled workers in the union, but will be unwilling to train their own unskilled workers. This may open up opportunities for skilled workers to move to the best paying firms, but this "pirating" of trained workers will further discourage firms with low pay scales (i.e., non-union firms) from training new workers only to lose them.

Direct evidence that minimum wage legislation or collective bargaining reduces training in industry is, at best, weak[6]. Indeed, very little research has been devoted to the investigation of this important policy question. Even if the evidence were stronger, it is not clear what type of training intervention would be justified. If minimum wages discourage training, then the best course would presumably be to encourage jurisdictions to, say, establish a significantly lower youth minimum wage up to the age of 20 or 21 to permit high-school leavers to gain job experience and the productivity (on average) needed to justify the adult minimum wage.

Secondly, consider institutional inflexibility as a barrier to training. The Dodge Report (Employment and Immigration, 1981a) argues that the postsecondary system, particularly the university system, has not responded quickly to changing skill demands. More direct financial encouragement, through the establishment of university centres of excellence in identified areas of actual or projected skill shortage, was one suggested remedy. Another was increased reliance upon federal training programs to satisfy skill requirements of the economy.

The available evidence does not seem to support the contention that the university system has been particularly inflexible. Undergraduate university enrollment has shifted dramatically toward computing science, business administration, and other areas of high demand in recent years[7] despite budgetary restrictions.

Moreover, the relevant question is not whether the existing institutional arrangements are perfect (since all such complex arrangements are likely to be imperfect) but whether alternative institutional arrangements can do a better job. Assuming that skill shortages can be identified (an assumption I will turn to later), it is not clear that reallocation of expenditures in the federal government is not plagued by the same problems as in universities and large private organizations. What is difficult for all such organizations is to replace existing ineffective programs with better ones. Such organizational shuffling is threatening, and likely to meet with knowledgeable and effective internal opposition. But that is the only type of substantial change that is possible under financial restraint when new programs cannot be added to older ineffective ones.

Finally, consider inadequate

information as a barrier to training. Since information is intrinsically a public good, it will be undersupplied by the private sector. An ambitious and well-funded information system is therefore needed to speed up labour market adjustment processes and alleviate skill bottlenecks as quickly as possible. The Canadian Occupational Projection System (or COPS) has recently been developed to co-ordinate and build upon existing information sources from the private and public sectors. As I understand COPS from the information available to me, it integrates the "top down" input-output approach to forecasting industrial output and occupational demand with the "bottom up" approach of adjusting these forecasts according to the judgment of the private sector and public agencies in the field. It also attempts to develop better projections of the occupational structure of the work force by region, particularly for graduates from postsecondary educational institutions. It is, I am told, well-funded and oriented toward public dissemination, which seem to be appropriate goals. I want to focus, therefore, on what I see as the limitations of systems such as COPS.

I have two major reservations about COPS. First, the acknowledged limitations of the input-output forecasting approach remain intact - such as interoccupational mobility, changing participation and retirement patterns, and shifting macroeconomic conditions[8]. If these forecasts are likely to be inaccurate, then there are many who argue that we need flexible and transferable skills to meet an uncertain future rather than carefully planned technical training programs designed for skill shortages that might not arise or that might disappear before trainees graduate[9]. Indeed, even the Allmand Parliamentary Task Force

on Employment Opportunities for the 1980s reaches the conclusion that such occupational projections are not sufficiently reliable to plan for future skill development. My second reservation concerns the quality of the information that enters the COPS model, particularly the information on shortages or job vacancies by detailed occupation. There is no apparent systematic and comprehensive method to collect vacancy information comparable, say, to the Labour Force Survey's method of collecting information on labour surpluses (the unemployed). Attempts to collect this information in such a manner, through the Job Vacancy Survey in the 1970s, were abandoned by Statistics Canada when financial cutbacks were required. Such information is undoubtedly messy to collect given our current state of knowledge (as are unemployment data) and Statistics Canada may well have been relieved to be rid of this Survey. Yet, I will argue in the rest of the paper, such information is crucial to identifying and understanding the problem of labour market imbalances and of evaluating the training programs already in place. Without this information, and the attendant analysis and evaluation, the prospects for training policy to reduce unemployment seem remote.

2.3 WHAT IS THE EVIDENCE FOR IMBALANCES?

I have argued in the previous section that the rationale for labour market imbalances and training policy intervention has only weak economic foundations, except in the case of information collection and provision where I see substantial problems with the current system. Nevertheless, a variety of evidence is regularly put forward to indicate

the severity of labour market imbalances in Canada and to justify some kind of policy intervention to address the problem, whatever the source. Let us turn to this evidence - in particular, the surveys of training needs and the evaluations of current public training programs.

A series of surveys of employers have been taken and publicized in recent years to identify unfilled job vacancies. The Human Resources Survey taken by the Economic Council of Canada found, for example, that about half the respondents had difficulties in meeting skill requirements, particularly among blue-collar, scientific, and engineering skills[10]. The pertinent question is whether such results indicate the existence of skill shortages beyond those that would occur normally in a smoothly functioning, but constantly changing, labour market. We must first recognize that there will always be some level of vacancies and unemployment for all skills in an economy. Presumably, when unemployment is high, as it has been recently, there will be fewer vacancies since firms will have a ready supply of applicants for vacant positions that arise. Having said that, what is an inappropriately large level of vacancies? The Human Resources Survey asks whether employers had any difficulty hiring personnel due to a shortage of qualified people. Many employers would likely experience some vacancies due to resignations, retirements, and growth even when unemployment is high. They might even believe that they had some difficulty in finding qualified workers, since unanticipated vacancies could lead to shortages over the period required for training and labour market adjustment even if the labour market is functioning smoothly, particularly if vacancies and imbalances are concentrated in a few

skills due to unbalanced growth and technological change. In short, there is nothing that I can see in such "snapshot" surveys to suggest that there are serious labour market imbalances that require public intervention.

What is required is a time series perspective, available only from repeated and comparable training surveys. Just as normal levels of unemployment are judged in a time series perspective, cyclical and trend movements in vacancies by skill could then be analyzed to see if current skill shortages are unwarranted and persisting (i.e., consistently high by historical standards). But training surveys have been conducted by a number of agencies, are rarely repeated by the same agency, and are generally not comparable. There is no co-ordination of surveys and hence no time series perspective to be gained.

Some authors (e.g., Green and Cousineau, 1976) have attempted to use aggregate vacancy and unemployment data to see whether there has been an increase in the vacancy rate, given the unemployment rate, over time (i.e., there has been a shift outward in the vacancy-unemployment rate relationship). This is the type of time series perspective that is required to assess labour market imbalances, but the results are far from conclusive. There are those who argue that the relationship between unemployment and vacancies must be investigated as part of a disequilibrium model of employment growth[11] and this typically eliminates the apparent outward shift in vacancies and unemployment. Moreover, the existing information on vacancies is unreliable. The only available measure for the 1980s is the Help Wanted Index, which simply counts the column-inches of job vacancy advertisements in major Canadian newspapers. An

earlier, more ambitious Job Vacancy Survey by Statistics Canada was discontinued in 1979. This Survey gathered vacancy information by detailed occupational classification at regular intervals and represents, in my opinion, a major information requirement for effective training planning and evaluation. Without such data, it is very difficult to identify and analyze imbalances in the labour market.

Evidence on labour market imbalances and the effectiveness of government intervention may also be gained from training program evaluations. The existence of imbalances is presumably a necessary (although not sufficient) condition for effective training programs reflected in acceptable social rates of return to publicly sponsored training. It is not a sufficient condition because, even if imbalances exist, training programs must be effective in identifying labour shortages and delivering training in those skills in short supply.

Employment and Immigration has recently completed and made public a series of evaluations of their institutional and industrial training programs[12]. These evaluations appear very favourable when it is assumed that all training provided would not have occurred in the absence of the program. In those circumstances, referred to as full incrementality, social benefit-cost ratios exceed 1.5 for all programs evaluated, although they are somewhat higher for industrial than institutional training.

Closer inspection reveals some problems, however. A check on the assumption of full incrementality is provided in the evaluation of industrial training programs by asking employers whether training would have occurred, and whether output would have been cut back, in the absence of the program. Only 47

percent of employers viewed publicly sponsored training as fully incremental and only 22 percent of employers anticipated reduced output without the program. When the degree of incrementality is considered, as it should be in assessing social benefits and costs, benefit-cost ratios fall below one. These results do not disagree with research findings which suggest that government assistance has little or no significant impact on industrial training duration[13].

There is another disturbing feature in these evaluations which ties in with the concerns about the lack of adequate information on labour market imbalances that I expressed earlier. In about half the cases, evaluation of training could not be conducted because information on labour market surplus or shortage was not available. Such information is crucial because training in surplus situations is assumed to provide no social benefits, while training in shortage situations is assumed to provide benefits equal to the trainee's gain in earnings compared to his or her previous job, assuming full incrementality. The bias introduced by this missing data cannot be ascertained, but the message seems clear: Better information concerning labour imbalances is needed to conduct proper evaluations of training programs. At the same time, such information will also permit better analysis of labour market imbalances with a view to improving future training policy formulation.

2.4 CONCLUSIONS

In summary, I argue that the current high rate of unemployment should not lead us to uncritically accept the view that more training programs of the type currently provided are appropriate. To accept this view is to accept the view that the cause of higher unemployment is growing labour market imbalances which can now be effectively addressed by public intervention to improve the operation of the labour market. Yet our understanding of the reasons why the labour market is slow to correct imbalances is primitive and the evidence that such imbalances exist is far from conclusive. What is really needed initially is a better information base upon which to analyze this labour market problem and to evaluate existing training programs. I recognize that this is not the short-term solution to unemployment that everyone is seeking, but I have little faith that simply spending more money on a problem that is poorly diagnosed and understood will really make the patient feel any better.

NOTES

- [1] Employment and Immigration Canada, 1981a.
- [2] Galbraith, 1981, p. 129.
- [3] Lilien, 1982.
- [4] Leighton and Mincer, 1981.
- [5] Simpson, 1985.
- [6] Simpson, 1984.
- [7] Selleck, 1983.
- [8] Axworthy, 1982.
- [9] Selleck, 1983; Cousineau and Houle, 1984.
- [10] Betcherman, 1982; Economic Council of Canada, 1982.
- [11] Warren, 1977.
- [12] Employment and Immigration, 1981b, 1982, 1983, 1984.
- [13] Simpson, 1984.

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Trends in Education and Entry to the Labour Force: A Canadian — U.S. Comparison

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This paper examines trends in the relationship between the level of formal schooling and entry into the first job for men in both Canada and the United States, using data from two large-scale mobility studies carried out in the two countries in 1973. We find first of all that, while levels of educational attainment have been consistently lower in Canada than in the U.S., throughout the first half of the twentieth century, only small differences are apparent in the distributions of first jobs. This implies that Canadian men have found it easier to enter higher-ranking occupations with less formal schooling than American men. Although we find that, consistent with previous research, the direct effect of socioeconomic origins on first job attainment is no stronger in Canada than in the U.S., in Canada parental status is much more likely to be transmitted through graded schooling than through post-secondary schooling than is the case in the U.S., reflecting in part the lesser degree to which occupational qualifications have become "inflated" in Canada.

3.1 INTRODUCTION

The notion that somehow the Canadian system of stratification has been less open with respect to intergenerational mobility than has the U.S. system is a persistent theme in work comparing the two societies. The attractiveness of this supposition rests on several assumptions about fundamental differences in the value systems and social structure of the two North American nations. First of all, the value system in Canada is presumed to be

more elitist and ascriptive than that of the U.S., although less so than that of Great Britain[1]. Secondly, this elitism is presumed to operate mainly through Canada's relatively less open educational system[2]. Porter argues that family background influences educational attainment to a greater extent in Canada than in the U.S. Given that the influence of education on occupational position is similar in the two societies, it follows that occupational inheritance ought to be more pronounced in Canada. Finally,

it is assumed by those portraying Canada as a less open society that the large element of foreign control in Canadian industry reduces the availability of higher-ranking positions, thus reducing mobility opportunities. Clement, for example, claims that "the existence of a powerful Canadian commercial elite, based in the Canadian upper class, and a predominantly foreign-controlled elite in production means that Canada remains a 'low mobility' society." [3]

This paper will focus on the second, more directly testable assumption, although the first and third speak to important mechanisms that would provide an explanation for any lesser degree of openness in Canadian society. Indeed, Clement's (1977) claim refers mainly to the amount of structural mobility permitted by the occupational structure produced by a particular path to economic development. Thus his claim would not necessarily be inconsistent with a degree of circulation mobility equal to that in the U.S. Unfortunately, structural mobility has usually been regarded as "noise" to be removed before any "real" mobility comparisons can be made [4]. While these issues are no less important, and will be addressed in a later paper in this series, we propose to deal here with Porter's approach, because of its pervasive influence on Canadian scholars.

The first step in Porter's (1965) reasoning has been supported by recent research; Wanner (1983) found in a comparative study of trends in educational inequality in Canada and the U.S. that in Canada parental socioeconomic status has been a more potent determinant of the likelihood of extending schooling beyond high school, particularly to university. The second step, that the rate of intergenerational mobility is lower in Canada, has not found support.

McRoberts and Selbee (1981) failed to find evidence for a difference in the rates of circulation mobility in the two societies. However, they do not explore the possibility that the way in which formal education is translated into occupational attainment may differ in the two countries, nor do they examine possible differences in the indirect effects of parental status on occupational attainment that operate through educational attainment.

Some findings on these issues have been reported in the literature, but the samples have either been limited to a single province, usually Ontario or Quebec (e.g., Dofny and Garon-Audy, 1969; Ornstein, 1981), or one or two cities (e.g., Cuneo and Curtis, 1975). Ornstein's results suggest that there is a stronger relationship between educational attainment and status of first job in Ontario than in the U.S. If true for Canada as a whole, we would certainly expect to find more intergenerational transmission of occupational status in Canada than in the U.S., given the stronger effect of parental status on educational attainment, particularly at higher levels [5]. But this expectation is inconsistent with McRoberts and Selbee's (1981) evidence that there is no appreciable difference in intergenerational mobility rates between the two countries.

The analysis reported here will attempt to sort out these issues by comparing results from national studies in both Canada and the U.S. instead of by comparing Canadian results for a limited geographic region to published U.S. results, as most comparative studies have done. We focus first on a comparison of the relative flows from educational backgrounds into first-job destinations among males in the two samples to detect differences in the typical

educational profiles of occupational groups between countries. To assess differences in the direct and indirect net effects of parental SES, we compare parameter estimates in a model of the first-job attainment process that also includes other background characteristics known to influence attainment. We concentrate on occupation of first job instead of on job at the time of the survey or longest job held primarily because to do so allows us to eliminate the possibility that it is differences in the time span between first and current job across cohorts that produces the observed trends in the effects of socioeconomic background on occupational attainment. As well, it has been frequently reported that the effect of education on first job is considerably stronger than its effect on subsequent occupations in the career[6]. That is, much of the effect of education on later occupations is mediated by first job. Since we propose to understand the linkages among socioeconomic background, education, and occupational attainment, we thought it simpler to restrict the analysis to the entry-level position and explore differences in career mobility in another place. All this is not to say that career mobility is not important, but to consider it would carry us into another stage of the life cycle and make the kinds of comparisons required here more difficult.

3.2 DATA AND MEASURES

The data used here are from the large-scale national mobility studies conducted in both Canada and the U.S. in 1973. The Canadian Mobility Study (CMS) was a survey of nearly 45,000 men and women originally conducted to investigate rates and patterns of intergenerational

occupational mobility in the Canadian population[7]. The data were collected by Statistics Canada as a supplement to their July, 1973 Labour Force Survey. Though measures for some of the variables come from the Survey interviews, the bulk of the measures were included in a self-administered questionnaire left with respondents and picked up several days later by field workers[8]. The design of the U.S. "Occupational Changes in a Generation Replicate Study" (OCG-II) was similar, although its target population did not include women in the labour force. A replication and extension of the original 1962 Blau and Duncan (1967) "Occupational Changes in a Generation" survey, the survey was carried out as a supplement to the March, 1973 Current Population Survey of the U.S. Bureau of the Census[9]. The final sample included some 33,600 noninstitutional, civilian men aged 20 to 65.

Neither the OCG-II nor the CMS sample was a simple random sample. Instead, complex multi-stage stratified samples were used, entailing some loss of sampling efficiency. The effect of sampling design on null hypothesis tests has been estimated for both data sets, and in both cases the design effect is below unity, requiring us to reduce the effective sample size to provide conservative tests. In the case of the OCG-II data the design factor has been estimated at 0.75[10], for the CMS data, the factor is considerably lower, estimated at 0.75[11].

The subpopulations to be studied here are white males in the U.S. and native-born males in Canada. This choice was forced upon us by the failure of the CMS to include a measure of race, a universal exclusion in surveys conducted by Statistics Canada. While this may result in some problems of comparability, this is relatively unlikely, since

Canada's population includes only a small proportion of blacks; they are far more integrated into the economic mainstream than is the case in the U.S., and the vast majority of them are immigrants and therefore excluded from this analysis[12]. We are including both anglophone and francophone Canadian men in the analysis despite the evidence that linguistic group is an often important dimension of stratification in Canadian society, with no counterpart in the U.S. until the relatively recent emergence of a large Spanish-speaking population. However, Boyd *et al.*, (1981) found no substantial difference in the patterns of effects of paternal education and occupation or respondents' education on attainment of first job, prompting them to conclude that "there is little difference between the two groups with respect to the process (emphasis in original) of stratification"[13] although they do observe differences between linguistic groups in the average levels of the status variables. They further note that the differences between anglophones and francophones are considerably less than differences documented by Featherman and Hauser (1978) between blacks and nonblacks in the U.S.

A difficulty that faces any comparative research is the need to obtain comparable measures of key variables. In the case of this study, that difficulty is compounded by the original investigators' reliance on their respective nation's national census agency in carrying out important parts of the field research. In the case of the CMS, Statistics Canada refused (and still refuses, although they exist) to release a detailed occupational code identifying unique occupational titles. All that is available is the Blishen-McRoberts (1976) socioeconomic index for all Canadian

occupations, and a sixteen category occupational classification devised by Pineo, Porter and McRoberts (1977). Fortunately, the OCG-11 data includes the U.S. Bureau of the Census detailed occupational classification, in addition to the Duncan (1961) socioeconomic index. By mapping the U.S. codes onto a six-category occupational classification created by collapsing the original sixteen-fold classification, McRoberts and Selbee (1981) were able to construct fairly comparable occupational classifications for the two countries[14]. It is these classifications on which we will rely in the portion of our analysis requiring a discrete measure of occupation.

In view of the lack of availability of a detailed occupational code for Canada, it was impossible for us to construct a common scale of occupational prestige or socioeconomic status for use in the regression-based analysis reported on later. What we did have available, however, were two indigenous scales of socioeconomic status constructed in exactly the same way, the Duncan SEI and the Blishen-McRoberts socioeconomic index for occupations in Canada. Both of these scales were developed by regressing the observed prestige ranking of some subset of occupations on the proportion of males earning above some income level and the proportion of males exceeding some level of schooling. Income and education data are then used to generate predicted scores for all occupations in the respective census classifications. Differences in the original scoring of the criterion prestige scales in the two countries, along with small differences in assigning the income and education values, resulted in sets of scores with different ranges: 0 to 96 in the case of the Duncan index, and 14 to 75 for the

Blishen-McRoberts scale. Comparisons of effects based on these indexes might be made by standardizing them, but by doing so we risk interpreting differences in standard deviations as real differences in effects. Instead, we attempted to make the two indexes comparable by simply performing a linear transformation on the range of the Blishen-McRoberts scale, making it comparable to the range of the Duncan index. After transformation the Blishen-McRoberts scale for occupation of first job has a mean of 37.60 and a standard deviation of 33.73, compared to a mean of 33.73 and a standard deviation of 24.58 for the Duncan index. The difference between the means is certainly well within the range of intercohort differences within the two countries, and suggests that adjusting the Canadian index in this way is not unreasonable. As well, the comparisons we will be making with them entail comparisons of effects, which are ratios of covariances to variances that only require of the raw score variables that their units be comparable.

It was also crucial for our purposes that the measures of educational attainment be equivalent. Since the OCG-II questionnaire included only a measure of years of schooling completed, it is only on this dimension of education that comparisons can be made. Unfortunately the CMS item tapping years of formal schooling was not comparable to the OCG-II item, since it merely asked for number of years spent in school, giving the respondents no instructions to exclude business, vocational or technical training or apprenticeships or on-the-job training, as did the OCG-II item. What we were able to do, however, was to construct a measure of years of schooling in Canada using an item that asked for specific type of

schooling that permitted us to exclude non-school training and grade repetitions. It is this measure that is used in the analysis that follows.

