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An overview of occupational forecasting in OECD countries

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1. Introduction

Projections of the structure of employment by occupation have not figured very prominently in recent discussions of labour market analysis in OECD countries. Yet occupational projections have been published for many years for Canada, France, the Federal Republic of Germany (i.e., West Germany), the United Kingdom, and the United States. During the 1980s there was a renewal of interest in a number of member countries in this kind of labour market information following the adoption of active labour market policies in the areas of employment, education, and training.

This interest has intensified in recent years as high levels of unemployment persist and policy makers look for information which would help to prevent the emergence of excess labour supply in many occupations and economic theorists focus on the role of human capital in endogenous growth models. In the last five years occupational forecasts have been published for Australia, Finland, Ireland and the Netherlands and work is under way on occupational forecasts for the European Union, Japan, Norway and Sweden.

2. Occupational forecasting in OECD countries before and after the first oil crisis

Occupational employment forecasts for OECD countries can be considered in terms of two time periods, from the end of the Second World War to the first oil crisis in the early 1970s and from the early 1970s to the present day. In the first period economists in Canada, France, the United States, and West Germany became concerned over the emergence of structural unemployment at a time when aggregate demand was quite strong. They were afraid there would be continuing shortages of qualified manpower in some areas (science, education, health) and surpluses of poorly educated workers in others (agriculture, building and construction). Denison's (1962) analysis of the sources of economic growth and the strong contribution to growth which highly educated workers could make focussed attention on the quality of the labour force. These developments stimulated

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demands for projections of the occupational structure of employment by manpower planners and policy makers responsible for the provision of education and training facilities.[1]

When employment in a particular occupation is growing, investment in the skills needed for the occupation is likely to be individually and socially profitable. Hence, current and planned training and education patterns should be skewed towards the growing occupations. Manpower planners argued in the early 1950s that occupational forecasts could play an important role in ensuring a smoother long-term adjustment of supply to demand in occupational labour markets, through educational planning procedures, than would have been possible by relying on market mechanisms alone. The manpower requirements method was developed by the United States Bureau of Labor Statistics in the 1950s to meet the need for evaluation of the future demand for labour. The projection models which were developed during the first period were strongly influenced by expectations of continuing economic growth and a prevalent belief in the government's ability to fine tune the economy. This belief manifested itself in relation to manpower forecasting in an expectation that projection results would be sufficiently accurate to enable planners to quickly adjust outflows of labour from education to the demands of production.

Table 1 shows the countries in which the manpower requirements method was used to make occupational forecasts during the 1960s and the 1970s and the main characteristics of the forecasts. This method was also adapted by Parnes (1962) for manpower planning and used in the OECD Mediterranean Regional Project to make forecasts of national educational needs over the period 1960–75 and to draw up plans to meet those needs.[2]

In Canada, France, West Germany, and the United Kingdom, where manpower forecasts were principally intended for decision makers with responsibility for the labour market and education, the projections were made for a small number of occupational groups whereas in the United States, where their primary role was for career guidance purposes, they were made for a large number of occupations. In all of the countries except the United States the number of industries for which employment forecasts were made exceeded the number of occupations—a reflection perhaps of the relative underdevelopment in the 1960s of human capital theory. The length of time for which forecasts were made varied from 3 years in the case of France to 15 years in the case of the United States. There periods were dictated by the different purposes for which the forecasts were required in different countries. In France, West Germany and the United Kingdom a relatively short time-horizon was used because of the link which planners wished to make between the medium-term demand for labour for production and the supply of labour by the education system. In the United States a long time-horizon was used because of the length of time it takes to educate and train highly skilled workers.

[1] The term 'manpower planning' was generally used throughout the 1950s and 1960s to describe attempts to bring the labour being supplied by the education system into balance with the demand for labour by the production system. It is now being replaced by the non-sexist term 'employment planning'.

