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Article abstract

This paper presents a quantitative retrospective evaluation of three Canadian occupational projections covering the period 1961 to 1981 in an attempt to assess their usefulness as a guide to education and training policies. Using appropriately adjusted, detailed occupational data from the 1961, 1971 and 1981 Canadian censuses, the results indicate that for major occupational groups the projections were generally acceptable (within ± 10%) and that the use of variable coefficients can provide useful additional information for occupational projections.

An Ex Post Evaluation of Canadian Occupational Projections, 1961-1981

David K. Foot
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This paper presents a quantitative retrospective evaluation of three Canadian occupational projections covering the period 1961 to 1981 in an attempt to assess their usefulness as a guide to education and training policies. Using appropriately adjusted, detailed occupational data from the 1961, 1971 and 1981 Canadian censuses, the results indicate that for major occupational groups the projections were generally acceptable (within ± 10%) and that the use of variable coefficients can provide useful additional information for occupational projections.

After an initial burst of enthusiasm in the 1960s, manpower forecasting became a discredited practice by the early 1970s. It was discredited on both theoretical grounds and because a number of the forecasts for specific occupations influenced government policy makers to make incorrect decisions with respect to changes in the supply of persons to the target occupations (Ahamad and Blaug 1973; and Dougherty 1985). Interest in occupational projections returned in the 1980s because of the continued desire by those responsible for educational and guidance decisions to have some indication of possible future developments given the continuing changes in the industrial and occupational mix of employment in Canada (Foot and Meltz 1987; Picot 1986; and Picot and Lavallée 1986). In addition, there was a new view that even the most unsophisticated of projection models, that with fixed occupational coefficients, "seems to work" (Freeman 1980). This was

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** The authors appreciate the advice and assistance of Employment and Immigration Canada as indicated in Foot and Meltz (1987) as well as the helpful suggestions of the unnamed referee.

consistent with an earlier finding in the 1960s that "most (occupational) estimates were close to the mark" (Swerdloff 1969).

This newer view was not intended to imply that projection models can be uncritically used to guide education and training policy. Rather the purpose was to suggest that such models may provide useful scenarios of possible developments in employment by occupation. With the latter view in mind, this paper examines the results of the three early national projection exercises in Canada that were prepared in the 1960s and 1970s – Meltz and Penz (1968), Ahamad (1969) and COFOR82 (1975). The paper first considers some theoretical and methodological issues. The numerical *ex post* accuracy of the three projections is then examined, followed by a more detailed analysis of fixed versus variable coefficient models in connection with one of the projections. The paper concludes with some general observations on the role of occupational projection models in labour market analysis. These observations have relevance for Employment and Immigration Canada's Canadian Occupational Projection System (COPS), which has been used since the 1980s and is primarily a fixed coefficient model.

THEORETICAL ISSUES

There are two main types of issues relating to occupational projections: the methodology employed in arriving at the projections, and the possible impact of the projections on labour market decisions.

The first issue on methodology requires consideration of the future demand for and supply of labour since what is being projected is the anticipated net result of these determinants. To do this in a precise manner ideally requires estimates of the price elasticities of demand and supply for each occupation and the cross elasticities of both demand and supply among occupations, since individuals with a given training can undertake a variety of occupations and employers can often utilize a range of types of training in the production of a particular product or service. (For an indication of the different types of educational backgrounds associated with occupations, see Employment and Immigration 1990).

The methodologies that are actually employed are much more mechanical than the ideal labour market analysis would suggest. In fact, the price dimension (wages and salaries) is, unfortunately, usually excluded. The primary focus is on a "demand" projection based on an assumed relationship between output by industry, labour productivity for each industry (which together produce employment by industry) and occupational coefficients within each industry. An alternative, but conceptually similar, approach is to estimate occupational coefficients

which directly relate numbers of persons employed by occupation to industry output.[1] To the extent that the supply side is considered, the projections are based on the numbers of persons in particular education and training programs, attrition (to other occupations and from the labour force) and immigration to specific occupations.