3.3 RESULTS

3.3.1 Flows From Education to First Job

Table 1 displays distributions of occupation of first job by highest level of school for Canada and the U.S. While these distributions (particularly the marginals) vary considerably by age cohort (a variable added later to assess trends), we can get a general picture of how these variables are related in the two countries from the tables shown here, which may be regarded as analogous to the tables of inflow and outflow percentages used in mobility analysis[15]. In this case the outflows from highest level of education to first job are represented by the column percentages, while the inflows to first job are indexed by the row percentages. Considerably lower levels of educational attainment for Canada are apparent in the row marginals; the percentage of the OCG-II sample either completing university or at least some post-graduate study is twice that in the CMS sample, while in Canada the percent completing elementary schooling only is nearly twice that in the U.S. Although this overall pattern conceals some convergence in recent birth cohorts[16], the striking feature of Table 1 is that this large difference in the educational distributions is not matched by the distributions of first jobs. The major difference here is a reversal between the two countries in the percentages in the upper and lower blue collar categories. This is in part the result of the large propor-

TABLE 1

Occupation at First Job by Highest Level of Schooling (Percentages), Canadian Native-Born Males and U.S. White Males, 1973

| Occupation of first job | Highest Level of Schooling | | | | | | TOTAL |
|-------------------------------------|----------------------------|------------------|-----------------------|----------------------|-----------------------------|----------------|------------------|
| | Elementary Only | Some High School | Some Post-Secondary | | | | |
| | | | Completed High School | Completed University | At Least Some Post-Graduate | | |
| Canada | | | | | | | |
| Professionals and Semiprofessionals | 0.8 (1.6) | 2.2 (4.6) | 7.0 (15.8) | 23.8 (24.9) | 65.7 (27.0) | 81.1 (26.1) | 12.0 (100.0) |
| Managers and Proprietors | 1.6 (5.3) | 4.2 (13.3) | 10.8 (36.4) | 17.4 (27.3) | 18.7 (11.5) | 13.0 (6.3) | 8.0 (100.0) |
| White Collar | 7.2 (11.7) | 18.5 (29.5) | 22.2 (37.6) | 22.6 (17.8) | 8.4 (2.6) | 3.7 (0.9) | 16.0 (100.0) |
| Upper Blue Collar | 14.8 (22.6) | 18.7 (27.9) | 24.1 (38.2) | 13.8 (10.1) | 3.5 (1.0) | 1.1 (0.3) | 17.1 (100.0) |
| Lower Blue Collar | 50.9 (36.8) | 46.2 (32.7) | 31.3 (23.6) | 18.3 (6.4) | 2.9 (0.4) | 0.9 (0.1) | 36.0 (100.0) |
| Farmers and Farm Labourers | 24.7 (59.3) | 10.2 (24.1) | 4.5 (11.3) | 4.2 (4.9) | 0.9 (0.4) | 0.2 (0.1) | 10.8 (100.0) |
| TOTAL | 100.0 (26.0) | 100.0 (25.5) | 100.0 (27.1) | 100.0 (12.6) | 100.0 (4.9) | 100.0 (3.9) | 100.0 (100.0) |
| (N)* | 2645 | 2591 | 2752 | 1280 | 503 | 393 | 10,164 |
| United States | | | | | | | |
| Professionals and Semiprofessionals | 0.7 (0.7) | 1.2 (1.1) | 4.4 (11.2) | 15.7 (14.8) | 45.6 (31.7) | 79.7 (40.6) | 15.3 (100.0) |
| Managers and Proprietors | 1.1 (1.9) | 1.6 (3.0) | 4.9 (25.1) | 14.2 (26.6) | 23.4 (32.4) | 10.8 (11.0) | 7.7 (100.0) |
| White Collar | 8.4 (6.5) | 14.2 (11.4) | 21.6 (47.0) | 27.2 (22.0) | 18.0 (10.7) | 5.5 (2.4) | 17.9 (100.0) |
| Upper Blue Collar | 30.0 (13.6) | 40.4 (18.4) | 39.8 (50.6) | 28.4 (13.4) | 8.2 (2.8) | 2.4 (0.6) | 30.6 (100.0) |
| Lower Blue Collar | 25.8 (19.8) | 29.4 (23.2) | 21.3 (45.7) | 11.4 (9.1) | 3.2 (1.9) | 0.7 (0.3) | 18.1 (100.0) |
| Farmers and Farm Labourers | 34.0 (45.5) | 13.2 (18.3) | 7.9 (29.7) | 3.0 (4.2) | 1.6 (1.6) | 0.9 (0.7) | 10.4 (100.0) |
| TOTAL | 100.0 (13.9) | 100.0 (14.3) | 100.0 (38.9) | 100.0 (14.4) | 100.0 (10.7) | 100.0 (7.8) | 100.0 (100.0) |
| (N)* | 2554 | 2628 | 7142 | 2652 | 1956 | 1432 | 18,364 |

Note: Row percentages are in parentheses.

* Sample sizes adjusted for sampling design. See text for explanation.

tion of the Canadian labour force employed in industries such as mining, smelting, and forestry in which the proportion of managerial and professional occupations is low[17]. Small differences favouring the U.S. are evident in professional and other white collar occupations, but these are not of the magnitude suggested by the observed differences in the educational distributions. What this means for the conditional distributions in the cells of the tables is that the educational attainment of incumbents of occupations of all kinds is typically lower in Canada than in the U.S. At the upper end, nearly all Canadian men with at least some post-graduate education enter the ranks of professional or managerial occupations; at the lower end, over three-quarters of Canadian men with elementary schooling only begin their careers in farm or lower blue collar occupations. The concentration is not nearly so great in the U.S.

Despite such concentration at the upper and lower ends of the occupational hierarchy, Table 1 also indicates that Canadian men find it easier to enter high-ranking occupations with less formal schooling than American men. Of those completing high school, nearly 18 percent of the Canadian men enter professional or managerial occupations, compared to just over 9 percent of the American men. In view of these countervailing tendencies in the Canadian table - strong association between educational background and first job destination in the extremes, much weaker association in the middle - we can only say at this point that, while the association between educational attainment and first job appears somewhat stronger in Canada, that association is apparently a nonlinear one, with greater weight being accorded graded

schooling than post-secondary schooling in the determination of occupational placement.

To gauge the extent of intercountry differences in the education/first-job relationship, we present a series of log-linear models in Table 2 that add birth cohort to the variables exhibited in Table 1 to preclude the possibility that the interactions observed there are an artifact of trends across cohorts in the twentieth century. Model 1 will serve as a baseline against which we will compare the fit of subsequent, more realistic models. It allows only the association between education and first job with all other associations constrained to be zero. A substantially better fit is obtained with Model 3, which incorporates not only an education-first job association, but also permits the marginal distributions of first job and education to vary by both birth cohort and country. Yet it leaves nearly 12 percent of the baseline chi-square unexplained, suggesting that one or more three-way interactions are required for a satisfactory fit. Model 4 accomplishes this by allowing the first job education relationship to vary by country, as well as allowing differences in the distributions of first job and education by cohort and country. The improvement in fit is considerable. However, a comparable improvement is obtained in Model 5, which allows the education/first-job relationship to vary by birth cohort instead of by country. Thus the best fitting Model (Model 6) includes both a country interaction and a cohort interaction. Models 7 and 8 simply provide tests for the significance of the country and cohort interactions. Both are significant, and both improve the fit beyond that provided by the baseline model by about 2.3 percent.

TABLE 2

Log-Linear Models of Intercountry Differences in the Relationship Between Highest Level of Schooling and Occupation of First Job by Age Cohort, Native-Born Canadian Males and White U.S. Males, 1973.

| Model | $LR\chi^2$ | d.f. | prob | $LR\chi^2_J/LR\chi^2_1$ |
|-----------------------------|------------|------|------|-------------------------|
| 1. [FE] [A] [C] | 6336.74 | 319 | .000 | 100.0 |
| 2. [FE] [AE] [C] | 4040.97 | 299 | .000 | 63.8 |
| 3. [FE] [FA] [EA] [FC] [EC] | 744.38 | 269 | .000 | 11.7 |
| 4. [EAC] [FAC] [FEC] | 261.00 | 200 | .002 | 4.1 |
| 5. [FEA] [EAC] [FAC] | 261.42 | 125 | .000 | 4.1 |
| 6. [FEA] [EAC] [FAC] [FEC] | 112.64 | 100 | .183 | 1.8 |
| 7. Model 6 vs. Model 4 | 148.36 | 100 | .000 | 2.3 |
| 8. Model 6 vs. Model 5 | 148.78 | 75 | .000 | 2.3 |

Note: Symbols are used as follows:

F = occupation of first job;
 E = highest level of schooling;
 C = country;
 A = age cohort.

We now have some confidence that the relationship between education and occupation of first job is heterogeneous across countries, but our earlier discussion of Table 1 indicated that this heterogeneity likely resides in specific locations in the joint distribution. Table 3 presents parameter estimates for education by country interaction effects on the log odds of entering each of the occupational categories. These estimates are from a series of logit models, one for each occupational category, in which the predetermined variables include not only the interactions reported in Table 3, but also the main effects of education,

country, and cohort and cohort by education and cohort by country interactions. In essence this represents an alternate specification of Model 6 (Table 2) in which first job is regarded as dependent on the other variables and their interactions. The estimates in Table 3 can be interpreted as the intercountry differences in the effect of each of the education categories on the log odds of entering each of the first job categories [18]. A positive sign indicates a stronger effect in Canada, a negative sign a stronger effect in the U.S. Thus, for example, those completing university have a significantly greater probability of

TABLE 3

Effects (λ 's) of Education by Country Interactions on the Log Odds of Entering First Job, Native-Born Canadian Males and White U.S. Males, 1973.

| Highest Level of Schooling (all by Country) | Occupation of First Job | | | | | |
|--|---|----------------------------------|-----------------|-------------------------|-------------------------|---------|
| | Professionals and Semi- Professionals | Managers and Pro- prietors | White Collar | Upper Blue Collar | Lower Blue Collar | Farm |
| Constant | -4.259 | -3.750 | -2.543 | -2.030 | .584 | -1.724 |
| Some High School | - .447 | - .607* | - .489* | .128 | .440* | - .279* |
| Completed High School | - .290 | - .467 | - .186 | - .255* | .638* | .044 |
| Some Post- Secondary | - .329 | .099 | .168 | - .114 | .631* | - .928 |
| Completed University | - .626 | .679* | .723* | - .196 | 1.272* | .093 |
| At Least Some Post-Graduate | .094 | .161 | .226 | - .525 | .343 | - .392 |

Note: These parameter values were estimated from a series of logit models equivalent to Model 6 of Table 1.

* Coefficient more than 1.96 times its standard error.

entering a managerial occupation in the U.S., while those with only some high school have a significantly greater probability of entering a managerial occupation in Canada. In the case of lower blue collar occupations, the higher concentration in Canada of men with elementary school training in this category is reflected in the significantly higher effects in the U.S. of all educational categories but post-graduate training. Another way of putting this is that men whose first job is lower blue collar in the U.S. are recruited from a greater variety of educational backgrounds than is true of such men in Canada. What this

suggests is that the effect of education on first job is not only different in the two countries, but is nonlinear, though in different ways, in both. The major shortcoming of our attempt to understand the linkages between schooling and occupation of first job is that our models have been misspecified in the sense that they have left out important socioeconomic background characteristics. So far, we are left with the impression that the relationship between these variables is strong, but would these relationships hold up in the presence of controls for socioeconomic background? More to the point, is there any difference

in the two countries in the way in which education mediates the influence of background on occupational attainment? The next section addresses this question.

3.3.2 Education as a Mediating Variable

To determine differences in the effect of education on status of first job in a more fully specified model, and capture the nonlinearities we found above, in Table 4 we regressed Duncan and transformed Blishen-McRoberts scores for occupation of first job on separate indicators of graded schooling (none through grade 12) and post-secondary schooling, coded 0 for grade 12 or less, 1 through 4 for years of university, and 5 for at least some post-graduate training. The so-called "spline function" created by incorporating separate variables for graded and post-secondary education allows us to estimate separate linear effects for the two levels of schooling[19]. As for the background variables, father's education is measured as years of schooling for both countries; father's occupation is measured on the transformed Blishen-McRoberts scale for Canada and the Duncan SEI for the U.S.; farm background is a dummy variable coded 1 if respondent's father was a farmer or farm labourer when respondent was age 16, 0 otherwise; broken family is a dummy variable coded 1 if respondent grew up without at least one parent, 0 otherwise; number of siblings is total number of respondent's brothers and sisters. The models are estimated separately for four ten-year and one five-year birth cohort to permit us to detect any trends over time in the effects of either background or education on first job. Reduced-form equations containing the background variables

only are also included to permit us to estimate their indirect effects via education.

In examining this table we are immediately struck by the contrasts in the effects of graded schooling and post-secondary schooling in the two countries. In Canada, an additional year of graded schooling produces about one more additional point in status of first job than is true in the U.S., with no apparent difference across cohort except in the most recent. There, the difference is almost two points. Since we can safely assume that this cohort, aged 21 to 26 in 1973, had completed its graded schooling, this is likely a real difference. In contrast, post-secondary schooling produces about one extra SEI point in the U.S. This is certainly consistent with our earlier finding that the relationship between schooling and first job is both nonlinear and different across the countries. There is also some tendency for post-secondary schooling to have an increasing effect on first job status in Canada, though not in the U.S. The only exception to the trend is the 1947-51 birth cohort. However, since these men were age 21 to 25 at the time of the survey, it is likely that a sizeable proportion of them had not yet completed their schooling, depressing the effect of the post-secondary variable in the model. This trend is certainly not surprising in view of the tendency for the Canadian and U.S. educational distributions to converge in the twentieth century[20]. The same sort of "credential inflation" that has characterized the American labour market also has been evident in Canada since the 1960s.

There is nothing in Table 4 to indicate that the direct effect of paternal occupation on respondent's first job is any stronger in Canada than in the U.S., i.e., as McRoberts

TABLE 4

Metric Regressions of SEI Scores for First Job on Background Characteristics and Schooling by Year of Birth, Canadian Native Born Males and U.S. White Males, 1973.

| Country and Birth Cohort | Independent Variables | | | | | | | R ² | |
|-----------------------------|------------------------|-----------------------|-----------------------|------------------|------------------|---------------------|-----------------------------|----------------|--------------|
| | Father's Occupation | Father's Education | Number of Siblings | Broken Family | Farm Origin | Graded Schooling | Post-Secondary Schooling | | Constant |
| Canada | | | | | | | | | |
| 1907 - 1916 | .201* .090* | 1.06* -.059 | -.712* -.335* | -5.07* -3.88* | -4.21* -4.49* | 2.41* | 6.82* | 25.09 9.68 | .212 .452 |
| 1917 - 1926 | .274* .147* | .815* .040 | -.893* -.289* | -1.08 -.276 | -4.13* -3.58* | 1.97* | 7.27* | 26.39 10.33 | .229 .482 |
| 1927 - 1936 | .257* .085* | 1.13* .193 | -.756* -.092 | -2.36 -1.66 | -2.53 -4.00* | 2.48* | 7.67* | 25.50 5.14 | .180 .524 |
| 1937 - 1946 | .366* .150* | .915* -.061 | -1.07* -.326* | -4.81* -3.53* | .005 -2.12* | 2.72* | 7.97* | 28.38 4.28 | .213 .555 |
| 1947 - 1951 | .192* .086* | .813 .072 | -.811* -.296 | -3.11 -.838 | .170 -.977 | 2.62* | 7.30* | 29.05 3.09 | .109 .355 |
| United States | | | | | | | | | |
| 1907 - 1916 | .305* .128 | .739* .032 | -1.18* -.372 | -2.91* -.591 | -5.04* -3.44 | 1.36 | 7.64 | 22.99 8.70 | .220 .438 |
| 1917 - 1926 | .299* .122* | .898* -.010 | -1.43* -.437* | -3.07* .387 | -5.98* -3.05* | 1.77* | 8.36* | 24.92 4.75 | .226 .547 |
| 1927 - 1936 | .300* .103* | 1.05* .124 | -1.55* -.359* | -2.65* .875 | -4.38* -2.86* | 1.60* | 8.56* | 25.37 5.85 | .230 .562 |
| 1937 - 1946 | .300* .120* | 1.05* .105 | -1.63* -.388* | -1.93 1.32 | -1.09 -2.95* | 1.61* | 8.31* | 22.70 4.41 | .216 .529 |
| 1947 - 1951 | .204* .095* | .668* -.018 | -1.34* -.566* | -3.50* -1.00 | -2.23 -4.40* | .839* | 7.14* | 22.74 14.34 | .133 .343 |

* Coefficients more than 1.96 times their standard errors.

Note: All coefficients are ordinary least-squares estimates. See text for a description of the measures.

and Selbee (1981) found, there is no evidence that occupational inheritance is more pronounced in Canada than in the U.S. Having said that, we must return to Porter's reasoning, with which we began. Assuming that the influence of socioeconomic background on educational attainment is stronger in Canada than in the U.S., the only way occupational inheritance in the two countries can be the same is if the indirect effect of background on first job is channeled through graded schooling more so than through post-secondary schooling. Table 5 addresses this issue. Although the decomposition of effects presented there is performed using standardized effects, which ordinarily should not be compared across populations, we feel confident in making comparisons of the proportions of the effects. As Alwin and Hauser have demonstrated, "the proportionate decomposition of an effect into its direct and indirect components is invariant with respect to the standardization of variables." [21] Therefore, we can meaningfully compare the proportions of total effects in the U.S. and Canada, even though the decomposition was performed using standardized coefficients.

It is evident from Table 5 that our reasoning was correct. Although there is no important difference to be observed in either the total effects or the direct effects of paternal education and occupation on first job, the way in which those effects are routed through graded schooling and post-secondary schooling are considerably different in the two countries. The percentage of the total effect of father's education mediated by graded schooling is consistently one-half to two-thirds greater in Canada. Even more startling, in the U.S., virtually none of the total effect of father's occupation is mediated by graded

schooling, whereas in Canada a declining but significant percentage is expressed through this form of schooling. At the same time, the percentage of the total effect of both father's education and father's occupation mediated by post-secondary education is considerably higher in the U.S., although again there is some evidence of convergence between the countries, especially in the transmission of the effect of paternal education.

3.4 CONCLUSIONS

To recapitulate, we have found that the way in which education is translated into entry-level positions in the labour force differs between Canada and the U.S., although there appears to be some convergence over time. Consistent with previous findings, we have seen that the direct effect of socioeconomic origins on first job is no stronger in Canada, but that the way in which parental status is transmitted via education is different than in the U.S., operating to a much larger, though declining, extent through graded schooling.

What are the implications of these findings for the persistent belief of most social scientists and policy makers that educational development will increase social equality, specifically that increased educational opportunities will enhance social mobility and decrease occupational and, ultimately, income inequality? Canada, with its higher level of educational inequality, is no more a closed society than is the U.S. While socioeconomic origins persist as important determinants of location in the occupational structure, the mechanism by which those origins are translated into occupational positions via education shift over time. While we

TABLE 5

Decomposition of the Effects of Paternal Status on Occupation of First Job for Native-Born Canadian Males and White U.S. Males, 1973.

| Paternal Status And Birth Cohort | Canada | | | | United States | | | |
|-------------------------------------|-----------------|---------------------|-----------------------------|------------------|-----------------|---------------------|-----------------------------|------------------|
| | Total Effect | Indirect Effect Via | | Direct Effect | Total Effect | Indirect Effect Via | | Direct Effect |
| | | Graded Schooling | Post-Secondary Schooling | | | Graded Schooling | Post-Secondary Schooling | |
| Father's education | | | | | | | | |
| 1907 - 1916 | .199 (100) | .102 (53.8) | .102 (51.3) | -.011 (-5.5) | .122 (100) | .037 (30.3) | .080 (65.6) | .005 (4.1) |
| 1917 - 1926 | .139 (100) | .059 (42.4) | .072 (51.8) | .007 (5.0) | .142 (100) | .039 (27.5) | .104 (73.2) | -.002 (-1.4) |
| 1927 - 1936 | .170 (100) | .055 (32.4) | .086 (51.0) | .029 (17.1) | .155 (100) | .035 (22.6) | .102 (65.8) | .018 (11.6) |
| 1937 - 1946 | .122 (100) | .044 (36.1) | .086 (70.5) | -.008 (-6.6) | .155 (100) | .030 (19.4) | .110 (71.0) | .015 (9.6) |
| 1947 - 1951 | .120 (100) | .034 (28.3) | .075 (62.5) | .011 (9.2) | .104 (100) | .014 (13.5) | .093 (89.4) | -.003 (-2.9) |
| Father's occupation | | | | | | | | |
| 1907 - 1916 | .206 (100) | .048 (23.3) | .066 (32.0) | .092 (44.7) | .279 (100) | .012 (4.3) | .150 (53.8) | .117 (41.9) |
| 1917 - 1926 | .270 (100) | .032 (11.9) | .093 (34.4) | .145 (53.7) | .262 (100) | .007 (2.7) | .148 (56.5) | .107 (40.8) |
| 1927 - 1936 | .238 (100) | .033 (13.9) | .126 (52.9) | .079 (33.2) | .258 (100) | .003 (1.2) | .167 (64.7) | .088 (34.1) |
| 1937 - 1946 | .318 (100) | .027 (8.5) | .161 (50.6) | .130 (40.9) | .278 (100) | -.001 (-0.4) | .168 (60.4) | .111 (39.9) |
| 1947 - 1951 | .197 (100) | .017 (8.6) | .091 (46.2) | .089 (45.2) | .221 (100) | -.000 (0.0) | .118 (53.4) | .103 (46.6) |

Note: These decompositions are based on standardized forms of the equations shown in Table 3 and their reduced forms not presented there. Percentages of total effects are in parentheses.

would not go so far as Boudon, who, on the basis of his simulation model of the system of inequality concluded that "educational growth as such has the effect of increasing rather than decreasing social and economic equality, even in the case of an educational system that becomes more equalitarian,"[22] we would suggest that the comparison presented here does not support the arguments of those who would use education as a tool to reduce other inequalities. The forces influencing the availability of desirable occupations,

such as technological change, investment patterns, the relocation of industries in other countries, are not very responsive to changes in the educational distribution. As in the case of Canada, a society in which large numbers of university-educated workers are not available will "make do" by imposing lower educational standards for workers. Whether or not this will result in lower productivity or, worse, a reduced level of innovation and related job creation is an open question.