[2] The Mediterranean Regional Project was initiated by bilateral agreements between the OECD and the governments of Greece, Italy, Portugal, Spain, Turkey, and the former Yugoslavia.

Table 1. *Main characteristics of early forecasts of occupational employment in OECD countries*

Country	Forecaster and date of forecast	Coverage occ × ind	Base–final year	Method	Area	Form of publication
Canada	Meltz and Penz (1968)	13 × 15	1961–1970	Trend extrapolation	Canada	Govt. report
France	CGP (1961)[a]	7 × 29	1962–1965	Project trend/adj. occ. coeffs.[b]	France	Govt. report
Germany, Fed. Rep.	Battelle Institut (1969)	52 × 35	1969–1976	Trend & RAS method	Germany Fed. Rep.	Batelle-Institut book
UK	MRG (1978)[a]	16 × 49	1978–1982	Project trend/adj. occ. coeffs.	UK	MRG report
USA	BLS (1963)[a]	162 × 124	1960–1975	Project trend/adj. occ. coeffs.	US	BLS reports

[a]BLS=Bureau of Labour Statistics, Washington; CGP=Commissariat General du Plan, Paris; MRG=Manpower Resources Group, Warwick.
[b]adj. occ. coeffs.=adjusted occupational coefficients. The occupational coefficients given by mechanical projection of the trend were adjusted in the light of quantitative information on developments in occupational labour markets.

Evaluations of the early forecasts for Canada, France, West Germany, the United States and for some of the countries participating in the Mediterranean Regional Project highlighted the difficulties of making projections accurate enough to finetune the educational qualifications of persons coming out of the educational system with the needs of the economy (see Hollister, 1967 and Ahamad and Blaug, 1973). They also showed that the relationships between education, training and occupation were far more complex than had been assumed. These results came at a time when there was a movement in Western European countries away from social engineering and finetuning of the economy. Concurrently the occupational projections which had been made in France and West Germany for the 1970s were thrown off target by significant underestimation of major structural transformations induced in the French and West Germany economies by the first oil price shock in the early 1970s.

These developments combined with the desire of some governments to distance themselves from occupational projections if it became politically necessary. Government agencies in some European countries withdrew from occupational forecasting work, or changed their approach, and educational planners began to look for forecasts to meet the social demand for education rather than to balance the supply and demand for labour by occupation. The Commissariat General du Plan in France, for example, decided not to give any comparisons of occupational supply and demand in the Seventh Plan for the period 1976–80 and not to include any occupational projections in the Eighth Plan for the period 1981–85. The Institut fur Arbeitsmarkt-und Berufsforschung der Bundesanstalt fur Arbeit (IAB—the Institute for Employment and Occupational Research at the Federal Institute for Labour) in West Germany developed a classification scheme for 'branches of activity' rather than for occupations.

Despite these attempts by government agencies to distance themselves from occupational forecasting work the demand for forecasts remained strong during the 1970s. Government agencies responded to this by commissioning forecasts from independent research organisations with specialist knowledge of the labour market. Occupational forecasters responded to the disappointing performance of the first generation models by adopting more flexible forecasting models, by focusing on medium-term rather than long-term issues, and by arguing that forecasts would be used to provide guidelines for active labour market policies rather than for educational planning purposes. They argued that good quality research and background information on occupational labour markets, even when not suitable for direct mechanical application by users, could improve policy making or enter effectively into individuals' career choices.

These responses led to the development of a second generation of occupational forecasting models from the late 1970s onwards. They were built on experience gained from the first generation models. They have been strongly influenced by the re-emergence of cyclical phases in economic growth and a realisation that occupational forecasting results are unlikely to be sufficiently accurate to permit fine adjustments in labour supply and demand because the data on which they are usually based are quite limited (see Youdi and Hinchliffe, 1985 and Hughes, 1991).