The largely mechanical nature of this exercise suggests that the results have to be used with considerable caution. The issue is whether the resulting occupational projections are of sufficient accuracy to provide useful input into labour market decisions, including policy formulation for education and training programs. In particular, are the results of the projection exercises sufficiently accurate to add information to what would be available in the absence of such exercises?

The second issue is the concern that projecting occupational requirements (gross or net) could have a distorting effect on the operation of labour markets. For the individual there could be a steering effect on career decisions. It has been argued (Hansen 1966: 11) that "...negative benefits could result from directing people into occupations or industries where openings no longer existed – either because the projection was wrong or the response to it greater than anticipated." The projections could prove to be incorrect because of inaccurate projections of aggregate demand and/or industry outputs, or because of unanticipated changes in technology, which influenced productivity performance or the occupational coefficients.

Interference with the classical functioning of labour markets also has a further dimension. Since policy makers and institutions may make decisions in response to the projections, there could be a steering effect on resource allocation decisions (Selleck 1983). For example, training programs may be expanded for fields that are projected to be in short supply. But the same result would have been achieved in the absence of decisions by policy makers since the likely increase in wages would induce more persons to enter the field. Because of the long lead time between these decisions and the ultimate supplies of graduates there is, perhaps, a greater likelihood of distortion with the combined market induced and policy induced expansion in supply. Under this viewpoint, therefore, it is better to let the market function without the possible distorting influence of occupational projections.

One difficulty with this approach is that because of the substantial time lag between current decisions (both individual and institutional) and future labour market supplies, the market solution can generate

1 There are of course a variety of other approaches for specific sectors which relate selected occupations to particular variables such as the ratio of pupils to teachers, population to physicians and dentists, etc.

substantial variations in wages and hence the numbers of students in the various occupations. This is the familiar cobweb effect (see Freeman 1976). These variations may be exacerbated if there are wage and salary linkages among occupations. The result may be extremely costly for both individuals and institutions. In addition, the result may be costly for society as a whole if the wage increases which may be required to produce the necessary labour market adjustments involve inflationary and growth-inhibiting bottlenecks and/or unemployment stemming from oversupply. Under these conditions the issue is whether or not the additional information provided by occupational projections can help avert these variations by contributing to a more smooth adjustment in the labour market.

Thus, under this viewpoint, while current market signals are clearly important, they may not fully capture the necessary information on the future especially given the long lead times between current decisions and future labour market supplies. The issue is whether the additional information in occupational projections could better assist both individuals and institutions in making appropriate long term decisions. For policy makers and institutions, the decisions concern programming, staffing and investments in facilities, which often require long lead times. In addition, the substantial time required to train students, especially in highly skilled occupations, further extend the planning horizon. Under these conditions, according to this viewpoint, it is likely that the uninformed market solution by itself will incur substantial costs and that accurate occupational projections can play a useful role in reducing these costs. The argument, therefore, centres on the accuracy of the projections, which is the focus of this paper.

METHODOLOGICAL ISSUES

In addition to the theoretical issues raised above there are two major methodological issues associated with occupational projections. One concerns the changes in occupational classifications, which make it difficult to compare projections with realizations over time. The second issue is associated with the characteristics of and hence the criteria for a "good" projection.

The first issue can be illustrated by the fact that two of the three Canadian projections considered in this paper employ a different occupational classification from that actually in use by the time of the target year. The problem arises from the practice, up to 1981, of changes in the occupational classifications used for the decennial population censuses. The largest change occurred in 1971 when only 9 out of 486 occupation classes were comparable between 1961 and 1971 (Meltz and

Stager 1979). While the changes between 1971 and 1981 were largely insignificant, another problem emerged in that one projection did not include all occupations. Professional and most managerial groups were excluded in COFOR82 because a separate study was planned at the time.