NOTES

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- [1] Naegele, 1961; Lipset, 1963.
- [2] Porter, 1965.
- [3] Clement, 1977, p. 293.
- [4] But see Simkus, 1984.
- [5] It would not be reasonable to generalize Ornstein's (1981) findings to all Canadian males because, in addition to using a sample limited to the province of Ontario, the data set he used consisted of interviews with the parents of children enrolled in Ontario public high schools. As Ornstein (1981, p. 185) himself notes, a number of potentially significant biases are introduced by excluding from the sample persons with no children in the public high schools, such as parents who send their children to private schools, unmarried persons, or parents with young children. Underrepresented in the sample are those parents with fewer children and parents (mainly lower SES or immigrants) whose children dropped out of high school.
- [6] For example, Featherman and Hauser, 1978.
- [7] The Canadian Mobility Study was funded by the Canada Council. Monica Boyd, Hugh A. McRoberts, and John Porter, all of Carleton University, Frank Jones and Peter Pineo, both of McMaster University, and John Goyder, University of Waterloo, served as principal investigators on the original project.
- [8] See Boyd and McRoberts, 1974.
- [9] See Featherman and Hauser, 1978. The Occupational Changes in a Generation Replicate Study was supported by the National Science Foundation and data collected by the U.S. Bureau of the Census. David L. Featherman and Robert M. Hauser were co-investigators.
- [10] Featherman and Hauser, 1978.
- [11] McRoberts and Selbee, 1981.
- [12] See Ponting and Wanner, 1983.
- [13] Boyd, et al., 1981, p. 666
- [14] See McRoberts and Selbee, 1981, Appendix A and Appendix B for details on the methods they used to produce this mapping and the grouping of the U.S. detailed occupational codes into the final six-fold classification.
- [15] Of course the analogy is not perfect, because the time ordering between these two variables sometimes varies, i.e., for a minority of respondents complete their highest level of schooling after entering their first full-time job. Featherman and Hauser (1978) estimate that this was true for about 12 percent of the OCG-II men aged 21 to 65, although the percentages are higher for cohorts involved in World War II and the Korean War.
- [16] See Wanner, 1983.

- [17] This suggests that gross career mobility in Canada is likely lower than that in the U.S., given that much of such mobility takes place within internal labour markets. If those labour markets are narrow at the top, fewer career promotions are possible (see Wanner and Lewis, 1983).
- [18] An alternative approach to estimating such heterogeneity in discrete data is that proposed by Goodman (1979) and elaborated by Clogg (1982) in which an ANOVA-like procedure is applied to the odds ratios in 2 by 2 subtables formed from adjacent rows and adjacent columns of the cross-classification. One estimates heterogeneity in association within the table by looking at row and/or column effects on the odds ratios constructed in this way.
- [19] See Featherman and Hauser, 1978, p. 261.
- [20] Wanner, 1983.
- [21] Alwin and Hauser, 1975, p. 41.
- [22] Boudon, 1974, p. 187.

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Education, Social Mobility and the Challenge of Technological Change

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4.1 INTRODUCTION

A key problem in understanding the challenge of technological change in education research and policy is that the process operates simultaneously and interactively at individual, establishment, institutional and market levels. Attempts to analyze the topic in terms of our respective disciplines often yield perplexing results. At times they lead us to accept false hypotheses, simply because of all too frequent failures in capturing the "true" interaction effect. Our own analysis of pressures induced by recent technological changes on education policy and research illustrate this point[1]. Specifically, there are a number of inherent policy and structural contradictions in these dual pressures on education:

- a. as an adjustment mechanism between technology and employment;
- b. as a mobility path between persons with different socioeconomic characteristics and the hierarchy of occupations.

Education researchers and policy-makers face serious difficulties in resolving these contradictions

partly because of problems in specifying the salient features of the technological change process.

This paper identifies some of the sources of these contradictory pressures on education research and policy. Given the significance of the employment system as a principal means of distributing income, the paper examines cyclical and structural changes in labour markets as a driving force for technological relevance, productivity and competitiveness on one hand, and issues of stratification, mobility and income distribution on the other. We argue that understanding of labour markets raises important issues not yet addressed in occupational status attainment and mobility research[2] or in recent human capital research[3].

First, the paper outlines recent developments in labour market structures. The best available evidence[4] indicates that technological change creates few new jobs directly, although through productivity growth a disproportionately large number of poorly paid service sector jobs are instead being created. A basic question in this paper is: "Are we in the process of creating a two-tier society and what problems will this create for income

distribution and social cohesion?" Next, we explore some implications of a changing occupational structure on occupational status attainment and mobility research. Does this research enable us to accept or reject the hypothesis that occupational structure matters to understanding status attainment and mobility processes? What are the implications for interpreting traditional causal explanations? Third, we ask similar questions with respect to recent human capital research. In short, what are the labour market implications of policies that focus primarily on technological relevance, productivity and competitiveness imperatives? Finally, implications for research and policy are discussed.

4.2 TECHNOLOGY AND THE STRUCTURE OF LABOUR MARKETS

The process by which technical changes accrue benefits to relatively small numbers of technical and professional workers while much larger numbers move into poorly paid service sector jobs has been popularized in the United States in terms of the "declining middle." [5] This line of argument emphasizes that the middle of the occupational structure - stable high paying semi-skilled and skilled blue collar occupations, middle levels of public service (police, fire, nursing and teaching) and lower levels of exempt white collar work - is giving way to a more polarized structure in which policy needs are increasingly in conflict with one another. Trends in manufacturing employment, public sector employment and union membership, and attitudes towards union membership and public sector employment are all brought to bear on the argument. For example, more than 3 million high-paying manufacturing

jobs were lost between 1979 and 1983, and new employment was concentrated in low-paying service occupations and part-time work. These job losses occurred in traditional unionized sectors of the U.S. economy which, combined with no growth in non-military public sector employment, reveals a growing inability of unions in traditional collective bargaining relationships to obtain high wages in stable working environments. In addition, an emerging literature on industrial relations strategy [6] documents corporate strategies to promote concession bargaining or non-union status in traditionally unionized sectors of the U.S. economy - an indication of the extent to which influential opinion against unions and collective bargaining has hardened.

Does the "declining middle" offer useful insight into current human resource research and policy in Canada? The answer - a qualified yes - appears to be documented by examining changing priorities among human resource forecasters and identifying the relevant concerns about technological relevance, productivity and competitiveness on one hand, and stratification, mobility and income distribution on the other. For example, numerous studies and reports in recent years have identified skill shortages in high technology occupations as a critical barrier to technological diffusion [7]. These findings represent a significant shift in interest since the Economic Council of Canada's 1979 Human Resources Survey (reported by Betcherman, 1982) suggested that shortages in product fabricating and repair (mechanics, equipment electricians, sewing machine operators) and machining (machinists, welders, tool and die makers, machine tool operators) occupations dominated expected shortages in high technology sciences and engineering. More recent

studies[8] strongly de-emphasize skill requirements in highly skilled manufacturing blue collar occupations in favour of engineering, systems analysts and programmers, engineering technologists and CAD/CAM occupations.

However, while the shift toward high technology occupations appears to be genuine and well-documented, the concerns expressed about the need to ensure technological relevance, improved productivity and competitiveness need to be evaluated in terms of the actual demands these occupations will impose on our economy. A first point is that our interests are concentrated in a small number of high skill white collar occupations. This can be illustrated by examining Tables 1 and 2. Based upon a Canadian Occupational Projections System (COPS) reference case scenario, occupations expected to contribute to employment growth for the years 1983-92 were identified[9]. Table 1 shows the top 30 occupations expected to contribute to employment growth and their socioeconomic prestige scores on the male- and female-based Blishen indices[10]. Of the top 15 occupations expected to contribute to employment growth, none are unambiguously high prestige occupations (scoring over 60 on both male and female indices), six occupations (truck drivers, janitors, carpenters, waiters, security guards, labourers) have unambiguously low prestige scores (lower than 39.99) and six occupations (secretaries, bookkeepers, cashiers, office clerks, typists, receptionists) have unambiguously middle prestige scores (between 40 and 59.99). The remaining three occupations (financial officers, sales management and nurses) are ambiguous in the sense that the index scores are either high or middle on the different sex-based indices. Of the top occupations, very few require

extensive, human resource policy initiatives to ensure a medium-term balance between labour supply and demand. For example, at present, three out of these 30 occupations have received a CEIC designation in Ontario as "occupations of national importance" (welders, industrial farm mechanics, systems analysts).

In contrast, Table 2 suggests that a policy response to facilitate more rapid technological diffusion resides in a set of small occupations where rapid increases in demand may be expected in the medium term. Further, the Table suggests that several (and perhaps many) of these occupations possess high skill requirements and high prestige. Five out of the 20 occupations have unambiguously high prestige scores, one scores unambiguously at the middle level, and three at the low level. The remainder are either ambiguous or cannot be classified. However, it is clear that the importance of these occupations to national productivity far outweighs their job creation potential. Employment in these 20 occupations was estimated at 81,000 in 1983. Even if employment in these occupations were to double between 1983 and 1992, the number of new job openings barely equals the requirements for secretaries and stenographers over the same period.

This raises a second point about the nature of the policy debates for ensuring technological relevance and improved productivity and competitiveness. Specifically, a variety of factors are encouraging policymakers to think increasingly in terms of better targetting of resources. For example, a Canada Employment and Immigration Commission (CEIC) consultation paper (1984) emphasizes the increasing importance of proper targetting as a response to the current environment of spending restraint. However, the nature

of the technological change process also appears to encourage an increased emphasis on targetting resources because

- a. the occupations critical to enhancing technological diffusion can be identified and appear to involve training and education for a relatively small number of people;
- b. many of the skills associated with technological literacy are generic (as opposed to job specific) in nature, which suggests that some of the training burden may better be shifted to the education system; and
- c. the training in these complex, high status occupations must produce graduates of very high quality in order to maximize productivity improvements - an objective that will require intensive training and substantial allocation of resources on a per trainee basis.

In contrast, the vast majority of projected employment growth requires little advanced education, minimal specific training and (arguably) little management from policy-makers.

A third related point is that the objectives of technological relevance, improved productivity and competitiveness involve people in the high-skill,

high-status occupations who have essentially entered primary labour markets: high pay and benefits, good promotion opportunities, and at least some ability to control the flow of new entrants into the occupation or profession[11]. Both economic and sociological analysts worry that shortages in these occupations could seriously impair the rate of technological diffusion because high wages could reduce the profitability of high technology

firms[12] or because of institutional barriers to complex learning[13]. Our survey of Ontario high technology employers, for example, identified unmet training needs attributed to knowledge requirements that transcended professional boundaries and insufficient economic incentives to obtain inter-disciplinary education. However, the importance of quality in high technology work appears to provide a continuing rationale for professional association and some restrictive labour supply practices. These appear to be less tenable (due to the changing occupational structure) in middle- and lower-skill occupations.

In isolation, these points tend to provide a serious rationale for restricting government's role to highly targetted intensive efforts in technological development and education. However, in a dynamic economy, these arguments may be subsumed by persistent problems in stratification, mobility and income distribution. In Kuttner's (1983) words, the underlying problem may not be an insufficient supply of good workers. Rather, the real problem may be an insufficient supply of good jobs. In this light, occupations facing relative and absolute employment decline in recent years, and the apparent erosion of traditional institutional supports may be sources of concern in terms of their stratification, mobility and income implications.

First, there is increasing evidence (although perhaps not as striking as in the U.S.) that traditional areas of occupational shortage are now experiencing significant job loss. Table 3 shows overall trends in manufacturing employment as well as employment trends in four occupational categories. Overall, manufacturing has lost 135,000 jobs over the last five years, a 6.5 percent decline. Over the same period,

machining occupations fell by more than 19 percent and product fabricating occupations by almost 6 percent. Part of these declining absolute employment levels may be attributed to the declining competitiveness of Canadian manufacturing[14] and part to such nascent technological changes as computer-aided manufacturing and robotics[15].

The point is, the shift in emphasis from skilled blue collar manufacturing to scientific and engineering occupations is being reinforced by significant job loss in skilled and unionized blue collar occupations. And, while this employment loss appears to be relatively less severe than the U.S., we should not rule out the possibility that this is a delayed reaction (due to a lag in capital investment in Canada) rather than a partial refutation of the declining middle hypothesis.

A second point is that the shift in emphasis from skilled blue collar manufacturing coincides with a reduction in influence of institutions devoted to redistributive objectives in our society. By this, we refer to difficulties Canadian unions have encountered organizing employees in service, retail trade and clerical occupations, and to the declining importance of the public sector as a source of new employment. As Kuttner (1983) points out, there is nothing intrinsic in assembling cars, mining coal, or pouring molten steel that requires high wages. Similarly, there is nothing intrinsic in service and clerical work that requires low wages. However, because unions in Canada appear to be quite unsuccessful in organizing fast-food workers, typists, bank clerks or even computer assemblers, job losses in manufacturing are being offset by new service sector jobs that pay far lower wages.

Further, the primary aspect of the service economy in which wages are good is the public sector. However, surpluses of teachers, professors and social workers across Canada, extensive layoffs in the British Columbia public service and cutbacks in new hiring in many provinces and at the federal level all suggest that the public sector's influence as a redistributive source of employment is in decline.

Related to this is an argument that the decreasing influence of unions and the public sector coincides with a decline in the legitimacy of their redistributive objectives. As manufacturing technologies become more mobile, blue collar labour markets have increasingly been in competition with overseas and Third World labour. This has forced wage concessions, moderation of wage demands and job loss, which have reduced the attractiveness of collective bargaining to potential union members. Further, high unemployment and high levels of new labour market entry from women and young adults act as a depressive force over union bargaining power. Finally, both manufacturing and the public sector have been facing a wages/job security tradeoff. For example, each one-dollar negotiated increase in automobile worker wages in the U.S. is estimated to make 1000 robots economically feasible. A projected concentration of robotics investment in automobile assembly work[16] places strong downward pressure on Canada's strongly assembly-oriented automobile industry. These trends all interact with one another to force wages and jobs at the middle of the occupational structure down toward the lower end. In contrast, as discussed above, despite concerns that highly skilled professional employees may engage in practices intended to restrict labour supply, the legitimacy of professional

association at the higher end of the occupational structure has nevertheless been reinforced by concerns about improving the quality and speed of technological diffusion.

To conclude, we suggest that insights for Canadian policy drawn from the declining middle hypothesis required some qualification. To be sure, the argument has been applied more successfully to the United States[17], where the attrition rate in manufacturing employment has nearly doubled the Canadian rate (3 million jobs between 1979 and 1983 compared with 170,000 jobs in Canada), the attrition rate in unionization has been much steeper than in Canada, and the attitude toward public sector employment appears to be more negative than in Canada. However, the reasons for these stronger trends in the U.S. may suggest that the most significant changes in the Canadian occupational structure are yet to come:

- a. Canada has a wage advantage in manufacturing relative to the United States due to the favourable exchange rate - this may be slowing the rate of change, but is unlikely to stop it;
- b. due to the relatively stronger representation in the public sector, collective bargaining in Canada has not yet experienced a significant erosion; however, it is not yet clear whether unions in Canada will be any more successful than their American counterparts in gaining entry in new sources of employment; and
- c. given the recent change of federal government and the high deficit, significant cutbacks in public employment may not have been ruled out as a possible policy response.

4.3 STATUS ATTAINMENT AND MOBILITY RESEARCH AND THE STRUCTURE OF LABOUR MARKETS

The contradictory policy pressures implied by the declining middle hypothesis are particularly important in analyzing education and training policy decisions and school-to-work transitions. In this section, we use some of our own research in the status attainment and mobility areas to raise questions and to suggest modes of analysis implicit in testing the implications of a declining middle framework. We examine three topics - returns to education, treatment of the occupational structure, and technological change - that require a re-examination in light of the declining middle hypothesis.

4.3.1 Returns to Education

There are consistent findings with respect to the effects of educational attainment on occupational attainment, measured as the occupational status of first full-time job since leaving school. Using U.S. data, Treiman and Terrell, 1975, p. 182, conclude that "for both sexes, occupational status depends on educational attainment and little else..." Featherman and Hauser, 1976, pp. 471, 481, find that "...schooling has the largest absolute and relative effects on occupational status." They "...find no support for popular notions of a declining socioeconomic importance of schooling." There is also considerable agreement that socioeconomic background factors have but little direct influence on occupational status attainment[18]. Rather, socioeconomic inequities strongly affect patterns of educational attainment, which in turn are so important to higher levels of occupational

achievement[19].

While the introduction of labour market effects does not challenge the principal findings about the importance of education, it is possible to specify some temporal trends that may confirm or disconfirm the hypothesis[20] that there have been no declining returns to education over time. A study of the changing relationship between university education and intergenerational social mobility in Ontario (Harvey, 1984) does reveal a marked deterioration in intergenerational upward occupational mobility prospects for both male and female university graduates. Data from surveys of Ontario B.A. and B.Sc. graduates (collected at four-year intervals between the years 1960 and 1976) show that a decline in mobility prospects set in after 1964. This coincided with increases in the general unemployment rate in Ontario, in which the labour market for many types of university-trained workers, including B.A. and B.Sc. graduates, started to weaken. This also coincided with major expansion in public investment in university education in Canada, intended to meet various (contradictory) objectives: development of human capital; a contribution to general social and cultural development; and the provision of greater equality of opportunity. One major implication is that an equality of opportunity objective interacted fundamentally with other objectives and labour market conditions in such a way that observed outcomes bore little resemblance to expected outcomes. To conclude, however, that the major expansion in public education had little or no effect on the occupational achievement of university graduates from lower socioeconomic backgrounds would not be appropriate. The analysis is unable to tell us what occupational achievement would have been in the absence of a

university degree.

A second approach to assessing labour market influences on temporal trends in returns to education has been to discard the assumption of linearity in the relationship between years of education and occupational status attainment[21]. Even relatively crude attempts at accounting for inherent non-linearities have shown significant difference in slope coefficients between different types of education decision. For example, Harvey and Kalwa, 1983, using pooled cross-sectional data for Ontario B.A. and B.Sc. graduates (1960-1976) show significantly higher returns to education for science majors, particularly for women. The authors could have expanded their analysis by creating separate science major variables for each year data were collected (that is, for 1960, 1964, 1968, 1972, 1976), in order to estimate temporal trends in returns to science education.

Research we are currently conducting using the 1973 Canadian Occupational Mobility Survey data set[22] allows us to do somewhat more detailed tests on alternative formulations of an education variable. For example, we can estimate separate returns to education coefficients according to the year respondents entered the labour force (for the time being, we have restricted our analysis to the years 1961-1972) and type of education - for example, years of education, controlling for university or post-secondary non-university attendance. Over time, we have observed the increasing importance of certain types of post-secondary non-university education (for example, the college of applied arts and technology system in Ontario), which leads us to believe that we can account for an overall decline in returns to education by pinpointing sources of the

decline and emerging sources of opportunity. In addition, we are able to experiment with functional form (for example, take the natural log of year of education) in order to account for inherent non-linearities[23].

The purpose of specifying potential threats to the simplifying assumption of linearity is three-fold. First, the universally accepted finding - education has the largest absolute and relative effect on occupational status[24] - requires further investigation in light of knowledge about changes in the educational system. We can argue that the community college system in Ontario and other provinces emerged as a policy response to changing occupational structure and labour market needs - the very factors that would suggest a fundamental discontinuity in the occupational status attainment process. Second, we are not convinced that Featherman and Hauser's (1976) finding of no declining returns to education over time stands up in Canada, particularly in light of contradictory findings suggested by other modes of analysis[25]. A diverging occupational structure may have little influence on average occupational status attainment, yet individuals who make less technologically relevant educational decisions may face a precipitous decline in returns to education. Third, as we all acknowledge, there are labour market and non-labour market objectives to public education that contradict the significance of some of these findings. For example, public education attempts to develop general human capital which may facilitate more rapid social or technological adjustments later in life. There are general social and cultural development objectives of public education that may not yet have been appropriately evaluated in terms of occupational

status attainment models.

4.3.2 Occupational Structure

It is our conclusion that there have been declining returns to education in Canada in the late 1960s and into the mid-1970s. According to available evidence[26] this trend has continued into the 1980s. In order to explain this trend, however, it is necessary to step outside of the traditional status attainment model and examine aspects of labour markets and occupational structure[27]. Traditional measurement techniques provide, at best, an indirect measure of temporal shifts in the underlying structure of the population.