An overview is provided in Table 2 of the main characteristics of recent occupational employment forecasts for Australia, Canada, Finland, France, West Germany, Ireland, the Netherlands, the United Kingdom, and the United States.[1] The Department of Employment, Education, and Training has produced forecasts for Australia because of growing interest in the implications of occupational change for the likely structure of the workforce at the end of the century. Employment and Immigration Canada (now Human Resources Development Canada) produces regular forecasts mainly for career guidance purposes and it revises its forecasts every two years. The Ministries of Education and Labour have produced occupational and educational forecasts for Finland in connection with the 'Labour Force 2000' project (see Tiainen, 1994). The Commissariat General du Plan commissions forecasts for France from independent research organisations as background information for economic and social planning in France but it does not publish the results as part of the French Plan although the research organisation which makes the projections publishes them. IAB discharges its responsibility for labour market and occupational research for Germany under the 1969 Employment Promotion Act by commissioning forecasts by 'branch of activity' from an independent research organisation, Prognos AG, with which it jointly publishes the results. The Training and Employment Authority for Ireland (Foras Aiseanna Saothar [FAS]) and the Economic and Social Research Institute (ESRI) in Dublin have recently developed an occupational forecasting system for Ireland which it is intended to use to produce forecasts every two years or so. The Researchcentrum voor Onderwijs en Arbeidsmarkt (ROA—Research Centre for Education and the Labour Market) in Maastricht was commissioned in 1987 by the Dutch Ministry of Education and Sciences to produce educational and occupational projections for the Netherlands. Its forecasts are updated every two years. The Institute for Employment Research (IER) at the University of Warwick publishes occupational projections for the United Kingdom at intervals of about 18 months or so. The Bureau of Labor Statistics (BLS) revises its occupational projections for the United States every two years, and publishes them in the *Monthly Labor Review*.

The main objectives of the models which are currently in use in OECD countries in Europe are to highlight for policy makers the implications of existing occupational trends and to bring to their attention the effects which different courses of action could have on the level and structure of occupational employment in the future. In Finland, France, Germany, Ireland and the United Kingdom the forecasts are designed to provide for broadly defined occupational groups to meet the needs of policy makers for information on the current and future outlook for occupational labour markets. Hence, the forecasts are generally made for 50 or fewer occupational groups. In Canada and the United States the forecasts are intended to provide national career guidance services, career guidance counsellors, and individuals with information on the current and future employment outlook for a wide range of specific occupations and the projections are made for about 500 occupational sub-groups. The approaches taken in Australia and the Netherlands are intermediate between these two groups of countries. The forecasts for Australia were

[1] Details of the forecasts for some of these countries are given in *Employment Outlook 1994* (OECD, 1994, Ch. 2).

Table 2. *Main characteristics of recent projections of occupational employment in OECD countries*

Country	Agency/model and date	Coverage occ × ind	Base–final year	Method	Area	Form of publication
Australia	DEET (1991)	120 × 112	1991–2001	Project occ. effect[b]	Australia	Govt. report
Canada	COPS (1989)	497 × 67	1990–2005	Fixed/variable coeffs.	Canada/provinces	Govt. report
Finland	Ministry of Education and Ministry of Labour (1993)	50 × 10	1990–2010	Project occ. effect	Finland	Govt. report
France	BIPE (1989)	18 × 40	1986–1994	Project trend/adj. occ. coeffs.[a]	France	BIPE report
Germany (West)	IAB/PROGNOS (1989)	34 × 38	1987–2010	Project trend/adj. coeffs.	Germany, Fed. Rep.	IAB book
Ireland	FAS/ESRI (1993)	42 × 29	1990–1996	Project trend/adj. occ. coeffs.	Ireland	FAS/ESRI report
Netherlands	ROA (1994)	93 × 14	1993–1998	Regression incld. trend	Netherlands	ROA report
United Kingdom	IER (1991)	22 × 49	1990–2000	Project trend/adj. occ. coeffs.	UK and regions	IER report
United States	BLS (1993)	500 × 250	1992–2005	Project trend/adj. occ. coeffs.	US	BLS reports