To enable quantitative comparisons between alternative occupational projections it was necessary to solve the problem of occupational classification changes. Consequently, the 1961 census data were reclassified on the 1971 base.[2] Fortunately, the 1981 data were already available on a 1971 base. In addition, it was necessary to determine those occupations in the earlier projections that could be made comparable to the 1971 occupational classification. This was done for major groups by assuming the same relationship existed in the target years as existed in the base year of 1961. To solve the problem of the missing groups (from COFOR82), comparisons were only made between the available projections and the actual data.[3]

The second issue concerns the criteria to be used to determine a "good" projection. Should the projection be judged on the basis of the level of employment, or its distribution over occupations? If the projected total employment differs from the actual then one or the other could be close, but not both. In the research which follows we have chosen to concentrate on levels of employment.

The choice is, essentially, arbitrary. Ideally the criteria should be related to the impact of the projection on individual and policy decisions, and the resultant impacts on particular labour markets. Note, however, that if the purpose of the projections is to influence policy, and if the policy were implemented successfully, then the criteria for judging a good projection should not be the difference from the actual realization, but rather how close it was to the desired estimate. This issue is not relevant here since no specific policy targets were set.

RESULTS

The differences between the predicted and the actual employment figures in each of the three studies are set out in Table 1. All projections employed the general methodology outlined above.

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2 The authors are grateful for the support and cooperation of Employment and Immigration Canada and Statistics Canada in this mammoth data task.

3 Since the target year for COFOR82 was 1982, the projections were prorated to provide an estimate for 1981, the closest census year.

TABLE 1

Ex post Comparison of Projections by Occupation Division (Per Cent of Actual)

OCCUPATIONS	*Meltz & Penz (B)* vs. Actual 1971*	*Ahamad (2)* vs. Actual 1975*	*COFOR82 vs. Actual 1981*
Managerial	-4.4	-10.3	-42.5
Professional	-9.5	1.3	N/A
Clerical	3.4	-14.0	-4.9
Sales	-0.7	-5.3	5.1
Service	-1.1	8.0	1.5
Transport, Communication	15.3	13.5	9.7
Crafts, Production	0.3	1.0	-1.2
Labourers	10.3	0.9	N/A
Farming	8.0	-20.8	-5.2
Fishing	10.1	-39.9	-21.2
Forestry	10.1	-13.1	28.2
Mining	-45.8	-18.1	-5.5

* See text and footnote #4 for details on choice of projection.
N/A – Not available.
Source: Calculations by the authors.

Table 1 shows the percentage difference between the projected employment in each occupational group and the *ex post* realization.[4] For example, Meltz and Penz, who project from 1963 to 1971,[5] underestimated employment in the managerial group by 4.4 percent for 1971, Ahamad, whose projections were from 1966 to 1975, was 10.3 percent under for 1975 and COFOR82, which projected from 1974 to 1982, was 42.5 percent under for 1981.[6] Looking across the three projections, it can be noted that all underestimated employment in the white collar and resource occupations and overestimated employment in some of the blue collar occupations. Each projection has a somewhat different pattern of over and underestimation, but all three underestimated managerial and mining occupations and overestimated transportation and communication occupations. All three were very accurate for crafts and production occupations. For total employment, Meltz and Penz were within less than .05 percent, Ahamad was below by 2.9 percent, and COFOR82 was under by 16.6 percent.

4 Since both Meltz and Penz (1968) and Ahamad (1969) provided two estimates, the estimate closest to the actual for the largest number of groups was used.

5 Metz and Penz (1968) initially projected occupational requirements to 1971 then adjusted the figures back to 1970 (p. 38-40).

6 It should be noted that the COFOR82 figure only dealt with a portion of the managerial group.

If a range of ± 10 percent is used as an arbitrary evaluation criterion[7] Meltz and Penz projected 9 of 11 (82%) in this range; Ahamad projected 6 of 12 (50%); and COFOR82 projected 7 of 10 (70%). If a more stringent range of ± 5 percent is used as the evaluation criterion then Meltz and Penz projected 5 of 11 (45%); Ahamad projected 4 of 12 (33%) and COFOR82 projected 5 of 10 (50%). Consequently, both Meltz and Penz and COFOR82 outperformed Ahamad according to these criteria. More important, however, is that a majority of the projections for major occupation groups in all three projections were within the range of ± 10 percent. This record suggests that even with the largely mechanical methods employed the results would appear to be, at least, acceptable. They were clearly superior to what would have resulted if all occupational groups had been projected to increase to the same extent as total employment.