An examination of sex differences in occupational status attainment reveals the difficulty of evaluating structural differences in terms of the traditional model. For example, a number of studies have concluded that the distribution of occupational status is virtually identical for both sexes[28]. As Spaeth (1977) points out, however, this may be an artifact of focussing analysis around the arithmetic mean. Given the common observation that women are excluded from occupations with high socioeconomic status and are less likely to enter low status ones, the similar arithmetic means may be accompanied by smaller standard deviations for women. A diverging occupational structure may well be inferred in a similar way. That is, deviations from the mean would increase in conjunction with a diverging occupational structure. Indeed, increasing standard deviations are observed in Harvey's (1984) data set (see Table 4). However, we can only view this as a weak, indirect test of the existence of a diverging occupational structure since we are unable to rule out

alternative explanations.

A more direct attempt at identifying structural influences was made by Harvey and Kalwa (1983). They include the general unemployment rate for Ontario in their model (for the years 1960-1976), as a means of reflecting the interaction of supply and demand in the labour market as well as the overall state of aggregate economic activity. The purpose of this inclusion was to address Horan's (1978) argument that status attainment research neglects the analysis of structural factors in the process of occupational attainment. Further, the inclusion was intended as a way of estimating the extent to which differences in occupational achievement are masked by the use of prestige as a measure of socioeconomic differentiation. The authors observed that the unemployment rate coefficient was strongly negative, which suggests that a decline in status apparently accompanies a weakening labour market. Further, this decline in status over time most likely understates the real economic effect of the fortunes of graduates, since even maintenance of status under weakening labour market conditions may well have had a negative influence on relative earnings.

These intriguing findings point to several new research needs. First, the unemployment rate is an admittedly crude measure of the labour market. It is subject to cyclical variation (due to fluctuations in the business cycle) and to a gradual temporal increase due to changes in the occupational structure. It is desirable to attempt to separate cyclical and structural effects. Second, the analysis can be extended from university graduates to the general population. Third, over time, there are significant changes in work force composition and job availability due to

demographic and technological changes. Experience shows that job-creating and job-destroying technological changes have been occurring in conjunction with one another - controlling for these changes in occupational structure allows us to unmask structural influences in the occupational status attainment process.

The importance of structural changes to understanding the occupational status attainment process can be inferred from a study using U.S. data on temporal changes in intergenerational occupational mobility [29]. Using data from the 1962 "Occupational Changes in a Generation" supplement to the Current Population Survey, the authors compare patterns of intergenerational mobility for men over nine 5-year cohorts. They do find significant differences in patterns of mobility. However, the authors conclude that no change has taken place in occupational mobility when the changing occupational distribution is taken into account. The authors raise an interesting point for more recent research that evaluates the implication of the declining middle hypothesis: that "rather than treating the underlying process of mobility as a variable in comparative research and the variation in the distribution of occupations as a disturbance, it may be more fruitful to treat transformations of the occupational structure as problematic in comparative mobility research."

4.3.3 Technological Change

This latter assertion poses interesting implications and challenges to research and policy on education, mobility and technological change. Specifically, it focuses attention on the occupational structure as problematic to research and

policy decisions. In these terms, evidence of a diverging occupational structure might be viewed with considerable concern because it may foreshadow a much greater decline in mobility prospects than might otherwise be anticipated.

4.4 HUMAN CAPITAL DEVELOPMENT AND THE STRUCTURE OF LABOUR MARKETS

The process of human capital development can be observed at many levels:

- a. the macro or societal level, where the quality of a society's human capital is inferred by such indicators as the rate of productivity increase or the changing skill requirements of jobs (Rumberger, 1981);
- b. the educational institution level, where we debate such issues as whether high school or university standards in mathematics and English should be raised, or whether the number of places in universities should be reduced (faster than the expected decline in university-age population) in order to improve quality for those who remain (Commission on the Future Development of Universities of Ontario, 1985);
- c. the job market or vocational training level, where researchers speculate that on-the-job development is insufficient for future (unanticipated) labour market needs, and infer a trend away from a "school-work-retirement" development model to a "life-long learning" model (CEIC, 1984);
- d. the individual level, where behavioural researchers try to explain why some people fear technological change while others thrive on it, and where cognitive barriers and opportunities for

learning are analyzed. At most levels, the interactions with the structure of labour markets are not well understood, nor are the interactions between levels. Even at the job market level, we don't know whether the hypothesized trend away from "school-work-retirement" to "life-long learning" is a trend that has been empirically verified or a direction policy-makers and researchers believe we ought to go. Further, we don't know whether it is an initiative that enhances technological efficiency and productivity or a way in which mobility prospects can be dramatically improved. While we hope it does both, a failure to consider the nature of the occupational structure may lead to initiatives that bear little resemblance with original objectives.

This latter caution may be illustrated with respect to two issues. First, there is a widely held belief that North Americans are over-educated. This is often operationalized either in terms of over-investment in public education (e.g., Freeman, 1976), or analysis of the post-graduation experience of generally educated (B.A. and B.Sc.) students[30]. We cannot directly support or reject this view. However, even assuming its truth, it does not follow that an effective education policy would necessarily reduce investment in general educational development in favour of more job-specific training or other government priorities. Such an approach effectively takes the occupational structure as given instead of viewing the occupational structure as an integral changeable part of a policy formulation process. Such an approach effectively excludes thinking that "the real problem is the supply of good jobs rather than the supply

of good workers." [31] Downsizing education could well create a self-fulfilling prophesy (in terms of diverging occupational structure) unless any such decisions are made in conjunction with their expected mobility outcomes and the extent to which they exclude other policy options. For example, could such decisions reduce our ability to pursue other policies to fill in the middle of a divergent occupational structure?

Second, we can explore the implications of a trend away from a "school-work-retirement" development model to a "life-long learning" model. If we accept a basic proposition of dual labour market analysis [32] - that pay, benefits and development opportunities accrue to individuals in primary labour market situations - then it is easy to see the implications of a "life-long learning" model in terms of a divergent occupational structure. The opportunities for continuous learning - paid educational leaves, opportunities to make use of proposed registered educational leave programs or skill development leave provisions under provincial labour codes [33], or even opportunities to profitably make use of job sharing arrangements - would accrue to individuals in primary labour market situations. If "life-long learning" is indeed where the future lies, then the question of access - a longstanding concern in the analysis of educational institutions - would have to be re-formulated in terms of labour market and institutional (firm-specific) issues.

4.5 IMPLICATIONS FOR RESEARCH AND POLICY

There are three principal conclusions to this paper. First, there is evidence that the middle of the occupational structure is giving way to a more polarized occupational structure. This diverging structure has implications both for human resource policies designed to enhance technological relevance and productivity and for issues of occupational attainment and mobility. Second, most existing research on occupational status attainment and mobility ignores the influence of occupational structures, even though rough attempts at specifying the structural influences yield meaningful results. Third, the process of human capital development is not well understood in terms of the underlying occupational structure. This creates a very real danger that current policy decisions may more severely restrict future developmental opportunities than is generally realized.

We have outlined some areas where there is a need for research. Clearly, there is a need for new data on occupational status attainment and mobility processes formatted in ways that facilitate linkages with labour market and technological change data. We outlined some possible linkages - by altering the form of education variables, by adding measures of labour market change (for example, the unemployment rate) and by adding in controls of the occupational structure - and how these linkages can alter perceptions of the status attainment and mobility processes. Finally, recent human capital development research is not well developed in terms of expected interaction between levels as well as with occupational structure variables. In short, there are a number of potentially critical implications of a divergent occupational

structure that need to be accepted or refuted by various streams of research.

With respect to education and training policy, we see implications in at least two major areas. First, some organization theorists argue that there are "good" and "bad" ways of implementing technological changes. The "good" way consciously introduces notions of empowerment, "bridging" positions between low-level routine jobs and higher developmental positions, job enrichment, training and re-training opportunities, quality of working life, affirmative action[34]. The "bad" way contains the polarized internal labour market structure without any of these bridging opportunities. If life-long access to learning opportunities becomes a more important part of the agenda, then some of these institutional remedies would warrant further investigation in terms of their influence on the (market-level) occupational structure. A basic question given an acceptable criterion (equality of opportunity or equality of results) is, what measures are most effective in terms of ensuring equality of access to life-long learning opportunities?

Second, nothing in this paper should be construed as detracting from the desirable objectives of technological relevance, technical excellence or productivity enhance-

ment in our society. However, the other side of the contradiction merits attention: that is, "the real problem is the supply of good jobs rather than the supply of good workers." In a sense, the contradiction can be resolved by realizing that a developmentally oriented, mobile occupational structure vastly increases the pool of qualifiable people for technologically relevant jobs. In other words, it makes sense to pursue policies that alter the shape of the occupational structure by increasing the supply of good jobs:

- a. at the societal level, by building a commitment to full employment and a strong public participation in education, training and mandated employment standards (e.g., affirmative action, educational leave programs);
- b. at the institutional (employees) level, by developing supportive occupational structures and by building a strong organizational commitment to training and development;
- c. at the institutional (educational) level, by developing supportive, relevant programming; and
- d. at individual or small group levels, by engaging in developmentally-oriented modes of work (job enrichment or enlargement, quality of working life, on-the-job training and others).

TABLE 1

A Scenario¹ Showing Occupations² Contributing Most to Employment Growth, Canada, 1983-92

| Rank | Occupational Title ³ | Projected Employment | | Socioeconomic | |
|----------------|---------------------------------|----------------------|-------|---------------|--------|
| | | 1983 | 1992 | Index | |
| (In Thousands) | | | | Male | Female |
| | | | | Index | Index |
| 1 | Secretaries and steno | 351.3 | 438.8 | 52 | 50 |
| 2 | Bookkeepers | 368.2 | 448.5 | 51 | 45 |
| 3 | Truck drivers | 238.0 | 310.0 | 30 | 36 |
| 4 | Financial officers | 140.9 | 180.0 | 68 | 56 |
| 5 | Janitors | 223.6 | 261.4 | 25 | 26 |
| 6 | Cashiers and tellers | 229.6 | 263.8 | 40 | 39 |
| 7 | Carpenters | 107.3 | 138.1 | 28 | 38 |
| 8 | General office clerks | 136.4 | 165.3 | 46 | 44 |
| 9 | Waiters | 252.4 | 281.0 | 28 | -- |
| 10 | Guards and other security | 76.9 | 101.5 | 29 | 36 |
| 11 | Typists, clerk/typist | 95.7 | 118.4 | 46 | 45 |
| 12 | Receptionists | 90.4 | 112.0 | 41 | 41 |
| 13 | Sales management occupations | 169.9 | 191.1 | 65 | 52 |
| 14 | Labourers: other construc. | 54.2 | 74.9 | 29 | 26 |
| 15 | Nurses, grad., nonsuper. | 185.5 | 206.1 | 51 | 62 |
| 16 | Welders | 79.8 | 99.8 | 35 | 28 |
| 17 | Industrial farm mechanics | 88.2 | 108.0 | 41 | 42 |
| 18 | Auto mechanics | 140.7 | 160.0 | 38 | 31 |
| 19 | Sewing machine occupations | 88.1 | 106.6 | 23 | 25 |
| 20 | Bus drivers | 49.0 | 67.4 | 32 | 30 |
| 21 | Chefs and cooks | 162.5 | 180.8 | 27 | 28 |
| 22 | Superv: other constr. | 66.5 | 84.3 | 46 | 38 |
| 23 | General managers | 79.2 | 96.8 | 67 | 69 |
| 24 | Nursery workers | 58.8 | 75.9 | 28 | 32 |
| 25 | E.D.P. equipment operators | 71.3 | 88.1 | 56 | 43 |
| 26 | Police officers: govt. | 53.8 | 69.3 | 60 | 65 |
| 27 | Stock clerks | 91.5 | 106.6 | 39 | 37 |
| 28 | System analysts | 56.8 | 71.9 | 69 | 73 |
| 29 | Shipping clerks | 84.2 | 98.5 | 34 | 34 |
| 30 | Commercial traveller | 95.9 | 109.6 | 57 | 49 |

Source: Consultation Paper on Training, Minister of Employment and Immigration, Canada, December 1984, p. 29.

¹ Based on COPS reference case scenario developed by Informetrica Ltd., October, 1983 and COPS own computations. Included are all occupations which are not supervisory or residual in nature.

² According to the Standard Occupational Classification, Statistics Canada, 1980.

³ Blishen and McRoberts, 1976, and Blishen and Carroll, 1978.

TABLE 2

Selected Small Occupations Where Relatively Rapid Increase in Demand Could be Expected in the Medium Term

| Occupational Title ² | Estimated Employment in 1983 (In Thousands) ¹ | | |
|---|---|---------------|-----------------|
| | | Male Index | Female Index |
| Organization and Methods Analysts | 9.0 | -- | -- |
| Chemists | 8.4 | 66 | 73 |
| Physicists | 1.3 | 69 | 74 |
| Architects | 7.1 | 72 | 68 |
| Chemical Engineers | 5.0 | 71 | 80 |
| Agricultural Engineers | 0.5 | -- | -- |
| Nuclear Engineers | 0.8 | 75 | -- |
| Community Planners | 5.7 | -- | -- |
| Architectural Technologists and Technicians | 1.2 | 63 | 52 |
| Mathematicians, Statisticians and Actuaries | 5.4 | 67 | 61 |
| Dental Laboratory Technicians | 3.9 | -- | -- |
| Advertising Sales Occupations | 8.4 | -- | -- |
| Business Services Sales Occupations | 4.7 | -- | -- |
| Forestry Conservation Occupations | 4.1 | 32 | 33 |
| Distilling - Chemicals | 2.9 | 57 | 26 |
| Precision Instruments Fabricating Labour: Electrical/Electronic Equipment | 2.6 | 38 | 31 |
| Subway and Street Railway Operating Occupations | 2.6 | 29 | 26 |
| Radio and T.V. Equipment Operators | 1.0 | 44 | 21 |
| Sound and Video Recording Operators | 4.0 | 57 | 45 |
| | 2.3 | 59 | 30 |

Source: Consultation Paper on Training, Minister of Employment and Immigration, Canada, December 1984, p. 28.

¹ Based on estimates of the Canadian Occupational Projection System (COPS).

² Blishen and McRoberts, 1976, and Blishen and Carroll, 1978.

TABLE 3

Paid Employment in Manufacturing and in Selected Occupational Groups, Canada, 1979-84

| | Manufacturing | Clerical | Service (In Thousands) | Machining | Product Fabricating |
|------|---------------|----------|---------------------------|-----------|------------------------|
| 1979 | 2090 | 1757 | 1155 | 273 | 937 |
| 1980 | 2080 | 1879 | 1224 | 261 | 931 |
| 1981 | 2060 | 1881 | 1243 | 255 | 941 |
| 1982 | 1799 | 1784 | 1248 | 217 | 810 |
| 1983 | 1920 | 1805 | 1298 | 212 | 871 |
| 1984 | 1955 | 1830 | 1290 | 220 | 884 |

Source: Data for November of each year, from Statistics Canada:
The Labour Force, Cat. #71-001.

TABLE 4

Mean Occupational Status by Year of Graduation and Sex

| Year of Graduation | Men | N | SD | Women | N | SD |
|-----------------------|------|------|------|-------|------|------|
| 1960 | 5.91 | 407 | 1.17 | 5.40 | 304 | .94 |
| 1964 | 5.97 | 666 | 1.14 | 5.50 | 494 | .96 |
| 1968 | 5.41 | 749 | 1.04 | 5.25 | 764 | 1.03 |
| 1972 | 4.91 | 964 | 1.30 | 4.85 | 911 | 1.13 |
| 1976 | 4.44 | 434 | 1.41 | 4.29 | 492 | 1.50 |
| TOTAL | 5.31 | 3220 | 1.32 | 5.03 | 2965 | 1.17 |

Source: Harvey, 1984.

NOTES

- [1] Harvey and Kalwa, 1983; Harvey, 1984; Harvey and Blakely, 1984.
- [2] Harvey and Kalwa, 1983; Harvey, 1984.
- [3] Reich, 1983.
- [4] CEIC, 1984; Younger, 1983; Informetrica, 1983.
- [5] Kuttner, 1983.
- [6] Kochan, McKersie and Cappelli, 1984.
- [7] For example, Harvey and Blakely, 1984; Younger, 1983; Labour Canada, 1982.
- [8] Harvey and Blakely 1984; Younger, 1983.
- [9] CEIC, 1984.
- [10] Blishen and McRoberts, 1976; Blishen and Carroll, 1978.
- [11] Doeringer and Piore, 1971.
- [12] Younger, 1983.
- [13] Harvey and Blakely, 1984.
- [14] Britton and Gilmour, 1978.
- [15] Peitchinis, 1983.
- [16] Levitan and Johnson, 1982.
- [17] Kuttner, 1983.
- [18] Cuneo and Curtis, 1975; Treiman and Terrell, 1975; McClendon, 1975; Featherman and Hauser, 1976.
- [19] Pike, 1970; Porter, Porter and Blishen, 1973.
- [20] Treiman and Terrell, 1975.
- [21] A linear approximation according to the number of years of education or units of education appears in many American and Canadian studies - the interpretation being that each additional year of education adds a fixed return measured in terms of prestige or income. While race and sex differences have been well documented, other inherent non-linearities (e.g., returns to university or non-university post-secondary education) may also respond to temporal changes.
- [22] Boyd and McRoberts, 1974.
- [23] For example, the status achievement of obtaining an M.B.A. compared with a B.A. may be significantly different from that of achieving a doctorate in business compared with the M.B.A.
- [24] Featherman and Hauser, 1976.
- [25] Harvey, 1984; Clark and Zsigmond, 1981; Selleck, 1980.
- [26] Clark and Zsigmond, 1981; Kuttner, 1983.
- [27] Harvey and Kalwa, 1983; Harvey, 1984.
- [28] Treiman and Terrell, 1975; McClendon, 1976; Featherman and Hauser, 1976.
- [29] Hauser, Koffel, Travis and Dickinson, 1975.
- [30] Clark and Zsigmond, 1981; Cotter and Dorfman, 1981.

- [31] Kuttner, 1983.
- [32] Doeringer and Piore, 1971.
- [33] Labour Canada, 1982; CEIC, 1984.
- [34] Kuttner, 1983; Reich, 1983; Rosenbaum, 1983; Driscoll, 1980.

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The Work Force Transition to New Computer Technologies: Changes in Skills and Quality of Work Life

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As new computer technologies are being introduced into the workplace, there is a great deal of concern about their impact on skill and training requirements. With little solid research, policy-makers have concluded that these computer technologies will render the current work force obsolete, and that it will take a major government effort to provide the basic computer skills they will need to remain employable. We address these concerns by examining the skills requirements of several major new computer technologies and the transition process in different types of firms.

The firms studied are a legal books publisher, aerospace company, and several electronics and computer manufacturers. The technologies are Computer-Aided Design systems for mechanical engineering and electronic components design, word processing systems as used by legal writers and editorial assistants, personal computers used for statistical analysis by managers, and a management information system used in credit and collections.

We find:

- * no dramatic skill changes;
- * computer technology requires only an incremental advance in knowledge and skills, and
- * the jobs still require workers to have a substantial proportion of their existing skills.
- * Moreover, there are important organizational and production process-specific skills and knowledge that are not replaced by the use of these new technologies.
- * The transition to using these technologies occurs relatively easily when there is support by the company.
- * Further, we find no substantial detrimental impact on the quality of worklife from the use of computer technology - the problems encountered were more reflective of the organization.

Thus, our findings have the following public policy implications:

- * there is only a minimal role for government in re-training - the evidence is that generic retraining programs historically have not been effective and will not be required for the "computer revolution." Instead, government expenditures are best directed to providing basic skills and remedial education to those unemployed;
- * because of the nature of skills shifts, and continued importance of existing skills and knowledge in "new" production processes, it is in the best interests of individual firms to provide their employees with the training and support necessary to use new technologies.
- * In terms of preserving or improving the condition of the workplace environment, labour's efforts are best directed at addressing organizational changes, not technological change.

5.1 INTRODUCTION

Technological innovation has been the hallmark of Western industrial development in the twentieth century. Its impact upon the labour force and upon conditions of work has been the subject of countless academic studies and heated political debates since the industrial revolution and mechanization of work and the workplace. The central concerns are the ways that firms and workers adapt to technological transformations of production processes.

Each new wave of innovation has introduced new skills to the labour force and posed new training requirements. Questions centre upon the extent to which the existing skills of workers have been made redundant and firms have chosen to alter their skill base through retraining versus the hiring of replacement workers. Technology has also changed the conditions of work, increasing or decreasing the challenge and craft inherent in different jobs, affecting the degree of safety and comfort afforded workers, and altering people's relations to their co-workers and supervisors.

Rates of pay and opportunities for advancement have been influenced by technological change as well.

Questions here centre upon the extent to which technology has improved the human environment in the workplace or led to its dehumanization.

With the advent of another wave of widespread industrial change, this one involving computerization of the production process, these questions are raised anew. Proponents of computer technology cite its capacity to increase productivity in firms, enhance international competitiveness and thus increase the job security of workers. Some claim it will also eliminate the tedium in many jobs while giving workers more resources and comfort on the job. These advocates of electronics promise a bright employment future for the computer literate and able. Conversely, detractors project upheavals in the labour force and the displacement of those unable to learn new skills or those who have become redundant in new production processes. Some predict that the new technologies will prove

deskilling and dehumanizing. They portend that adaptation to technological change will ravage many in the work force.