Note: (1) BIPE=Bureau d'Information et de Previsions Economiques, Paris; BLS=Bureau of Labour Statistics, Washington; COPS=Canadian Occupational Projection System; DEET=Department of Employment, Education and Training, Canberra; FAS/ESRI=Foras Aiseanna Saothar—the Employment and Training Authority for Ireland/Economic and Social Research Institute, Dublin; IAB=Institut fur Arbeitsmarkt-und Berufsforschung, Nuremberg; IER=Institute for Employment Research, Warwick; ROA=Researchcentrum voor Onderwijs en Arbeidsmarkt, Maastricht.

[a]adj. occ. coefs.=adjusted occupational coefficients. The occupational coefficients given by mechanical projection of the trend are adjusted in the light of quantitative information on developments in occupational labour markets.

[b]Project occ. effect=project occupational effect derived from shift-share analysis of sources of change in employment.

made to bring out the implications of major trends in the economy for occupational employment and to find out if a more skilled workforce is needed. The forecasts for the Netherlands are intended primarily for career guidance purposes. In both countries the forecasts are made for around 100 occupational sub-groups.

In nearly all OECD countries for which occupational forecasts were made before and after the first oil crisis the projection period has lengthened and there has been an increase in the number of occupational groups for which projections are made. In the majority of countries in Table 2 the number of occupational groups used now exceeds the number of industrial groups—a sign of the development of human capital theory which has been made since the 1960s and also of the demands of policy makers for more detailed information on the occupational structure of employment.

Occupational forecasts now have two main roles—a policy role and an information role. Their policy function is to supply information on employment trends for broadly defined occupational groups for labour market decision makers. Their information function is to supply information on employment trends for a large number of occupational sub-groups which will make the labour market more transparent for career guidance counsellors, school leavers, employers, and other individuals. The policy role is summarised by Wilson (1992, p. 52) in a recent description of the work which the Institute for Employment Research does on forecasting changes in the structure of employment in the United Kingdom:

> Our prime objective . . . is to provide a set of 'points of reference' for policy makers and other interested parties. These should indicate the sort of economic environment they are likely to face, highlighting the main problem areas, quantifying the scale of any difficulties that may be foreseen, and estimating the impact of different policies.
> [Occupational] projections . . . provide a useful 'point of departure' for those interested in planning for the future. The alternatives are, on the one hand, to rely on past data 'to speak for itself' or, on the other hand to reject all attempts at quantification. The former is extremely restrictive and rules out the consideration of major structural change. It also provides little or no insight into the reasons for past developments. The latter alternative denies the very real need of policy makers for some guidance on the likely size of the problems they may face.

The information role is summarised by Dekker, de Grip, and Heijke (1994, p. 55) in an account of the work of the ROA in the Netherlands:

> The activities of the Research Centre for Education and the Labour Market (ROA) focus on increasing the transparency of the match between education and the labour market. A special effort is made to generate information on the labour market prospects of occupational groups and the graduates from various types of education. This information is primarily intended to assist young people in choosing an occupation or training course. The information can also play a role in answering policy questions as regard tuning training facilities to the needs of the labour market and how best to harness the potential of the population's qualifications to achieve economic growth.

3. How occupational forecasts are made

The basic data required to project a country's occupational structure are statistics of employment in each sector classified by occupation. Typically such data are

available for OECD countries from the Census of Population at five- or ten-year intervals and there are a number of countries in Western Europe and North America for which data are available at one- or two-year intervals from labour force surveys or special occupational employment surveys. Census and labour force employment statistics are usually cross-classified by occupation and industry to give the employment matrix which is required to produce forecasts of the occupational structure of employment in conjunction with macroeconometric or Input-Output projections of employment by sector in a target year. A variety of methods can be used to make occupational employment forecasts. They can be divided into matrix and single cell methods. Matrix methods take account of interrelationships between the cells of the employment matrix whereas single cell methods treat each cell as if it were independent of the other cells. In the early days of occupational forecasting there were experiments with the RAS matrix model.[1] They showed that the performance of the RAS model was reasonably satisfactory. However, it proved difficult to give a meaningful economic interpretation of the results, as Evans and Lindley (1973) note, and this model is now most often used to fill in the cells of occupation by industry or occupation by education matrices where information is available on total employment by occupation, industry, and occupation (see van Eijs and Borghans, 1993).