A comparison of the projections for selected detailed occupations with the actual employment for the three projections indicates that, in general, the greater the specificity of the occupations the further the projections are likely to be from the actual employment. While 82 percent of the major occupational groups in Meltz and Penz were within ± 10 percent of the actual, 35 per cent (9 of 26) of the detailed occupations were within the same range.[8] The figures for Ahamad and COFOR82 also declined, from 50 percent to 29 percent (12 of 41) in the case of Ahamad, and from 70 percent to 28 percent (107 out of 283), for COFOR82. Regression analysis indicated an inverse relationship between employment size in an occupation and the percentage error, but the correlation was weak, explaining only one percent of the variance.

Many reasons can be found for these differences. The main causes are inaccuracies in the projections of total employment, in industrial productivity performance, and in the assumed occupational mix in industrial employment. The last issue is now considered in more detail.

FIXED VERSUS VARIABLE COEFFICIENT MODELS

Freeman (1980) has argued that the fixed coefficient model provided "a good fix on changes in [occupational] employment" for the United States for the period 1960-1970. The projection models developed for Canada by Meltz and Penz and Ahamad used variable

7 The precise boundary used in this study is up to and including 10.4%; that is, results that would be rounded to 10%.

8 When a range of ± 20% is used as the criterion almost half of the occupations fall within the range for the Ahamad and COFOR82 projections, and a majority for Meltz and Penz.

occupational coefficients,[9] while COFOR82 used fixed coefficients. The preceding analysis indicated that the "success rate" for major groups ranked Meltz and Penz and COFOR82 above Ahamad. Based on these initial results, no clear superiority of one methodology over another therefore emerges.

The difficulty with these comparisons is that they cover different time periods and differing labour supply and demand situations. Given the available information it was possible to examine the separate factors responsible for the changes in occupational composition in Meltz and Penz. The results of what would have been predicted by Meltz and Penz using a fixed coefficient model are compared with what the variable coefficient model actually projected in Table 2.

TABLE 2

Comparison of Projected and Actual Occupational Employment Using Fixed and Variable Occupational Coefficients, 1971

OCCUPATION	*Actual Change percentage points*	*Fixed Coefficient*		*Variable Coeficient*		*Coefficient Change in Proportion Explained*
		percentage points	*% of actual*	*percentage points*	*% of actual*	
Managerial	1.8	0.1	6	0.6	33	27
Professional	4.5	2.0	44	2.7	60	16
Clerical	3.3	0.9	27	1.6	48	21
Sales	-0.5	0.1	-20	0.0	0	20
Service	-0.5	1.3	-260	1.5	-300	-40
Transport	-0.5	-0.3	60	-0.1	20	-40
Construction	-2.1	0.3	-14	-0.1	5	19
Production	-1.4	0.3	-21	0.1	7	28
Farming	-3.7	4.2	114	-4.3	116	-2
Fishing	-0.2	-0.1	50	-0.2	100	50
Forestry	-0.6	0.3	-50	0.2	-33	17
Mining	-0.2	-0.2	100	-0.3	150	-50

Source: Meltz and Penz (1968) and calculations by the authors.

To accomplish this task, the fixed coefficient model projections of output and labour productivity by industry are combined to produce employment by industry. The base year (fixed) occupational coefficients are then applied to produce estimates of employment by occupation. The impact of variable coefficients is shown when the variable occupational coefficients are applied to the estimates of employment by industry and compared with the results obtained using the base year (fixed) coefficients.

9 Largely judgmental procedures based on trends in the occupational coefficients were used to project the variations in the occupational coefficients.

The results show that in 8 of the 12 (67%) major occupational groups the use of variable coefficients brings the projection closer to the actual figures. For example, in each of the white collar occupations (managerial, professional, clerical and sales) the use of variable coefficients improved the projection noticeably. The most dramatic gain was in the managerial category where the projected change was an increase of 0.6 percentage points compared with only 0.1 for the fixed coefficient model (an increase of 27 per cent in the proportion explained). These results provide evidence of the superiority of a variable coefficients model.