While not Pollyannaish about the prospects of technological change, we do not anticipate the brutish future anticipated by its doomsayers. Our conclusion is based upon evidence collected in case studies in two industries which address the impact of computer technology. Our results show the firms studied to be quite dependent upon the existing skills and, in particular, the craft knowledge of current workers for operating the new technologies. We find that workers are quite able to learn new skills required for their jobs with minimal retraining programs. Furthermore, we find that firms which previously had a humanistic orientation continue to create conditions of work congenial to human association. When problems do emerge, we trace these to organizational and political factors rather than to any technological imperatives.

These cases become a point of departure for considering the role of government and the private firm in the process of technological change. In the case of employment and skills training, and in the case of maintenance of healthy working conditions, American society has traditionally assigned the public and private sector distinct functions. The public sector has been charged, for example, with providing entrants to the work force the basic skills necessary for employment. In this economy we have also assigned the public sector responsibility for labour force shifts, using a tax on employers to provide financial support to sustain workers making forced job transitions. The private sector, in contrast, has largely limited its role to developing the specific skills needed in fulfilling

production requirements. Firms have also been unrestrained in evaluating market factors and making managerial judgments in decisions on the hiring and displacement of workers.

There has also been a separation of functions as to maintenance of healthy working conditions in American society. The private sector has assumed such responsibilities, as these bear on the retention and motivation of workers. In some instances, such conditions have been negotiated with representatives of unionized workers. The public sector has assumed only the broadest protective role to ensure a degree of safety in the workplace and equal opportunity for workers to gain employment and advancement in firms. It is fair to say that, by and large, government has assumed a reactive function in its protective role, with only minimal participation in advanced planning or evaluation of industrial changes.

The arrival of computer technology has been coincident with shifts in the location of production facilities, the decline in key industries, and, in recent years, the highest sustained levels of unemployment in the postwar period. These factors have led to a reassessment of the role of government and the private sector in managing labour force adjustments. In current industrial policy debates many are clailing upon government to take a more active role in shaping the course of industrial development. There is also a consensus that government needs to begin development of retraining programs for workers whose skills are thought to be made obsolete by technological change. This latter proposal is based upon the assumption that it will be most expedient and economically efficient for companies to replace their existing work force with those who have obtained new general skills in

computerization through their schooling. It is the premise that new production processes will require a fundamentally new set of basic skills that is leading policy-makers to have government assume this training function in our society. Moreover, it is thought that a substantial proportion of the unemployment problem can be addressed through such programs. However, this solution begs the questions. Before legislating solutions to hypothetical problems, we must first pause to ask: Will technological change require new skills radically different from existing ones? Will current workers be unable to acquire those skills? Or will it prove uneconomical for firms to train them? Will new job entrants have a competitive advantage because of a general training in computer skills?

Evidence from our cases suggest that the questions above can be answered with a strong "NO." Indeed, the findings suggest that computerization does not replace the skills of an existing work force and that firms are not acting in their best economic interests by replacing their existing work forces. Instead, computer skills are an "add-on" to existing skills and we thus come to the view that it is more cost effective for firms to take responsibility for training current workers in new job-related computer skills. This challenges the assumption that computerization requires a new set of basic skills, the equivalent of, say, reading and writing, which might be best provided by the public sector. Since computerization does not require a new set of basic skills, nor render current workers' skills obsolete, computer specific retraining programs will not be an effective public sector remedy for current or future unemployment. There is an additional question of government's

responsibility to protect the welfare and well-being of workers during the transition to new production processes. In this paper, we shall look at the rationale for such a role focused on computerization in the 1980s.

5.2 TECHNOLOGICAL CHANGE AND TRANSFORMATION OF SKILL

In the mid-1970s, the development of the microchip enabled tremendous computing power to be put in relatively small devices, and brought drastic reductions in computing costs. This changed the application of computing capabilities: it made possible the use of computers in everything from office equipment to shopfloor machinery and engineering design systems.

Like the new technologies of each age, microelectronic technology is being seen as revolutionizing the current ways of work. Like other technology before it, this technology promises a greater degree of automatic control of production processes, subject to less worker intervention, knowledge and overall involvement in production activity. Recent developments in industrial applications of microelectronic technology have renewed interest in the labour process in many areas - from sociologists and economists to policy-makers, labour leaders and corporate executives. There is intense interest in this technology because it is thought to be unique in the types of changes it will bring to the industrial arena.

It is suggested that the transition to microelectronic technology involves a different skill process than previous types of mechanical technologies. Some studies claim there is a general tendency to reduce the skill level required of the work force, while others see a

greater bifurcation of skill, with rapid declines in middle skill levels of the labour force[1]. Other studies conclude that recent industrialization has caused a general shift in the nature of skills, from motor- and craft-oriented skills to mental and perceptual activities involving a greater span of discretion and responsibility[2]. In white collar and professional work, one study suggests that there is a transition to "new worlds of computer-mediated work." This involves the evolution of qualitatively new forms of work activity. Rather than the active application of knowledge and skill, especially that of judgment and discretion, there is a "secondary application" of work knowledge and skill, mediated by the computer[3]. Manual work is undergoing a similar transition. There is, according to one writer, an "intellectualization of craft knowledge," in which skill is the "capacity not to perform a certain operation by hand but to instruct a machine to perform the necessary manipulations." [4]

Whatever the exact nature of the skill changes, these studies suggest that the changes are qualitatively different than those of previous technologies, and the direction of microelectronic innovation is toward deskilling and rationalizing the workplace[5]. In this regard, the prevalent assumptions about computer technology are:

- (1) computer-based industrial technologies are for automation and, as such, they replace existing skills;
- (2) they thus make obsolete current working knowledge and skills and
- (3) dramatically different new skills are needed for these "computer transformed" occupations.

These assumptions are based on the premise that there is a general leveling of working skills such that knowledge of computer technology is of greater importance than job specific skills. For example, in the computer field, knowledge of computers is considered basic, and its specific applications (e.g., business, financial, medical) are second to that knowledge. It is often assumed that the proliferation of computers throughout industry will transform many occupations in a similar fashion so that these generic computer skills will be the primary requirement, with specific skills being secondary. This is the basis for regarding computer knowledge as a matter of literacy rather than skill. Just as reading and writing are general skills that are transportable, so too computer knowledge and facility is being regarded as a generic skill that will, in part, replace specific occupational and industrial skills. Thus, the direction of current legislation is to have the public sector provide general computer skills as basic training. In the following sections we will address the underlying premises about the impact of microelectronic technology on skills and quality of worklife.

5.3 THE CASE OF SKILLS

To examine these theories about changes by computer technology, and to provide some answers to basic policy-relevant questions, we have drawn on our research projects which deal with the impact of several types of computer-based technologies in three different types of firms and six occupational groups. The firms are a legal books publisher and aerospace company and several electronics and computer manufacturers. The technologies are

Computer-Aided Design Systems used for mechanical engineering and electronic components design, word processors, personal computers and a Management Information System.

The methods of study are:

- (1) interviews with workers and observation of work tasks in the legal publishing firm and on computer-aided design systems in aerospace, computer and electronics firms; and,
- (2) quality of worklife surveys of users and non-users of the technology after its introduction in the legal publisher for three different technologies; word processing for legal writers and editors; statistical analysis on personal computers by managers; and a mainframe based Management Information System for accounts, collections and customer service personnel.

Computer-Aided Design (CAD) systems promise to bring the most radical change in skill requirements of an occupation. The CAD system is used in drafting and electronics design for drawing and analysis. The system consists of a graphics computer screen connected to a computer, providing an electronic drawing board which enables the designer to draw and redraw his or her design by pressing a few buttons or typing in a short set of instructions. This has virtually replaced the drafting board and the need to draw by hand.

While the computer graphics capabilities speed up the drawing process, it is the automatic software routines for design that promise to transform the occupation. The descriptions of CAD proclaim that it can "perform complex engineering analyses; automatically detect design errors; automatically revise all drawings and documentation; in

short, CAD/CAE streamlines and integrates the entire design, engineering and construction process..."[6] The "CAD (software) may even propose designs. (It will) suggest a layout after the designer specifies what a (computer) chip (that he or she is designing) should do." The hand drawing of an electronics component is no longer necessary: the "tedious and long job of drawing all the connections for a 150,000 transistor chip is done automatically by pushing a button..."[7]

The essence of this computerization is a substantial occupational transformation. These automatic routines, in theory, obviate the need for design skill and substitute a less skilled yet complex training in procedures for the operation of CAD. According to its formal design, CAD transforms what was "user" knowledge, that is, knowing how to design and use the system to accomplish this task, to "operator" knowledge where the job consists of knowing a complex set of operations in order to run the machine. This will potentially transform the design process from board design to CAD operation; that is to say, the skill of designing a board is embedded in the systems software so that an understanding of how to operate the CAD system will allow the operator to produce the board with the minimum of design skills. This would substitute a more generic set of computer skills for the specific knowledge of a particular type of product design.

However, the lofty designs for automation are far from becoming reality. None of the companies' studies was able to truly transform the design tasks as the CAD literature or electronic soothsayers predicted. Most design applications are very complex and exceed the automation capacities of the CAD systems. CAD produces designs which are often

inefficient, not even equal to designs produced by a novice designer. Designers interviewed unanimously felt that CAD extended their design abilities, but was only a tool, for their use, not a replacement for their knowledge, skill and experience.

Because of its complexity, the design task is not amenable to rote design by a machine. Even in the simplest boards there are a tremendous number of connections and possible permutations which make a computational approach to design impossible. Instead, "problem-solving" algorithms are used, but electronic problem solving still pales beside the best of human problem solvers. Thus, the design process still requires the intelligence, skill and ingenuity of a human designer. There was not one instance where experienced designers were successfully replaced by "CAD operators."

When CAD was first being introduced, however, there were some who believed that the computer revolution had fulfilled its promise. There were two instances where companies attempted to use CAD to automate their design process. The first brought in CAD operators to do PC board designs on their newly acquired CAD equipment[8]. These CAD operators had little design experience and were expected to take over the work of the experienced designers who did not know how to use the CAD system, and who were paid a great deal more. A second company, an electronics firm, had been doing only the engineering of the boards and then having the design and production done through an outside vendor.

Both of these companies failed miserably: the first was unable to put a board into production until it brought some of the experienced designers into the department, while

the second company, unable to get a single board out in 18 months - even after they brought in an experienced board designer and CAD trainer to help their operators - closed the department, sold the equipment and went back to using an outside vendor. The failure of the anticipated deskilling and obsolescence of the designer's knowledge, training and skill was explained succinctly by one CAD trainer who said, "Sure, you can train a clerk to become a CAD operator and design a board... but it'll look like a board designed by a clerk!" These companies failed because they drastically reorganized their production process in accordance with the promised or theoretical capabilities of the CAD systems.

These companies' failure to use CAD effectively stemmed from their approach to automating the design process. Other companies avoided similar failures only because they had experienced and highly skilled designers who used these systems to supplement their skills. Since CAD does not replace the designer or the need for his or her experience, CAD systems have to be introduced into the existing production process, utilizing the existing workforce. The retraining necessary to operate these complex systems was surprisingly minimal. The average training period was two to three weeks to learn the basics of the system. This usually consisted of three to five days of training classes - either in-house or through an outside vendor - and a couple of weeks of practice. Sometimes they returned to classes for two or three days of advanced training, but usually they were able to progress on their own, with occasional calls to the trainer for assistance. After four months in most cases, and no more than six months in any of the cases, the designers felt they had fully mastered the system and had fully integrated

it into their work.

In interviewing managers in electronics companies we inquired about their hiring practices. They uniformly said they would hire someone with two to three years of traditional design experience over someone just out of school but who knew the new technology. They were opposed to the substitution of new technology training for traditional training. In fact, some said that it should only be supplemental training after the designer had some design work experience.

The point here is that computer training should not be used as a substitute for understanding the basic principles of design. The CAD system transforms work such that these systems are an indispensable tool, but they do not replace the skill of the worker. The acquisition of the requisite computer skill to use a CAD system is a marginal addition to the skills and knowledge of an experienced designer, well within the grasp of those currently employed.

In the legal publishing firm we find automation systems that promise to transform both the style and substance of office work. The systems used by this firm are representative of different types of technology that are expected to transform much of the world of white collar work. Finding a terminal or computer on nearly every desk, even the casual observer notices the dramatic changes in work tasks. In our interviews and survey, we focused on the skills and training required to effectively employ this technology.

The legal publisher has a staff of lawyers who write their legal publications and editorial assistants who copy edit the work. Within the past two years the company has introduced a sophisticated word processing system for the lawyers/writers and editorial assistants.

This has required both the lawyers and editorial assistants to use the word processing system for all of their work. This transition was made relatively easily, with in-house support staff conducting short training sessions and providing consultation.

The significant impact of the computer here was not the change in skills, for this involved relatively minor skill acquisition, but the shift in tasks. The lawyers previously gave all their writing, editing and corrections to the editorial assistants to edit, proofread and type. With the word processor, they now enter their text directly on the system. This has not changed the substantive knowledge necessary to write legal texts, but added new skills and tasks to their job. For some of the lawyers/writers these new tasks are not welcome, but the overall improvement in writing on a word processor and the faster editing turnaround proved to be a beneficial change.

In addition to word processing changes, the editorial assistants have had a more substantive change in their job because of changes in the production of the manuscripts. They are now using photocomposition methods of printing which necessitates entering typesetting codes into the manuscript. These are codes which define page formats, type style (e.g., italics, boldface) and other instructions for determining the final format of the book. This has required that they learn these typesetting codes and acquire a broader understanding of the final format of the book and the production process. The acquisition of these skills required training beyond learning the word processing system, but it posed no major obstacles for the editorial assistants. In fact, they were generally positive about learning this new skill

for it made the work more interesting and added more variety to their job. One editorial assistant commented, "I recently began working on computer/word processors and that has given me something new and different to work with for the first time in several years." They saw this as an advance from "using nineteenth century methods to edit and produce books." These added duties were recognized by the company through advancement and pay raises.

In the credit and collections department of the legal publisher, a mainframe-based management information system was introduced to record and track all customer information. Before the introduction of computers all customer information was recorded by hand on large index cards and required the collector to sort through these cards in filing cabinets. Over a weekend new computer systems were installed and the collectors were instructed on its use in several hours. Beyond occasional problems in the system, they reported no problems in operating the computer and obtaining information. They found that this enhanced their work by giving them more information about the customer's account and the company's production and billing process. One collector found that the "new computer system provides us more information about what books have been shipped to the customer from the warehouse, all payments received up to the past 24 hours, and lets us put holds on all shipments to delinquent accounts." With all information and instructions "on-line," the collectors and service representatives now have direct and immediate control over a customer's account.

The impact of the computer system in this department goes beyond the technical changes in information handling. By tying them into the company-wide information system they

become part of an integrated production process, expanding their knowledge of, and participation in, the workings of the company. Although the computer system made the use of information easier and automated certain functions, the change in job tasks is an increase in responsibility, which also increases the importance of their role in the company. In terms of training in the publishing company and the electronics and computer firms, we found that driving their quest for computer skills was a substantive interest in the job tasks, not an interest in running a computer for its own sake. That is to say, computer knowledge was subsidiary to education and training in the particular occupational field. Moreover, the automating aspects of this computerization of the company involved the simpler tasks of the job, and in some cases increased the importance of the tasks they were now doing. This underscores the findings of other studies which also conclude that computers eliminate some of the drudgery of a job, but do not automate the substantive aspects of its performance. Thus, bringing computers into the office does not appear to replace the significant skills of workers or introduce substantial transitional barriers for the current work force.

5.4 THE MYTH OF AUTOMATION

The assumption of automation is that technological development will be able to largely remove the necessity for humans in the production process. The two fundamental premises are that performance of work tasks can be specified and rationalized, and that production processes are basically static. Although the formal engineering world may be subject to precise analysis,

measurement, specification and prediction, in practice there are unexpected contingencies; development of skills that are not formally required to do the job (and thus not identified as part of the task), yet necessary for proficiency; and non-rational (and not easily, if at all rationalized) aspects of a task that depend upon intuitive problem solving, informal skills and a "feel" for the proper performance of the job.

Rather than automating skilled occupations, the inherent difficulties of rationalizing complex work processes means that it is the simplest tasks that will be automated. The designers interviewed generally found the autorouting routines successfully routed about 40 percent of the connections on the board. However, since it was the simplest 40 percent of the total number of connections, it automated a much smaller proportion of the overall design process. Secondly, computers require that all tasks and operations be rationalized, allowing the application of fixed rules or computational procedures, not the exercise of "judgment." It is therefore the tasks which are already the most rationalized and capable of rote performance that will be most readily amenable to computerization. Thus, what the technology is relatively effective at doing in board design is automating the least skilled work - the simplest connections - leaving only the most skilled aspects for the designer.

In the legal publisher, the word processing and rewriting capabilities now available for the lawyers and editorial assistants allowed them more time on the substantive tasks. In the credit and collections department, the computerization of record retrieval and recording provided the collectors more time to focus on the challenging

aspects of their job and expand their role in providing customer service.

In all these industries and occupations we find that, as a proportion of the worker's time, computerization allows him or her to increase the amount spent on the more complex tasks and the exercise of his or her experience and judgment. Moreover, there is no transformation of existing skills. There may be some changes in how the skills are applied, but not their substantive content or their acquisition.

In the use of CAD, the case is often made that the limitations and problems are just temporary "bugs" in the system, and as soon as they are fixed we will see microelectronic technology having a drastic impact on skills and the organization of work. In office automation, the truly paperless, peopleless office is expected to arrive with the next generation of "thinking," "speaking" and "hearing" computers. It is for these developments that we must plan, so the futurists and policymakers explain.

These assumptions about skill changes and the impact of technology rest on the notion that the technology is applied to a static production process with only the new technology changing. This assumption leads to the claims that these interim problems and reliance on workers' skills and knowledge are idiosyncratic, eventually will be solved, and thus obviate the need for future worker initiative. Particularly during periods of intensive innovation, but also during "normal" operation, most sophisticated production processes are experimental and in constant evolution. A few recent studies of industry and technology have noted the ever changing, dynamic nature of innovation and production and the

need for human agency to solve shopfloor contingencies[9]. It is more often the exception than the rule that a production process remains static.

The view of technological innovation as the only dynamic change does not take into account the interplay between a new innovation and process and product changes. A new technology is both a response to, and spurs on the development of new products and processes which also increase in complexity. In terms of production process changes, microelectronic technology has greater capabilities than any previous technology and, consequently, the range and complexity of its proposed applications are also greater than those of any previous technologies. Although CAD systems make drawing and redrawing 20 times faster, designers experiment with five or ten times as many designs. In the legal publishing firm, the speed and ease of changes on the word processing system encourages lawyers to do more revisions and make more detailed corrections. It thus raises expectations for the appearance and quality of final manuscripts. Although the word processor dramatically reduces the time editorial assistants spend making editing changes, the direct link between the word processor and photo compositor adds new responsibilities to the editing position. Copy editing now includes entering the formatting codes to produce camera-ready copy. Thus, some or much of the potential productivity increases are absorbed as the design process changes.

In terms of product changes, the greater capabilities of microelectronics also extend the range of possibilities of what can be produced with the new technology. For example, the extraordinary tolerances and multi-axis machining possible with numerical-controlled (NC)

machinery result in the production of qualitatively new products. Although at the time when it was first developed the automatic functions of NC had the potential to automate the machining of some types of parts, new types of products and more exacting specifications for existing products quickly exceeded the auto-mating potential of the new machinery. While the tremendous capacity of computer-controlled machine tools might easily have the capability to automatically make aircraft parts for the Kittyhawk, they are being applied to the production of infinitely more complex parts for the space shuttle, the F-15 and Boeing 767. Similarly, with CAD we are not applying the enormous capacity of microelectronics to automatically design vacuum tubes, for that would be akin to killing flies with an elephant gun. With the development of CAD we find that the design and production of new products, such as VLSI chips and much denser and complex PC boards, is possible.

In office systems we also find new developments in the nature of the products and services provided. In the legal publisher, it is only with the ease of making changes and updating publications with the word processor that they will be able to profitably keep abreast of the enormous number of, and quickly changing, laws and regulations they write about. As mentioned, the editorial assistants now produce a copy that will go directly into print. With the old methods of type setting, some of the copy editor's errors would be corrected by the typesetter, and typographical errors were rather minor errors of an occasional misspelled word. With photo composition a typographical error in one of the special characters used for formatting the text has much greater ramifications. For example, typing in the wrong character for closing a

footnote might result in 50 pages of text being printed as one footnote. The use of computers in the editorial assistant's job thus was not limited to automating the tasks of manual copy editing, but transformed their product from a manuscript to be typeset to an electronically stored file that went directly to the printed page.