Most OECD countries face difficulties in making occupational forecasts because there are normally only two or three data points available on occupational employment from the Census of Population. Hence, relatively simple single cell methods have to be used to extrapolate trends in occupational shares. It has been found from experience that these methods give the best results when combined with expert knowledge of the current position in occupational labour markets and judgement of what is likely to happen during the projection period. In all of the countries in Table 2, with the exception of Australia, Finland, and the Netherlands, trend projection methods are used and the results are adjusted in the light of expert assessment of likely developments in occupational labour markets. For Australia a shift-share analysis is used to identify the size of the occupational effect on employment during the intercensal periods 1971–76, 1976–81 and 1981–86 and the trend in the occupational effect is extrapolated to the end of the century. A similar approach is used in making forecasts for Finland. For the Netherlands the forecasts are made using regression equations which incorporate the influence of economic variables on the occupational composition of employment. However, a recent evaluation of forecasting results for the Netherlands for the period 1987–94 by Borghans, van Eijs and de Grip (1994) shows the importance of including a trend term in the forecasting method and the latest forecasts for the Netherlands rely more heavily on recent trends than earlier forecasts.

A standard approach to occupational forecasting work has now been developed and it provides a framework for producing forecasts which is used by most of the agencies involved in this kind of work in OECD countries. The forecasts are made in a sequence of steps which yield estimates of labour requirements by occupation given the growth which is expected to take place in the economy during the

[1] The RAS model grew out of work by Stone and others on the Cambridge Growth Project on the temporal behaviour of Input–Output relations.

projection period. These steps involve consideration of the size of the labour force in the base year and its expected size in the target year, employment in each sector in the base and target years, and projections of the occupational composition of employment within each sector in the target year.

Some forecasting agencies such as IAB in Germany, ROA in the Netherlands, and Human Resources Development in Canada take the further step of linking occupation with education and forecasting the demand for labour by type of education (see Tessaring, 1994; Dekker, de Grip, and Heijke, 1994; and Employment and Immigration Canada, 1983). Comprehensive data on the course of study being followed by those in the education and training systems and on the educational composition of occupations are required before the demand and supply sides of occupational labour markets can be linked in this way. The absence of good educational data for a number of OECD countries and the hazy correspondence between education and occupation has probably hindered the development by other forecasting organisations of supply-side models to match demand-side models.

4. Criticisms of occupational forecasting

When forecasts of the occupational structure of employment are combined with independent forecasts of labour supply, based on examination of retirements from the labour force and entries to occupations from the educational system, large discrepancies between supply and demand are often projected. In practice, such large discrepancies may not arise because when unemployment rates for particular occupations are high workers may be able to switch to different occupations. When vacancy rates are high, wages may rise to choke off excess demand, workers may train for the skills which are in short supply, and employers may adjust production techniques to substitute workers with a related skill who are in plentiful supply. The important question is: how long does it take the labour market to make these adjustments?

Economists differ in their answers. In general, neo-classical economists argue that labour markets are flexible, that skill substitution is relatively easy, and that wage differentials adjust to quickly eliminate any imbalances which affect particular occupations. This capacity of the economy to adjust means that there is very little need for occupational forecasts, and even less for government intervention in the labour market (see Psacharopoulos, 1991). However, it is accepted that there is a need for information on the skills and occupations in which the best returns to investment in human capital can be earned. Individuals should move into occupations which currently have low unemployment rates and which have high wages, relative to the investment in training they require. This is the commonsense basis of the human capital approach which was developed by Becker (1964) and others during the 1960s.