The successor to COFOR, the Canadian Occupational Projection System (COPS) developed by Employment and Immigration Canada, is a fixed coefficient model that has introduced variable occupational coefficients into certain regions and industries. COPS has also included information on labour supply, such as student flow from the educational system, and has developed submodels for construction, teachers and health occupations. The results in this paper confirm that a variable coefficients approach is likely to produce superior results.

The use of variable occupational coefficients permits the possibility of explicitly taking into consideration known technological changes whose likely impact can be foreseen. The incorporation of variable coefficients into a projection model also emphasizes the importance of continually monitoring the developments in the structure of industries and assessing the implications for occupational requirements. To do this, in turn, requires more detailed occupational data than are regularly being obtained in Canada. The availability of quinquennial census data means that every five years there will be detailed data on an occupation by industry basis. While the quinquennial census is a step forward more frequent data are desirable to accurately monitor and update the projection models.[10]

CONCLUSIONS

The *ex post* analysis of the three Canadian occupational projections confirms the findings of Swerdloff (1969) and Freeman (1980) that for broad categories such projections do appear to provide reasonable results. For the major occupational groups, all three projections (Meltz and Penz 1968; Ahamad 1969; and COFOR82 1975) were within a range of ± 10 percent of the *ex post* actual employment for the majority of the groups. As might be expected, the projection accuracy declined as the occupational detail increased.

10 For an attempt to overcome the lack of time series data using a cross-sectional approach see Siedule and Leckie (1983).

However, these *ex post* evaluations do suggest that a variable coefficients model can provide useful additional information for occupational projections. Perhaps this is not surprising since it can be argued that such variation permits the model to capture some of the anticipated labour market adjustments outlined above that are omitted from the fixed coefficient methodology.

The findings in this paper do not suggest that it is possible to simply take on faith the results of any occupational projection. They do suggest, however, that such exercises can perhaps provide useful information for labour market studies, especially when combined with analyses of the functioning of particular labour markets.

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Évaluation ex post des projections occupationnelles au Canada 1961-1981

Les projections sur la main-d'oeuvre sont devenues, depuis les années 1970, un exercice critiqué tant sur le plan théorique que pratique. Ce n'est que dans les années 1980 que l'intérêt pour celles-ci renaît grâce à une ouverture aux modèles de prévisions peu complexes qui «semblent fonctionner». Cet article aborde dans un premier temps les questions d'ordre théorique et méthodologique. Par la suite, il rend compte d'une évaluation ex post de la précision numérique de trois systèmes de projections des emplois utilisés au Canada. Finalement, il compare les modèles à coefficient fixe aux modèles à coefficient variable.

Une première constatation porte sur le fait que les projections de main-d'oeuvre tiennent davantage du recours à une mécanique que d'un souci d'analyser fidèlement le marché du travail et qu'elles se basent essentiellement sur la demande de travail. En dépit de ces caractéristiques, ces projections fournissent des informations permettant au marché de minimiser ses coûts d'adaptation.

On remarque que la comparaison entre les projections et les conjonctures qu'elles tentent de prévoir se heurte au changement des définitions survenu au cours des ans. Conséquemment, des ajustement ont été nécessaires pour assurer un examen valable des données allant de 1961 à 1981. Cette recherche dénote pour les trois systèmes une sous-évaluation des emplois chez les cols blancs et le personnel de soutien et une sur-estimation de certains emplois de cols bleus. Enfin, l'ensemble des prévisions se situaient dans un intervalle de ±10%.

À la lumière des résultats, aucune méthodologie ne semble avoir le dessus sur les autres. Toutefois, un regard spécifique sur chaque prévision permet de constater la supériorité des modèles à coefficient variable sur ceux à coefficient fixe, surtout pour ce qui est des cols blancs. L'atout du modèle à coefficient variable repose sur sa capacité de recueillir les ajustements par anticipation du marché du travail, omis par la méthodologie du coefficient fixe.