The most effective use of computer technology is not in a manner which supplants old skills with new, lower-level skills, nor with exotic computer skills. Rather, the most effective use of new technologies is that which builds on the old skills. Design skills and experience are still critical to the design process, though the use of the knowledge and skills are different on a CAD system. Office computer systems have not automated substantive aspects of work as the knowledge of law and copy editing is still vital. These new systems require the acquisition of new technical skills, but these are incremental advances of the existing skills. The most significant changes may often be the non-technical ones as new tasks and greater responsibilities are added to existing jobs.

The notion of "obsolescence of skills" is wrong. As an engineer said, "Ohms law isn't obsolete. Neither is the law of gravity - apples still fall down!" Skills are not supplanted, but transformed and added to. There is still a need for basic knowledge, although its application may be different. For that, workers need to learn additional skills, but this is not a substitution of skills. Moreover, technology-specific skills are but one component of a matrix of vital skills and knowledge about both the production process and the organization. As our research finds that major upheavels of production processes do not occur, we find the technological

change to be an incremental addition to the skills and knowledge that workers have, and as new responsibilities are added they build upon the existing skills.

5.5 TECHNOLOGICAL CHANGE AND THE TRANSFORMATION OF THE WORKPLACE

Apart from its impact upon the skill base in firms, computer technology has also been projected to fundamentally alter the conditions of employment in organizations. Its great promise is to increase efficiency by substituting machine time for human time in calculation and calibration. This logic surely applies to the CAD and word processing applications studied here. In addition, computerization can be applied to information management and result in providing both workers and managers with more timely and accurate information needed to do their jobs. Applied to scheduling and monitoring systems it can also smooth work flows, improve coordination, reduce "fire-fighting," and rationalize the production process.

There are potential problems with computerization already noted in field studies and specified in the literature. One consequence, discussed as it bears upon skills, is the deskilling of jobs leading to the substitution of lesser skilled labour. Even without such substitution, however, jobs can be made less challenging, and more routine and repetitive, through automation. This is evident in the factory where robotics can supplant craft knowledge and the role of "feel" in the production effort. CAD and word processing also have the potential, once skills are mastered, to routinize work and eliminate through rationalization and standardization, creative potential. Another

consequence concerns a decline in comfort and safety on the job. Workspaces may become cluttered and ill-adapted to human physiology; constant monitoring or interaction with a computer screen can produce eyestrain and stress. Coupled with routinized, machine-paced work, this can dramatically increase overall job stress. One final consequence of computerization concerns a change in social relations. Since the computer becomes the source of information and communication, there may be less contact between co-workers. The centralization of a data base and development of electronic mail systems and the creation of work stations that create word processing pools further reduce the need for person-to-person contact.

Other changes in the work environment are technologically oriented but managerial in application. As an example, computerization can enrich jobs when used to link tasks into an integrated whole. It can also segment jobs much as earlier technology spawned the assembly line. The decision as to how to divide work is a managerial choice. The acquisition of new computer skills can enhance employees' value to a firm, and their increased productivity can warrant a larger pay rate. Whether to increase pay is, again, a managerial choice. Finally, computer technology can influence opportunities for advancement. Certainly the acquisition of word processing skills increases the marketability of clerical personnel and the development of programming knowledge can open new job vistas for operators. What career routes develop within a firm is, however, fundamentally a managerial, as opposed to technological, matter.

Does the introduction of computer technology alter the conditions of work in an organization? Data collected from the publisher addresses

the impact of computerization on jobs, the work environment, control, and motivation as well as on performance within the firm.

5.6 THE CASE OF WORKPLACE CHANGE

Data from three separate user groups, using three distinct technologies, helps to illuminate changes in the work environment related to computer technology. These data come from a survey administered in the organization eight months to one and a half years after the introduction of computer technology. The first set of data come from editorial assistants using an advanced word processing system. Table 1 shows their ratings of the impact of this technology upon their job resources and motivation, their development of skills and chances to advance, on their work environment and its control and, finally, their view of its impact upon their work and the organization. The measuring scale ranges from a positive impact (a score above 4.0) to a negative impact, with 4.0 on the scale representing no substantial change. To some degree, the editorial assistant users find benefits of computerization in their access to more relevant information and in the increase in variety and interest in their work. Note that these operators also learned new skills on the job and reported a slight increase in their chances for advancement in the firm.

There is a downside to computerization for them, however, as users report less contact with co-workers and less safety on their jobs. Significantly, they report more accountability for their work and closer supervision of it, but they also report feeling slightly less responsible for their jobs. The word processing system has enabled

them to do their jobs better. It has eliminated tedious re-typing of manuscripts and allowed them to have more interaction with authors during the process of manuscript preparation. At the same time, supervisors in the firm now monitor their production more closely and this may have decreased their sense of responsibility for progress of the manuscripts.

The editorial assistants in the company find the technology has had a positive impact on production and workflow and made the company more effective in its operations. They see less benefit in an improved quality of work life in the firm. What limits this perception of benefits? For one, their workload remains demanding and there has been scant change in the repetitive and routine aspect of their job. Second, their supervisors now have the capacity to more fully monitor their efforts. Finally, concerns over potential hazards in working with the technology and a loss of contact with co-workers may have dampened the overall appeal of the technological change. For these editorial assistants, then, technology is primarily a work aid that adds to their work resources and increases, to some degree, the motivation inherent in their jobs. It has not significantly altered the human environment of their work - either positively or negatively.

The next set of data come from clerical workers using the company's mainframe computer. These personnel report many benefits from the new technology, as Table 2 records. It adds to their resources and motivation and has a decided and positive impact upon production. Significantly, this technology has given them a more complete job as those in credit can now oversee the entire billing process and make adjustments to customer accounts on-line. Those

in the accounting and finance area are able to use several data bases in compilation of financial reports. For both groups, no notable problems were reported as concerns safety and contact with co-workers. Indeed, they register positive scores on overall impact on quality of work life.

The final set of data come from managers using personal computers for financial analyses and production planning and linked by a tele-mail communication system. These users also report generally favourable results from computerization. Significantly, computerization seems to have added to their workload. It requires them to do more planning and to communicate more regularly with others over the tele-mail system. One can no longer buy time by attributing delays to the postal service. The computer also seems to have had little impact over their control of work. The decentralization of the personal computer application has been consistent with their decentralized management structure.

What can be said of these data? Overall, they suggest that computer technology is not only a work aid that builds upon existing skills, but also an important resource for performing their jobs, and one that adds to the intrinsic appeal of their jobs. This addition is greatest when associated with combining work tasks, as in the case of the clerical personnel, or with the addition of meaningful duties, as in the case of more detailed financial analysis for managers. The costs to the human environment, in a loss of safety and contact with co-workers, was noted by editorial assistants. Significantly, steps have been taken to respond to these concerns throughout implementation of the word processing systems in their areas.

5.7 THE ROLE OF IMPLEMENTATION

The favourable results cited by personnel in the publishing firm, and the favourable impact on production, stand in sharp contrast to the results in two of the CAD cases. Partly this is due to the managerial strategies for technological change in the two studies. In the case of CAD, an explicit strategy of management was to plan for deskilling and the replacement of skilled designers with those of lesser skill to simply operate the machinery. We found the designer's craft knowledge essential to effective use of the systems. At the publisher, by contrast, the systems were introduced as a work aid and aimed at building on existing skills.

More broadly, managers at the publisher involved users in the actual design and implementation of new systems. Some 96 percent of the users reported that they understood the reasons behind the introduction of new technology, and the great majority felt the firm chose the right equipment and allocated it correctly. Some 50 percent said they were consulted appropriately about the system introduction, and most felt well-trained and adequately supported in making the transition. Significantly, managers and clerical personnel gave the highest marks to training and technical support. Editorial assistants gave this a lower rating, and this may account for part of their discontent with the new systems.

In addition, the company made changes in compensation for some key operations and worked with their employees to ensure that working conditions would be suited to their physiological and psychological needs. Changes in job designs were implemented as feasible and appropriate.

The broader point is that

technology does, to some extent, create changes in the work environment. Sensitivity to human factors and consultation with users can minimize some of the undesirable consequences. Management choices, as concerning work design, compensation, career planning, and general working conditions, make a difference in determining the impact of computers upon people. The question this poses is whether private firms have the knowledge and incentives necessary for making the transition to computerization effectively and humanely, and what role the government can play in this transition.

5.8 IMPLICATIONS FOR PUBLIC POLICY

The impact of industrial technological change on the labour force and workers' abilities to adapt has been the subject of federal studies from the U.S. Commissioner of Labour's 1898 report on "Hand and Machine Labour," to several 1930s Congressional studies of "labour-saving technology," to a plethora of studies on automation and cybernation during the late 1950s and early 1960s.

Most of these studies, however, have not resulted in effective public policy. In fact, the Manpower Development and Training Act (retraining legislation enacted in 1960 in response to technological displacement fears aroused from studies in the 1950s) was completely misguided. What was discovered was that there was no significant need for retraining of technologically displaced workers as those that were displaced had little problem making the skills and employment transition, and in any event they were not a significant proportion of the unemployed. The programs established under this act were unable to fill enrollment quotas and became

effective only subsequently, when reoriented to provide basic skills to the chronically unemployed.

In the past five years we again hear the familiar prediction of yet another industrial revolution that will make the current workforce obsolete. Once again the retraining of technologically displaced workers is the focus of much public attention and policy, without so much as a footnote to the lessons of past retraining experiences and research. In the United States, the Reagan administration more than doubled 1984 federal funding for retraining programs over 1983 levels, and Congress is considering "Individual Retraining Accounts" to provide lifelong retraining opportunities for all workers. In Canada, a recent governmental task force concluded that,

Existing public and private training initiatives are found to be inadequate to meet the massive re-training needs resulting from rapid technological and structural changes... Given the pace of technological and structural change, the challenge before us is obvious: we must put in place mechanisms and policies to ensure the achievement of needed levels of training and retraining[10].

Presumably to address this need, there is government funding for a "Skill Investment" program "to enable workers to obtain new skills in response to changing technology." It will be "training focused on occupations sensitive to technological change." Similar to the Individual Retraining Accounts proposal in the U.S., this grant will also explore "the feasibility of options to help workers save for future training/education costs, which would be designed to help individuals help

themselves."[11]

While legislation is being drawn up to implement such programs, and there is a great deal of discussion over tax incentives and other means of financing retraining and labour force adjustments to technological change, it is based on little understanding of the processes of technological displacement, effective ways for workers to make the transition to working with new, computer-based industrial technologies, or assessment of the need for retraining.

The implication of our findings is that when process technologies change, skills are rarely supplanted, but rather transformed and added to; the change is incremental because production processes inherently change very slowly - the experimental nature and limitations of new technologies preclude a radical reorganization of production to the theoretical specifications of design engineers (and the more complex the technology the greater the limitations); and finally, it should be noted that the production system is not technologically determined but the result of a dynamic process with many changing dimensions. Despite technological change, organizational and production process specific knowledge continue to be important. The introduction of computers requires an addition to existing skills, but these are incremental advances well within the reach of the current workforce.

The overriding emphasis on government sponsored retraining programs, especially in the United States, is the result of insufficiently analyzing the impact of computer technology, and avoiding expenditures which are politically unpopular. To effectively address unemployment requires greater planning on the macroeconomic level and providing the basic skills and education needed by new entrants to the

labour force and the long term unemployed. In an era of retreat from the state's commitment to ensuring the welfare of the disadvantaged, programs to aid those who have inadequate education and basic skills are suspect as extravagant programs for those who failed to help themselves. Alternatively, the proposed technology retraining programs which receive the most political support are these programs that target a population which will curry the sympathies of the voting public: namely, programs for middle-income workers who have a long employment history in the basic industries and, through no fault of their own, have become victims of industrial progress. Moreover, the assumption is that the technological advances have outpaced workers' capacity to adapt and the ability of private companies to provide them with the necessary training.

As discussed, we find that the technological transition will not require a major commitment of government retraining funds. Such programs, while politically popular, are doomed to repeat the history of past retraining program failures. Instead, we suggest that current unemployment, as well as that in the coming decade, will be best addressed by government reaffirming its role of addressing the deficiencies in basic education and skills among the unemployed.

Insofar as there is a need for

retraining, our research suggests that the private sector recognize the continued importance of the specific skills and experience of its existing workforce. In so doing, expenditures for training and workplace improvements can be treated as investments in human capital that have a significant material payoff. Indeed, research in human resource accounting suggests that such investments may yield a greater return than investments in other capital assets. This perspective is complemented by changing demographics in the U.S. population. Quite simply, there will be fewer workers available for employment in the mid-1990s, so the retention and development of current resources becomes ever more important to organizations today. Furthermore, this investment strategy is compatible with business strategies emphasizing greater flexibility in production and more quality in final goods and services. International competition has increased the importance of skill performance over sheer increases in the quantity of output.

These strategic requirements demand a more broadly skilled and loyal workforce. It is only through an explicit commitment to their employees, especially as it means providing them with necessary skills for continued employment and career development, that individual firms will be able to meet the challenges of the next decade.

TABLE 1

Impact of Computer Technology on Editorial Assistants

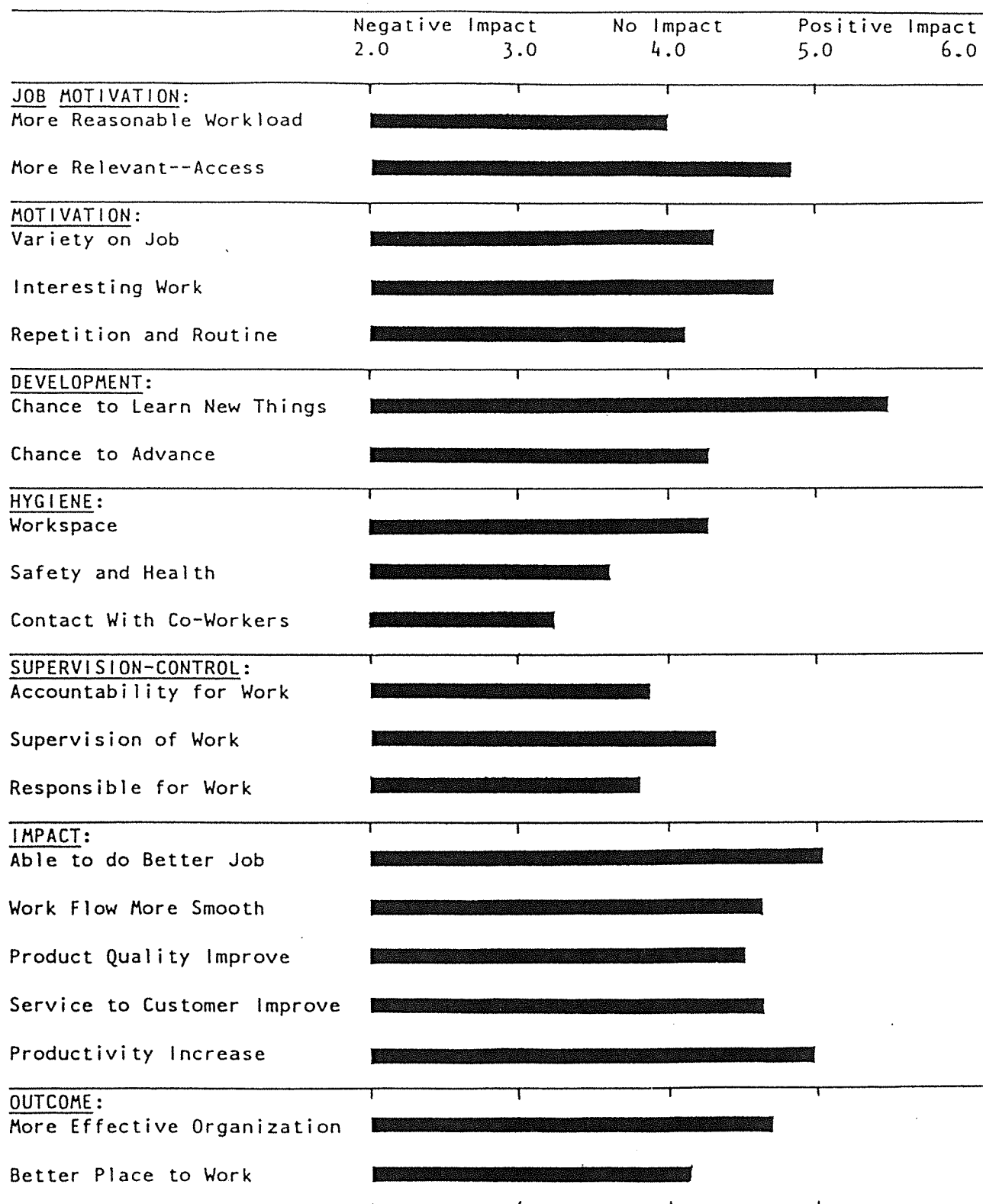


TABLE 2

Impact of Computer Technology on Credit and Collection

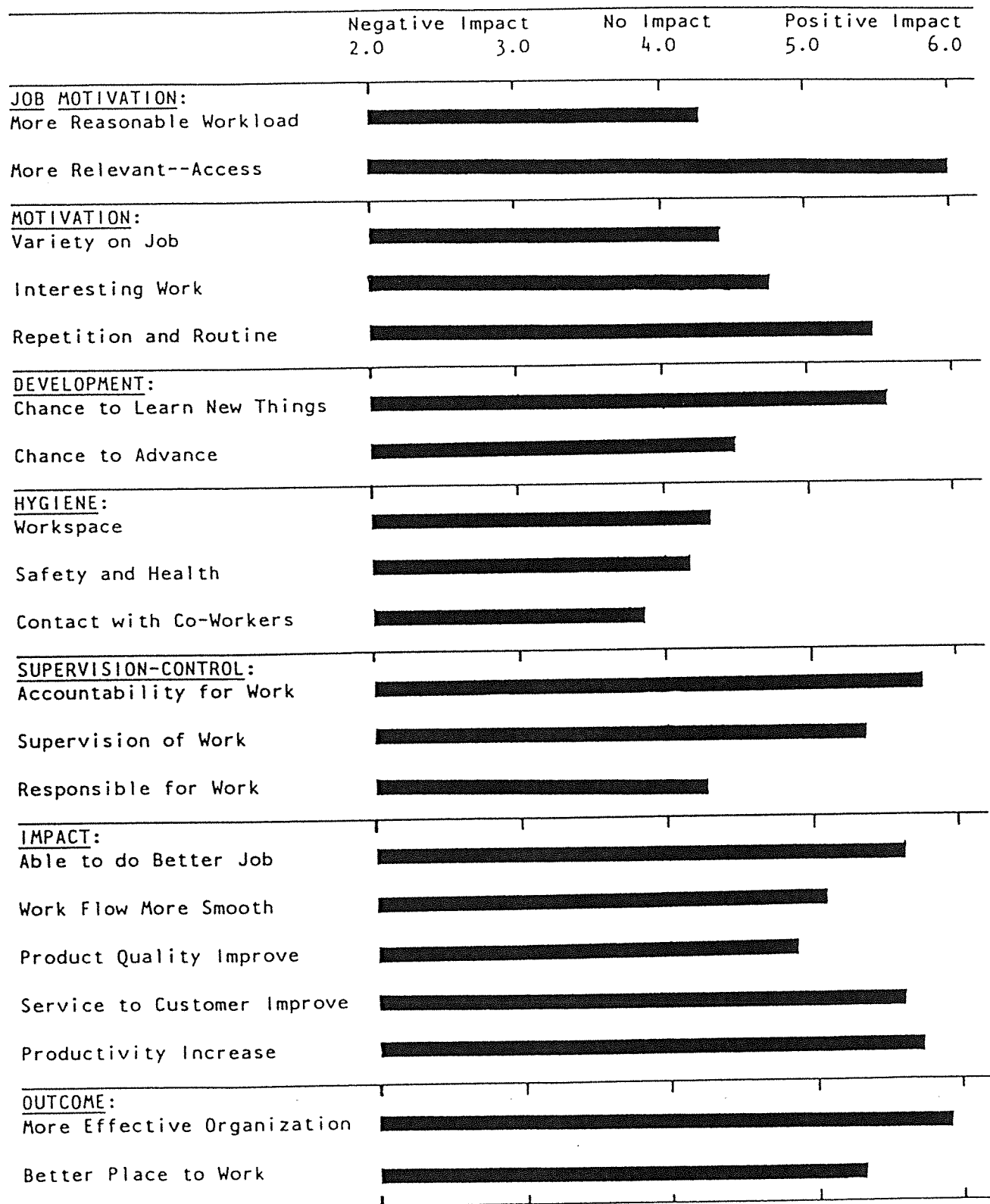
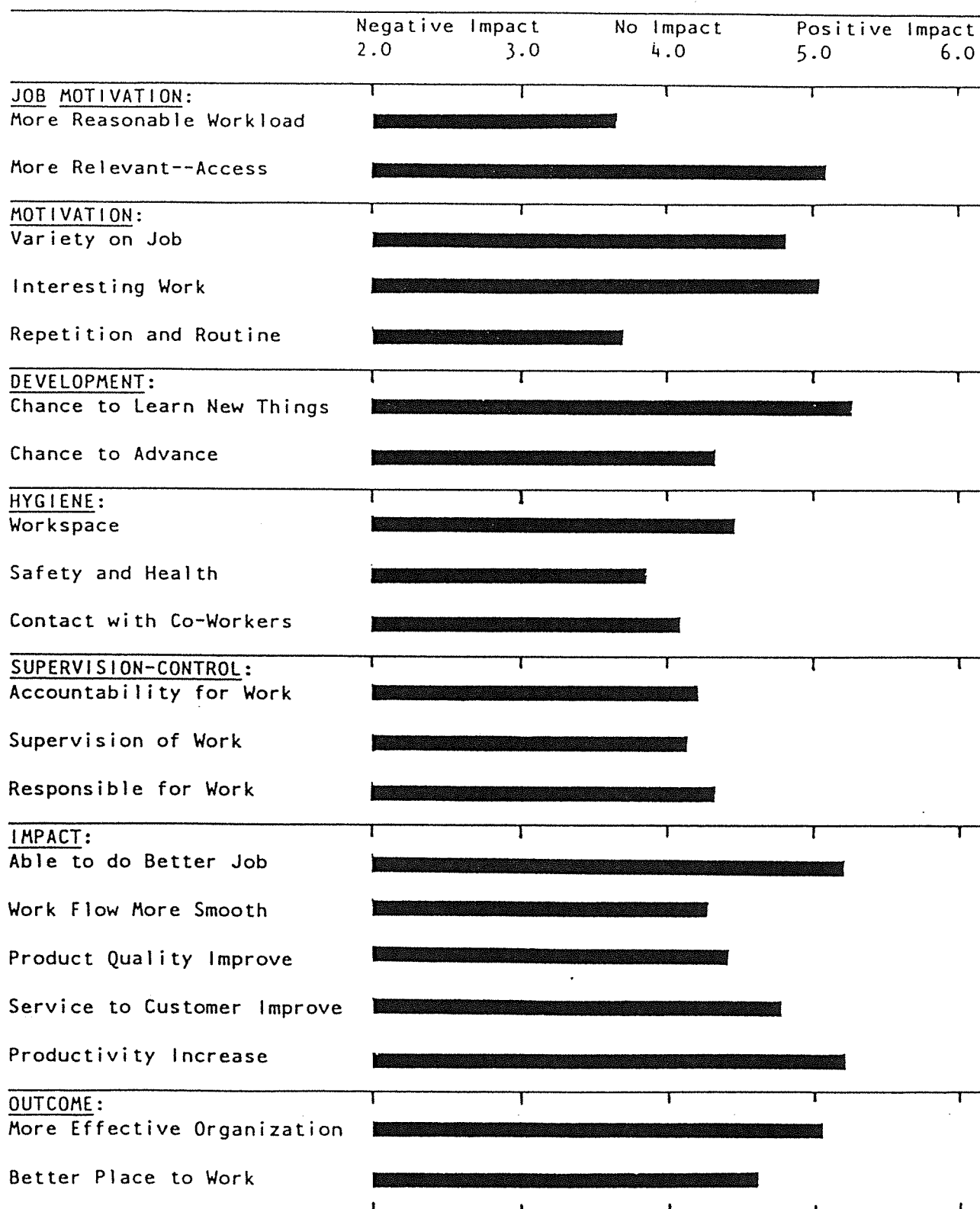