Institutional and Keynesian economists argue, in the main, that labour markets are relatively inflexible, that skill substitution is difficult, and that wage differentials do not adjust quickly to clear the labour market. For example, Heijke (1994, p. 1) has recently argued that:

The labour market is certainly not flexible in its operation. There are many separate submarkets, differentiated by occupation and types of training, among other things, and these submarkets are seldom in equilibrium. Alongside submarkets with shortages one finds others with surpluses, and in many submarkets periods of shortages alternate with periods of surplus.

and that:

. . . events in the market and the trends which are emerging in the market are not sufficiently transparent for the actors in the labour market to be able to respond to them appropriately.

Lindley (1980, p. 15) notes that 'evidence of market failure or very slow operation of the market mechanism is commonplace' at microeconomic level. Haskel and Martin (1990) point out that business surveys show that skill shortages existed throughout the countries of the European Community during the period 1987–89 and they also argue (Haskel and Martin, 1992, Abstract) that in the United Kingdom during the period 1983–86 'if the percentage of firms suffering skill shortages had not risen over this period, productivity growth would have been 5.4% per annum rather than the actual figure of 4.7%.'

The Commission of the European Communities (1991, Chapter 7, p. 127) presents evidence in an article on skill shortages in Europe that the Community's quarterly business surveys 'suggest that, over the period 1982 to 1990, recruitment difficulties increased throughout the Community, with the exception of Ireland and Denmark'. In 1982 when the number of unemployed in the EC was nearly 13.0 million, the index of recruitment difficulties, based on the Community's quarterly business surveys, was 2.0. In 1986 when the number of unemployed had risen to 15.6 million, the index of recruitment difficulty had risen to 5.0 and in 1990 when unemployment had fallen to 12.5 million, the index had risen to 9.0. This and other evidence on the extent of skill shortages suggests that such shortages can persist for a long time even when the unemployment rate is quite high.

It is also worth noting that an examination of the changing relationship between unemployment and vacancy data during the 1970s and 1980s in the OECD *Employment Outlook 1992* (OECD, 1992, p. 67) concluded that 'since the early 1970s, most countries have had an outward movement of the Beveridge curve and this seems to have occurred on a fairly wide scale in the 1980s'. Hence, adjustment mechanisms for job matching appear to have become less effective despite the efforts which have been made in many OECD countries to increase labour market flexibility to improve the match between the skills workers have and the skills employers are looking for.

Differences between neo-classical and institutional and Keynesian perspectives on how labour markets work lead to opposing views on the need for government intervention in the labour market. There is very little room in the neo-classical perspective for governments to pursue active labour market policies because labour market adjustment mechanisms are thought to be sufficiently flexible to eliminate any imbalances which occur in occupational labour markets.

The important role which social rules, collective action, and custom and tradition play in the operation of labour markets convinces many institutional and Keynesian

economists that there is a need for government action to improve the flow of information, to overcome market failures and to eliminate restrictive practices.

The implications of these contrasting views for labour market policies can be illustrated by the case of training.[1] Neo-classical economists argue that investment will be made in training if the present value of additional future earnings outweighs the present value of wages foregone to pay for the training. This calculation is made by individuals in the case of general training and by firms in the case of specific training. Since collectively the decisions of individuals and firms are believed to lead to the optimal amount of training being undertaken there is no room for government intervention to improve on this outcome.

Institutional and Keynesian economists argue that imperfections in capital and labour markets provide some workers with better access to training opportunities and credit than others and that private decisions about training are based only on private costs and benefits. The exclusion of social costs and benefits from the investment decision means that the amount of training provided is not optimal so there is room for government intervention to provide better access to training opportunities and financial assistance.