TABLE 3

Impact of Computer Technology on Management



NOTES

- [1] Robert T. Lund, "Manufacturing Technology and Human Resource Policy," testimony before joint hearings of the House Committee on Science and Technology, June 9, 1983; Bob Kutner, "The Declining Middle," The Atlantic Monthly, July, 1983.
- [2] Louis Davis and James Taylor, "Technology Effects on Job, Workers and Organizational Structure: A Contingency View," in The Quality of Working Life, L. Davis and J. Taylor (eds.), New York, Free Press, 1975.
- [3] Shoshana Zuboff, "New Worlds of Computer-Mediated Work," Harvard Business Review, September-October, 1982.
- [4] Charles Sabel, Work and Politics, Cambridge, Mass., Cambridge University Press, 1982, p. 67.
- [5] The most prominent spokesperson of this position is Harley Shaiken. See, for example, "The Automated Factory: The View From the Shopfloor," Technology Review, January, 1985.
- [6] Computervision Brochure, "Powerful New Tools For the AEC Market."
- [7] "What is CAD?" PROTO v. 3:1, 1985, p. 13.
- [8] These were not board designers or CAD users, as the designers who use CAD refer to themselves. As was discovered during the interviews, this seemingly minor semantic difference was actually of great significance, indicative of their perception and attitude about the impact of CAD and the skill level of designers using it. No one who actually used CAD or worked closely with CAD designers, used the term "CAD operator," referring instead to "CAD users." The significance of this is that a CAD "user" refers to someone who uses CAD for his or her purposes, as a tool to enhance his or her skills, while CAD "operator" denotes someone running a machine, not employing his or her skills for a particular task with the aid of the machine, much like a computer user is different than a computer operator. The emphasis becomes particularly important in the kind of training and orientation one takes: if one sees designing as the function of a CAD operator, then the focus is on someone whose primary training is in the operation of the system, versus a CAD user whose training is as a designer who can use a CAD system.
- [9] Larry Hirschhorn, Beyond Mechanization, Cambridge, Mass, MIT Press, 1984; Ramchandran Jaikumar and Roger Bohn, "Production Management: A Dynamic Approach," HBS Working Paper, April, 1984; Marjory Blumenthal and Jim Dray, "The Automated Factory: Vision and Reality," Technology Review, January, 1985. Paul Adler, "New Technologies, New Skills," Harvard Business School Working Paper, May, 1984.
- [10] Progressive Conservative Party of Canada, "A Task Force on Technological Change and Manpower Retraining," April 7, 1984, p. 2-6.
- [11] "Six New Orientations For Em-

ployment Strategies," February
14, 1985.

The Role of the Schools in Preparation for Work

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6.1 INTRODUCTION AND CONTEXT

Few public issues have received more attention in the past couple of years than youth unemployment and its related questions - the role and quality of secondary schools, the role of post-secondary training, and the overall relationship between education and employment. The very fact of a conference on Transitions to Work speaks to the concern of a variety of interests - government, employers, labour, educational institutions, and, of course, young people themselves.

Despite widespread agreement that high rates of unemployment and job dislocation among young people are here for some time to come, there is no shortage of proposals as to what could be done to alleviate the problem. Multiple remedies have been proposed. Reforms in education have been suggested, including tougher standards and more vocational emphasis in secondary schools, more apprenticeship and other skill training, and changes in the relative priority of various university programs. There has even been suggestion of an educational voucher plan at the post-secondary level, in which students, rather than institutions, would be funded.

Similarly, there have been a variety of ideas about the role of young people in the labour force itself. These have included wage subsidy programs, programs to encourage entrepreneurship among the young, programs to deal with school drop-outs and other "hard-core" unemployed, and even the proposed abolition of minimum wages for young people.

There have been two difficulties with much of the public policy debate on this matter so far. First, there has been little attention to evidence. While ideas have abounded, few have been supported by careful consideration of what their likely effects would be. And there has been little evaluation of those initiatives which have been taken, so that evidence is not as available as it might be. (Parenthetically, it could be noted that this is hardly surprising; public policy questions often focus on the need to do something rather than examining the value of what has been done.)

The second problem is a related one. It has to do with the weak conceptualizations of the issue of transition to work. Few of the policy proposals which are made are based on an explicit formulation of the problem, such that key variables

can be identified which are amenable to some policy change. For the most part the debate is among advocates, who have taken positions in which a very few elements are singled out as being critical, and little attention is given to examining the entire phenomenon in all its complexity. If one considers the arguments for many of the programs and policies mentioned earlier, for example, it can be seen that they are almost all based on simplified frames of reference which presume that a single program or policy will make major and significant changes.

This paper seeks to contribute to the debate on transitions to work by focussing on one segment of that transition - the contribution of secondary schools in relation to what happens to young people after they leave high school. The paper is based primarily on Canadian research on this issue, but has also been influenced by other conceptual and empirical work. The main studies are concerned with high school students' intentions[1], and with their actual activities after leaving secondary school[2]. The paper will define a number of major policy issues which arise from this research, and will conclude, with due caution and humility, by suggesting some policy consequences of this body of research relating to the ability of schools to do better in this area.

6.2 AN OVERVIEW OF FINDINGS

It is not the intent of this paper to describe the findings of various studies in any detail. Rather, three major issues which arise from the studies taken as a group are presented and defined.

1. Students' plans for post-high school activity are quite varied.

Although this might seem an evident conclusion, its import, as we shall see later, has not always been adequately considered. The fact is that high school students in Canada indicate a variety of pursuits which they might undertake. Only one of these, it is important to state, is post-secondary education. Best estimates are that only about half of the graduating class in any year (and these, it should be noted, are only about 75 percent of their grade 9 cohort) intend with any degree of definiteness to go on immediately to post-secondary education. The remaining half report that they intend to go to work, or that they are undecided. Moreover, of those intending post-secondary a substantial portion (it would seem about a third) want to attend a college rather than a university. The high school population, then, can be divided into four groups, each of which is relatively large - those intending to go on to university; those intending to go to a college; those intending to work; and those who do not know.

2. Students' plans are very frequently subject to change.

Studies are unanimous in noting that students' expressed intentions while in high school do not correspond very well with their subsequent actions. At the aggregate level, students' intentions are indeed borne out. That is, post-secondary enrolment in the fall is about what one would expect from surveys of students in the spring. But - and this is a crucial point - very often the students going are not the ones who said they would be going. At the individual level, expressed

intentions appear to be highly unreliable guides.

The evidence indicates that about half of any given student population will have done something other than intended within about two years of that expression of intention. Even among those most definite in their plans, there will be a considerable degree of change in actual behaviour. Moreover, the number of students not fulfilling their high school plans increases steadily over time.

Changes in plans are not random. Those intending to go on to university are least likely to change, followed by those intending college, and those intending to work. This pattern, however, is likely a proxy for social class, or socioeconomic status, which correlates highly with changes in plan. That is, the higher the socioeconomic background of the student, the lower the likelihood of a change in plan.

Worth noting here is the contention of American researchers that students' plans while in school cannot be taken too seriously in the first place; that a significant portion are either very recent intentions, revised from earlier plans, or are simply invented as answers to a question on a survey form[3]. In other words, the mistake may lie in treating students' expressed intentions as motivators of subsequent behaviour rather than as having the character of wishes.

3. Students' activities after high school are influenced by a wide variety of factors, with no single influence being predominant.

Students report being influenced by people, by events, and

by their own predispositions. Among people, parents are clearly the key influences for most students, with all others (siblings, friends, teachers) trailing far behind. School counsellors tend to rank quite low. In addition, such factors as the perceived state of the economy, desire for a change in lifestyle, or someone taking a personal interest in their plans are also reported as influences by substantial numbers of students.

The role of schooling generally in the process of formulating plans and carrying them out - or not carrying them out - is an uncertain one. Debate continues on the macro-level impact of education on such matters as occupational choice and income. The best evidence would seem to be that the effects of school programs are present, but are not great[4]. From the point of view of individuals, however, schooling would appear to be a minor factor in the transition to work. For one thing, students do not report their school programs, or teachers, or counsellors as being among the major influences on their decisions. Further, young people's views about the quality of their high school education tend to decline over time after they leave school; they tend to wish that the emphasis had been more practical[5]. And there is consistent evidence that the types of jobs to which students aspire while in high school are highly unrealistic in terms of the actual structure of the labour market[6].

Rather than relying on planning and information, most students seem to follow a process of trial and error, in which "plans" are made for the short term, attempts are made to carry these

out, and adjustments - or even complete shifts of direction - are made readily and rapidly in the face of changing circumstances. For example, a student wishes - and that word is used advisedly - to obtain technical training in a given area, finds that she cannot gain admission, happens to have the chance of a job (typically a low-paying, entry level job in a service industry), and takes it. Or a student enrolls in one post-secondary program, but discovers it is not what he wants, and transfers to a different program, or a different institution.

There appears, as well, to be a long-term trend towards more movement back and forth between the educational system and the labour force. The word "appears" is used because the recession of the past few years did change the pattern; many more students returned to or remained in schools due, most likely, to their inability to find jobs. Nonetheless, it is clear that patterns of post-secondary attendance and work are becoming more diversified. For example, the number of high school students in Manitoba who report that they may, depending on circumstances, go on to post-secondary has been increasing steadily over the past few years, while the number with expressed "definite" plans not to go on has been declining[7]. Anisef, *et al.*, (1980) found in Ontario that there were large numbers of shifts from full-time study to part-time study and full-time work. It should be noted, however, that such shifts are also class-linked. That is,

students from lower socioeconomic status families are more likely to make such shifts, while higher status students are more likely to continue directly through post-secondary. Unfortunately, the extent to which such shifts are a matter of choice versus a matter of financial or other necessity is not known, so we cannot tell whether values are more critical than money.

To summarize, Canadian evidence on the transition from high school reveals the following:

- high school students' plans are quite varied;
- such plans may not have much commitment behind them;
- those definitely intending post-secondary education constitute less than half of all high school students;
- students' plans change frequently;
- changes in plan are highly unpredictable, and largely a matter of individual circumstances;
- a large number of influences may affect students' plans as well as their actual behaviour;
- no one influence can be said to be predominant for most students;
- schools appear to have only a weak influence on students' post-secondary plans and experiences;
- the process of transition is, for many students, a matter of adjustment to circumstances rather than one of carrying out a plan.

It remains to discuss the implications for schools and other institutions of these findings.

6.3 IMPLICATIONS

The findings suggest the following basic directions for policy and action related to transition to work issues.

1. Information is not a solution.

The finding that information may not be the critical element in students' decision-making is consistent with what is known about the way in which people make decisions, namely that such processes are far more complex and less straightforward than decision-making models often assume. Far from defining problems, analyzing options, and selecting the optimal solution, people appear to deal with decisions in ways which are intuitive, non-linear, and include multiple variables with shifting and unspecified weightings[8].

The weight of the evidence suggests overwhelmingly that providing more, better, or earlier information to students is unlikely to have a major impact on transition issues. Of course, information is not a bad thing, but it is not the basket in which we should be putting all our eggs.

2. Students need more experience with work, and more opportunity to analyze such experience.

This means time spent in actual workplaces. Such experience needs to be far more common than it is, and it needs to be beyond the limits most young people now encounter - that is, working part-time or summers in poorly paid service jobs, so that they can experience, rather than hear about, a wider variety of jobs.

Of course, not all experience

is equally valuable, or, indeed, of much value at all. It is crucial, therefore, that work experience for students include a reflective and analytical aspect, in which students can think about what their experience means, and what implications it might hold for subsequent action. What does their experience at work tell them about work, about a particular job, about themselves, and their skills and aspirations? Without such reflection, more experience is of uncertain value.

3. There should be increased institutional flexibility to respond to changes in young people's plans.

Since plans are going to continue to change, the institutions involved have an obligation to accommodate such changes. We need to structure institutions not so much for the well-motivated student who will go straight through, but for that majority of students who will move from one thing to another for a period of several - perhaps many - years.

Organizationally, schools are still very much lock-step institutions. But such strategies as offering part-time high school programs, expanding evening and summer programs, making re-entry easier, providing settings in which adult students can feel at home, or even taking courses out of the building into workplace and community sites could erase some of the difficulties young people currently experience in moving from school to work and back.

4. Efforts to address these issues must go beyond students and young people to deal with peers and families.

Families and friends have much more influence on most students than do institutions. Accordingly, the institutions need to make more effort to address the concerns of families, and to draw parents and peers into various programs in whatever ways seem feasible.

6.4 A ROLE FOR THE SCHOOLS

It is important to consider the degree to which the schools could be expected to deal with these suggestions. Three points are noteworthy here.

First, schools have not viewed preparation for work as a high priority. Educators rate this objective well below other objectives, both academic and social. (Students rate preparation for work as their highest priority goal for schools, but as in most institutions, the wishes of the clients are not the most important consideration.) To begin with, then, the schools would require a substantial reorientation of priorities in order for there to be any substantive change.

It must be noted, further, that schools are not institutionally well-suited to carrying out the functions just noted. Schools are academically focussed places, with particular emphasis on knowledge as an abstraction, and on preparation for further academic studies, notably in universities. (This despite the fact, noted earlier, that most students do not go to university.) Schools focus on information rather than on experience. Almost all time is spent on knowledge as determined by external sources, such as textbooks, rather than on knowledge which originates with students.

There are other difficulties as well. The great bulk of teachers are themselves products of an

academic system. For many, their entire experience has been spent in schools and universities, as students and now as teachers. Few educators have much experience in other parts of the labour force. Moreover, their socialization is heavily supportive of the academic emphasis noted above.

These influences can be seen in present school practices in the area of preparation for work. To begin with, such programs are seen not as central parts of the school but as ancillary enterprises to be carried out by "extra" staff such as counsellors, when such people and time for them to work are available. The very notion of "career day" is an indication of the minor role which preparation for work activities now play. There are no credits for such programs in most schools, indicating to students that they are really not very important. Vocational education is often seen as a program alternative to keep less-motivated students in school rather than as a true preparation for work. Vocational and technical programs, students, and staff typically have low status in schools. An interesting example here is the recent Ontario high school credit reforms. Intended to give greater importance to areas such as technical education work experience, they are widely viewed as leading to much decreased activity in just these areas as students opt for the required courses in the minimum allowable time.

Given these facts - that preparation for work is not a priority for schools, and that the schools are not well suited to carry it out - one must ask whether the requisite change in orientation and practice to make schools effective in this area are likely to be forthcoming. At best, it could be said that it will take major efforts to make preparation for work an effective

part of school programming and organization.

If the schools were to accept this responsibility, however, there are a number of strategies which could be used. Career orientation and information, now regarded as an ancillary function of guidance staff, would have to become a central goal of the school, and be embodied in many subject areas. In other words, the entire instructional program could be reoriented to pay more attention to work-related matters. In social studies this could involve labour history, or sociology of work. In English it could involve the study of literature which deals with the workplace (and some very great writing is to be found in that corpus, it might be noted). In science the actual application of technology in work settings, and its impact on work, could be a topic of study. And so on.

At the same time, schools would have to be reorganized to allow more opportunity for students of all ability levels to experience work, whether through vocational programs, co-op education, or work experience programs. This would require changes in timetabling, supervision, and school organization, but it could certainly be done.

The evidence indicates that high school vocational education is not particularly valuable when regarded strictly as preparation for jobs[9]. There is a growing consensus that high school work-related programming should focus on skills which are applicable across a variety of occupations, even though these might be taught within a specific context. At the same time, vocational education has frequently been thought of as a program for low ability or unmotivated students, and has not really been an option for much of the study body. Changes to allow more access to vocational education are

certainly a feasible option.

Finally, the schools must have a role in helping students interpret and analyze their knowledge and experience of work. The school is uniquely suited to assisting students in sorting out what work means, and helping them analyze critically their own place within the labour force and the economy. This is a function which is both highly relevant to students and has considerable merit in academic terms, yet has basically been ignored by education. For example, many high school students work part-time. But schools do not typically use this experience as part of either career education or curriculum more generally. In fact, part-time work is often seen by the school as a distraction from real education.

6.5 AN ALTERNATIVE APPROACH

More likely, in this author's view, is that schools will not move significantly in any of the above directions, for the reasons alluded to earlier. Tradition, staffing, organization, and expectations within schools all militate against any major refocussing of purpose. If this is the case, then other solutions will have to be sought.

One alternative is to move responsibility for the transition to work clearly out of the schools, and assign it elsewhere. For example, both Britain and the United States have implemented various forms of job training entitlement for young people. Job entitlement schemes basically involve creating programs which provide young people with a combination of training and employment such that, over a period of time, they can develop skills leading to permanent employment. Such programs may be run through government departments - usually other

than Education - or through local organizations such as business groups, or through specially created training councils which are representative of various community interests, or through individual employers, or in a number of other ways. They are, though, firmly rooted in non-educational settings in almost all cases. The recent proposals by the Federal Government certainly contain substantial elements of this sort of orientation. Indeed, it has been clear for several years now that the Federal Government would like to shift its investment in training away, at least in part, from its present heavy reliance on educational institutions such as schools and colleges towards settings in the labour force.

It would appear, therefore, that elements of this solution are gradually coming into place as more and more programs which involve training, pre-employment preparation, and other job-related activities are created in community settings through non-institutional agencies. Missing at present are an overall policy framework for these efforts, and a clear sense of responsibilities between the educational institutions and these other service providers.

If such a conception were to be adopted as public policy, the role of the school could be described quite clearly, and the conditions needed for its fulfillment would not be particularly difficult to achieve. The schools would no longer have a substantive role in preparation for work for most students. Career education, vocational education and work experience would become less important in schools, which would focus more on providing basic and advanced academic skills.

How would schools relate to a system of out-of-school training? Largely by serving as access points

for entry to various programs, allowing eligible students the time to participate, and awarding credit for such programs where appropriate. Academic programs which support training through development of knowledge and intellectual skills could be developed. Schools might even undertake to provide space, equipment, and support for such programs within their buildings so as to make access easier. But primary responsibility would not rest with the school. The relationship would be one of referral and cooperation, rather like that which presently exists between the schools and a variety of social services for children. Since models already exist, it is likely that a similar arrangement could be made to work reasonably well.

6.6 CONCLUSION

Having weighed the evidence to this point, it seems logical, though perhaps somewhat heretical, to suggest that schools should be given a smaller role in the preparation for work. Given the requirements for effective action in this field, the nature of schools, the emergence of alternative services, and the experience of other countries with out-of-school schemes, the best policy option appears to be to entrust the major portion of responsibility for work preparation to institutions other than the school. Schools could then act primarily as a point of access in both directions (that is, from students to services, and from services to students). The schools would then continue to focus on that for which they are best suited - academic preparation for further study - while students would be given a wider range of choices than is currently available in schools. Such a partnership would

appear to be sensible and feasible,
and should, in the author's view,
become the objective of governments

concerned with the issue of preparation of young people for work.

NOTES

The paper contains the personal views of the author, and does not necessarily represent the policy or opinions of Manitoba Education.

- [1] McCort, 1984.
- [2] Anisef, 1974; Anisef, Paasche and Turritin, 1980; Bremner, Russell and Warrack, 1979; Levin, 1984; Russell, 1978.
- [3] Alexander and Cook, 1979.
- [4] Borus, 1984; Haughey, 1984; Levin, 1983.
- [5] Taylor, Stafford and Place, 1981.
- [6] Levin, 1983; Taylor, Stafford and Place, 1981.
- [7] McCort, 1984.
- [8] See, for example, Simon, 1957, or, on the impact of information on decisions, Tversky and Kahnemann, 1974.
- [9] Borus, 1984; Gustman and Steinmeier, 1982; U.S. Department of Education, 1980; Woods and Haney, 1981.

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Book Reviews

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International Patterns of Inflation: A Study in Contrasts, Ezra Solomon, (ed.), The Conference Board and American Council of Life Insurance, 1984. (278 pp.).

This volume sets out to explain why "essentially common global economic forces" produced such varying inflationary results in different countries during the 1970s. The experience of eight countries, the seven summit countries plus Switzerland, is examined. A long introductory essay on the United States by the editor also provides the global context. Individual country essays were written by economists drawn from business or business school backgrounds. A brief statistical appendix completes the volume.

While the individual essays contain much interesting information on the countries concerned, the overall objective of the volume is not achieved. The reader is left to draw his own conclusions as to why Italy and the United Kingdom, for example, experienced such high rates of inflation in the mid-to-late seventies whereas Japan and West Germany were able to bring inflation under much better control. Views advanced in different essays are often contradictory. The high inflation in the United Kingdom is

attributed directly to the large deficit. Yet a comparative analysis would have revealed that over the period from 1975 to 1982 both Germany and Japan had deficits as large or larger than the U.K. when measured as a percent of G.D.P.

Many of the individual essays show only a cursory awareness of the common global forces that were affecting the developed world as a whole in the 1970s. All make some reference to the two major oil price increases but many of the authors seem unaware of the major non-oil commodity price explosion that occurred from 1972 to 1974. Nor is there much evidence of any awareness of the sharp decline in the rate of growth in the developed world as a whole after 1973 or of the virtual cessation in the growth of real capital investment since that date among the European members of the O.E.C.D. Prior to 1973 real investment in that area had been growing for a decade or more at a 6 percent annual rate.

Perhaps most surprising is how little evidence was placed on the

pattern of collective bargaining and wage determination in different countries. One does not learn that much of Germany's success in controlling inflation is partly, perhaps even primarily, due to a highly centralized system of collective bargaining involving one-year contracts, all renegotiated at about the same time each year. Similarly, Japan has a system of one-year contracts, all renewed at the same time each year in the so-called Spring Offensive. In contrast, Canada and the United States have a great many two- and three-year contracts negotiated at different times over the year and in a highly decentralized fashion.

The volume also underlines the weakness of economists' scientific methodology. Individual writers draw conclusions on the basis of what seems the most casual sort of empiricism. Even in the editor's introductory essay there is no serious attempt to examine carefully the causes of the commodity price explosion of the early seventies. The conventional wisdom attributing it to exceptionally strong growth among developed countries is simply accepted.

The picture of the sources of inflation that emerges is highly eclectic. While all writers give some

lip service to monetary forces and emphasize the need for monetary restraint, many other sources of inflation are emphasized as well. One does not get the impression that this group of economists believes along with Milton Friedman that inflation is "always and everywhere a monetary phenomenon." Indeed, one could find as much support for Joan Robinson's dictum that "inflation is essentially a struggle for a share of the product."

Still, although no firm conclusions emerge, the reader will find the individual essays an interesting survey of the many different approaches that were taken as governments wrestled with the much stronger inflationary forces that emerged in the 1970s. What is not clear is whether they would fare much better in dealing with inflation if similar inflationary pressures were to emerge in the future. In addition, individual essays offer fascinating insights into the experiences of these countries. To cite one example, Ezra Solomon, writing about the United States, gives a concise and informative account of the way in which the U.S. financial system had to be modified to enable it to cope with higher interest rates and rates of inflation.

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R. Zuker and G.P. Jenkins, Blue Gold: Hydro Electric Rent in Canada, Economic Council of Canada, Supply and Services Canada, Ottawa, 1984 (45 pp.) and Statistical Appendices (58 pp.).

This study undertakes the task of measuring the economic rent attributable to hydro-electric resource sites in Newfoundland (Churchill Falls), Quebec, Ontario, Manitoba and British Columbia in 1979. The approach taken was to calculate the difference between "the annual economic cost of a hypothetical, least-cost, all-thermal system." The findings of Zuker and Jenkins are that hydro-electric rents in Canada in 1979 totalled almost \$4.4 billion, averaging \$185 per capita for Canada with above average economic rents attributable to sites in Newfoundland (\$1,262 per capita), Manitoba (\$508 per capita), British Columbia (\$334 per capita) and Quebec (\$210 per capita). In addition, the study derives estimates of the redistribution of these rents among users by province and to United States users by employing an iterative input-output type of procedure. The authors estimate that nearly \$500 million in economic rent was lost on exports to United States users in 1979 (\$124 million on Manitoba exports alone). Combined with rents redistributed through extra-provincial sales (\$543 million was lost by Newfoundland alone to other provinces), the net result was that rents gained amounted to \$320 per capita in Manitoba, \$304 per capita in British Columbia, \$257 per capita in Quebec, and \$203 per capita in Newfoundland, with the rent gains in the remaining provinces being below the Canadian average of \$165 per capita.

There is no doubt that this research effort by Zuker and Jenkins represents a valuable contribution to the understanding and appreciation of the importance of

hydro-electric resource issues in Canada. In my opinion, the primary value of the study will be realized if it "will encourage discussion of the conceptual and empirical issues"[1] involved in attempting to measure hydro resource rents with sufficient precision to be of some value in public policy formulation. Aside from this, I think, careful scrutiny of the study raises serious questions about the reliability of the hydro resource rent estimates that are reported.

For the moment, let us accept the Zuker-Jenkins conceptual assumptions about how to measure economic rent, which are outlined very clearly and carefully in chapters 1 and 2 of the study. These chapters could easily serve as a textbook treatment of the subject for students of energy economics and even for interested non-economists. This clear exposition continues in the first part of chapter 3, which describes the conceptual approach of the study in designing the hypothetical all-thermal system that provides the basis for the rent estimates. In contrast, the application of this approach, using an "economic dispatch" model, is reported (page 22) with minimal explanation and discussion. The Statistical Appendices to the study, published under separate cover, report only the final configuration of thermal generating plants generated by the model. The lack of detail on its structure, parameters and assumptions means that the model is essentially a black box that doesn't lend itself to close scrutiny. Also, the actual load duration curves employed in the exercise are not reported.

In spite of these impediments,

enough can be reconstructed to demonstrate that something is wrong with this model in that the configuration of thermal generating plants assumed in the study is puzzling and results in a significant over-estimation of some economic rents. For example, we are given the "surprising" result that, in Manitoba, an all-thermal system would include 520 megawatts of gas turbine capacity (Table A.3) operating at 39.6 percent capacity factor (page 29) producing 1.8 million megawatt-hours of energy at a 1979 cost for fuel alone of \$200.55 million (Table 3.1) or 111 mills/kwh (\$111/megawatt-hour - see Table A.1). A simple calculation shows that the total cost of 520 megawatts of coal thermal capacity operated at 39.6 percent capacity factor averages only about 40 mills/kwh so the gas turbine capacity is uneconomic. Another crude calculation, using the given data, suggests that gas turbine capacity becomes economic in Manitoba only for peaking power at capacity factors well below 10 percent.

Furthermore, it seems to me that operating coal thermal and gas turbine plants at capacity factors of only 52.6 percent and 39.6 percent respectively, when the system demand load factor is 70.1 percent, doesn't make sense. It is only possible if there is considerable excess capacity in the all-thermal system, which is obviously then an uneconomic situation. This leads to the question of why the alternative all-thermal system in Manitoba would be planned to require 3520 megawatts of generating capacity to meet a 1979 Manitoba peak load of under 2600 megawatts?

By far the most numerous and quantitatively serious questions concerning the Zuker-Jenkins approach to measuring hydro resource rents, arise in relation to chapter 4 (and related Statistical

Appendices). This chapter outlines the computation of economic costs of the current hydro-thermal system and of adjustments to the economic costs of the alternative all-thermal system. Again, the case of Manitoba, computed as having the highest hydro resource rent per kwh and per capita, can serve as the example.

In Table 4.1 of the study, the all-thermal system costs for 1979 are given as \$1.194 billion (or 66 mills/kwh) representing an increase of almost \$500 million (or 21.3 mills/kwh) over the \$697 million all-thermal generating cost computed in Table 3.1. Over 35 percent or \$175 million of this increase is an augmentation of generation cost (Table B.4, lines 1-3) to provide for a supposed discrepancy between "cost for energy required at source" and "cost for energy generated." The question is why wouldn't Manitoba accomplish this by increasing the capacity factor of coal thermal generation to 68 percent from 52.6 percent for a variable cost increase of \$68 million instead of, in effect, increasing coal and gas turbine generating capacity by 25 percent for this annual total cost increase of \$175 million.

A second, more obvious, question is why have over 6,300,000 megawatt-hours of extra-provincial sales (to the United States, Ontario and Saskatchewan) been assumed as part of the 18,000,000 megawatt-hours of energy sales for the alternative all-thermal system? There is no reason to assume that Manitoba would or could be selling (for 66 mills/kwh!) over one-third of its electricity production to United States, Ontario and Saskatchewan markets if it was operating an all-thermal system. Moreover, even for the current hydro-electric system these extra-provincial energy sales in 1979 did not represent any kind of system planning optimum. Instead, they largely

represent loss-minimizing sales of surplus energy from excess hydro generating capacity irreversibly constructed (in Manitoba, as in other provinces) during the 1970s in anticipation of high domestic rates of load growth that did not materialize. Therefore, Figure 4.1 and the related discussion in the study is quite misleading. It implies that the amount by which the analysis overstates the value of hydro rents, by assuming demand based on electricity sales under the current system, is "not likely to be large in relative terms" (page 32) even though there are many ways to draw that diagram to show the opposite result. In the case of Manitoba, this overstatement probably amounts to most of the \$193 million of hydro resource rents calculated in the study as being redistributed to the United States and other provinces.

In addition to the upward bias due to assumed demand quantities, several other aspects of the economic cost estimates appear to bias the economic rents upward. In valuing the capital stock of the current hydro-thermal generating facilities at net replacement cost, the study applies an aggregative Statistics Canada index, of the ratio of net replacement value of capital to the historical cost of the capital stock in the Miscellaneous Utilities sector, which apparently incorporates a relatively high depreciation rate of .0284 (or about 35 years) for generation capital. This combination of assumptions appears to underestimate the replacement cost of current hydro generating facilities significantly. For example, in the case of Manitoba, the net replacement cost valuation of generating plant capital at \$2.662 billion (Table B.1) appears much too low. It is less than \$750/kw while it could be expected to be over \$1,000/kw in 1979. I suspect that this is in large part

due to the assumed depreciation rate which is considerably higher than the 67-year service life (for a rate of about .015 per year) depreciation generally employed for hydroelectric generating plants in Manitoba.

Also, the estimates of historical cost of transmission capital in the study appear to be much too low at \$160 million (Table B.1). The 1976 Manitoba Hydro annual report shows a 1975 debt of \$244 million on the new H.V.D.C. transmission system alone which at that time was undergoing further expansion. One suspects that some of the capital value of transmission facilities (perhaps the D.C. converter facilities) has been included under the valuation of distribution system capital. This would bias downward the cost of the current hydro-thermal system and bias upward the cost of the alternative all-thermal system by an equal amount and, therefore, contributes further to the upward bias in the Zuker-Jenkins estimates of economic rent.

So far in this discussion, I have accepted the Zuker-Jenkins conceptual framework for measuring economic rent. It is, however, certainly evident that some of the necessary assumptions underlying the theoretical concept of economic rent defined by the authors (pages 4 and 5) must be violated in applying the concept to hydro-electric resources. Electrical utilities in Canada are monopolies and their objectives are not merely profit maximization, so there is nothing approaching the perfectly competitive market conditions implied in the theoretical definition of economic rent. The economic interactions between Canadian utilities and with United States utilities might be most aptly characterized as bilateral monopoly or game theoretic situations. For these reasons, the distinction between producers' economic rent and

consumers' surplus may be indeterminate and any measure of economic rent may be quite arbitrary or subjective.

Another aspect is that electric energy is not a homogeneous commodity in terms of its market characteristics. It is supplied at different voltages and under different conditions of reliability (firm vs. interruptable) and demand for it is segmented as to time of day and season. Therefore, a conceptual measure of economic rents that is based on averages of aggregated costs is likely to be less than satisfactory as a proxy for willingness-to-pay for the supply of various categories of electricity.

Finally, there is the fact that hydro resource sites are only capable of accruing economic rent after they are developed through capital expenditures on large-scale and usually indivisible generating facilities. These must be planned well in advance and constructed over a long period of time to meet anticipated

but uncertain future demand. One implication of this is that it is important to distinguish between economic rents on scarce hydro resource sites and the quasi-rents that might accrue due to scarcity of generating facilities (i.e., underinvestment) on relatively abundant hydro resource sites. While a province like Ontario, may be perhaps placed in the first category, it may be argued that Quebec, British Columbia and Manitoba fall readily into the latter category. The conceptual measure of economic rent in the study is too simplistic to make this distinction.

To conclude, the issues of inclusion of resource rents in equalization formulas and of federal appropriation of hydro resource rents are bound to be controversial. It seems important for the hydro resource rent calculations themselves to be conceptually and empirically as uncontroversial as possible. In this respect, the Zuker-Jenkins study appears to fall somewhat short.

George Chuchman, Department of Economics, University of Manitoba.

F.J. Anderson, Natural Resources in Canada: Economic Theory and Policy, Methuen, Toronto, 1985 (301 pp.).

Given the historical role of natural resources in Canada's economic development, our current dependence on resource industries, and questions of their future contribution to the changing structure of the Canadian economy, Fredrick Anderson's book, Natural Resources in Canada: Economic Theory and Policy is a welcome contribution. It is written as a textbook in natural resource economics but it will be of interest to both students and practitioners in natural resource

economics and resource management.

The book opens with an overview of the importance of resource industries - forestry, fisheries, metal mining, potash, coal, petroleum and hydro-electric power - to the Canadian economy, exports, and regional economies within Canada. Their significance is measured in terms of their contribution to national and provincial Gross Domestic Product, and to commodity exports. The dependence of particular provinces and regions on resources and on specific

resource industries is demonstrated.

The second chapter draws upon the Canadian literature on resource economics to illustrate the application of input-output models and regional economies, and to illustrate the longer-term impacts on the Canadian economy of a reduced dependence on resource industries.

The next four chapters discuss non-renewable resources and focus specifically on minerals. The now classic Hotelling model of resource depletion is presented in chapter 3, and used to demonstrate the impact of resource availability, quality, mining costs, discount rates, technical change and other factors on resource use, resource prices, and potential economic rents over time.

The issue of and empirical evidence on resource scarcity is examined in chapter 4, along with the implications for Canada.

Potential and actual economic rents from resources, idealized and actual resource taxation in Canada are compared in Chapter 5. Recent work on estimating the magnitude of Canadian resource rents is reviewed.

Case studies of Canadian oil policies and of potash are presented in chapter 6.

Chapter 7 applies economic theory and analysis to forest management issues and discusses some key issues of Canadian forest policies.

Chapter 8 reviews the standard models of fisheries economics and discusses issues in Canadian fisheries policies.

The final chapter draws together the major economic issues identified from the economic analysis, policy reviews and case studies of earlier chapters.

The book provides a useful introduction to the application of economic theory and analysis to natural resources; and to Canadian resource issues, literature, and studies. There are places where the review of literature in the field and the results of studies is too brief, and one needs to refer to the sources reviewed, but on the whole the review of literature and studies is useful.

The book is focused heavily on non-renewable (extractive) resources, and on resource commodities and industries. Four of the nine chapters discuss primarily non-renewable resources, only two discuss renewable resources. This focus follows from the overview in chapter 1 which measured the contribution of resources and the resource industries to the Canadian economy in terms of Gross Domestic Product. Gross Domestic Product measures are based on commodity outputs and market values. They ignore non-market values, public (i.e., collective) goods and services, and externalities. Consequently non-marketed resources, resource uses and resource values such as outdoor recreation, parks, hunting and fishing, many water resource uses, environmental quality, et cetera, are overlooked. These involve important aspects of natural resource economics that warrant discussion. They are an unfortunate omission.

However, with these cautions and qualifications the book represents a contribution to Canadian policy analysis. It is recommended to economists and to others interested in natural resource economics and resource management.

John Gray, Department of Economics, University of Manitoba.

NOTES

- [1] To quote the discussion (on page 32) by the authors of the vastly different estimates of hydro-electric rents by Bernard, Bridges and Scott in a 1982 paper.

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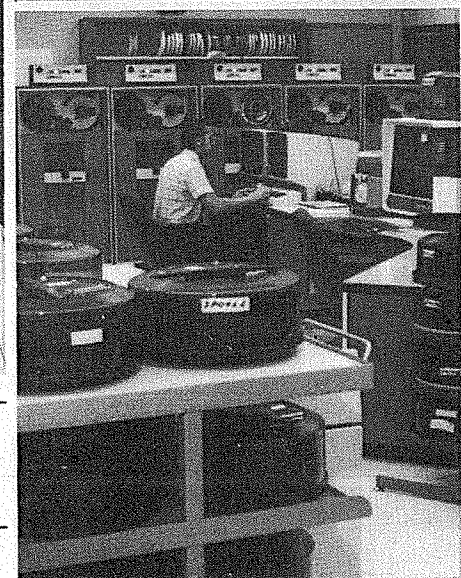
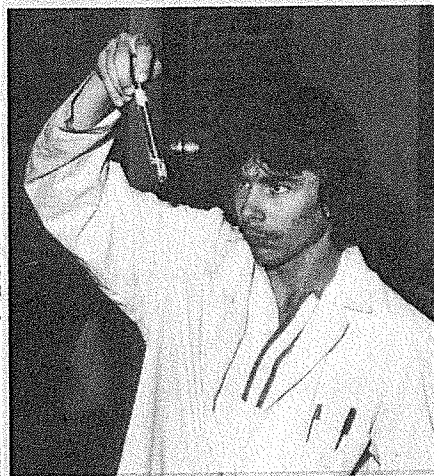
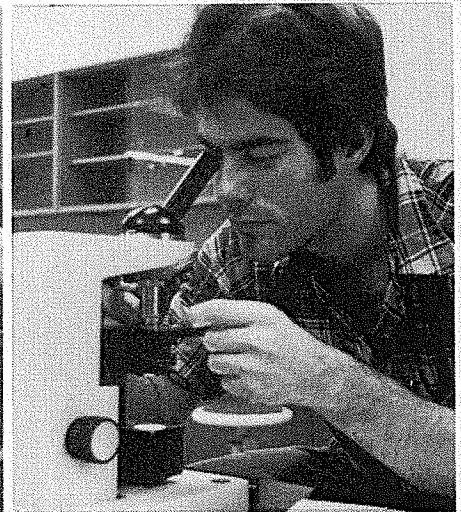
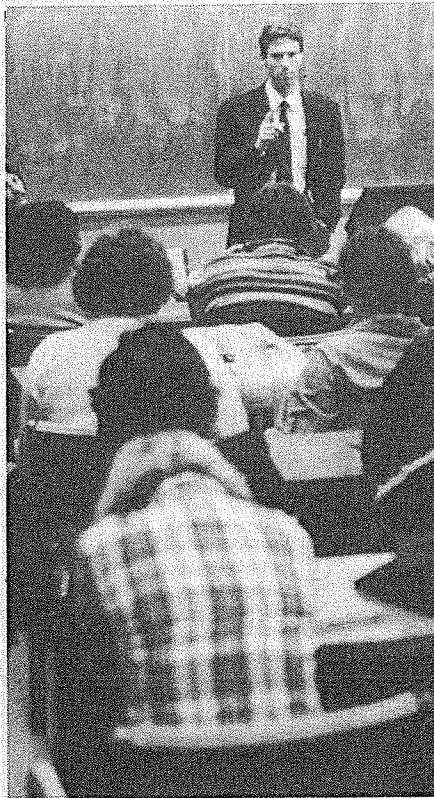
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