5. Track record of occupational forecasts

Evaluation of occupational forecasts have proved difficult for some countries because of intercensal revisions to the classifications used to make them. In the United States, for example, forecasts were made in the early 1960s for 162 occupations for the period 1960–75. Changes in the occupational classification system between the 1960 and 1970 censuses left only 76 of the 162 detailed occupations sufficiently comparable for evaluation.[2]

The results of evaluations for Canada, France, the Netherlands, and the United States are given in Table 3. There is no absolute way of judging the performance of occupational projections so three different measures are used in Table 3. The first is the mean absolute percentage error (MAPE):

$$\text{MAPE} = 1/n \Sigma |E_j|,$$

where E_j is the percentage error for the category j and n is the number of categories. This statistic is a common summary measure for evaluating the general performance of projections.[3] The second measure is the distribution of the forecast errors. This provides information on the accuracy with which the actual values in the cells of the occupation by industry matrix are projected. Table 3 shows what proportion of the cells were projected to within plus or minus 10%, 10 to 20%, and more than 20%

[1] The following paragraphs are based on discussions of the case for training by Hasluck and Duffy (1992) and Chapman (1993).

[2] There are other classification problems which can effect evaluation of the accuracy of occupational forecasts. The *Employment Outlook 1987* (OECD, 1987, p. 68) describes the process of 'grading creep' or 'classification drift' in which employees in low skill occupations are regraded and the numbers employed in high skill occupations increase.

[3] This measure depends on the aggregation level which is used and it may be unduly influenced by poor forecasts for very small occupations. Ideally the forecast error should be weighted by the size of the occupation. The unweighted average is used as the information required to estimate the weighted average is not available for most of the forecasts given in Table 3.

Table 3. *Accuracy of occupational projections made from 1960–1987 for the United States, Canada, France, and the Netherlands*

Country	Forecaster	Period	Occs.	MAPE	Percentage error <10	10–20	>20	Range (%)
United States	BLS	1960–75	76	21%	29	37	34	−43 to +136
	BLS	1960–75	9	6%	89	11	0	−7 to +10
	BLS	1970–80	64	22%	38	12	50	−47 to +89
	BLS	1970–80	9	7%	67	33	0	−17 to +1
	BLS	1980–90	131	21%	26	34	40	−97 to +56
	BLS	1980–90	8	9%	63	25	12	−22 to +16
Canada	Melz and Penz	1961–71	12	10%	58	33	8	−46 to +15
	Ahamad	1967–75	12	12%	42	42	16	−40 to +14
	COFOR82	1974–81	10	13%	70	0	30	−43 to +10
	COPS	1986–92	79	12%	35	27	38	−47 to +25
	COPS	1986–92	20	7%	71	24	5	−26 to +44
France	CGP	1966–70	105	(10%)		n.a.		−63 to +21
	CGP	1966–70	16	(6%)	94	6	0	−15 to +9
	CGP	1971–75	40	(12%)		n.a.		n.a.
Netherlands	ROA	1987–92	73	23%		n.a.		−75 to +138

Sources: United States: Carey (1980), Carey and Kasunic (1982), Rosenthal (1992); Canada: Meltz and Penz (1968), Foot and Meltz (1992); France: Psacharopoulos (1973), Paul (1985); The Netherlands: Borghans, van Eijs and de Grip (1994).

of the actual value. The third measure is the range of projections. This shows whether the projections fall within a broad or narrow band around the actual values.

Occupational projection agencies often use the first and second measures to assess the accuracy of their projections by comparing them with what are judged to be reasonable standards. A mean absolute percentage error of less than plus or minus 10% is often used as a standard of accuracy (Blaug, 1967, p. 279). Another standard which is used is whether at least half of the cells are projected to within plus or minus 10% of the actual value. It is clear from the figures in Table 3 on the mean absolute percentage errors and the percentage of cells forecast to within plus or minus 10% of the actual value that the performance of the projections for major occupational groups is satisfactory but that there is considerable scope for improving the projections for occupational sub-groups.

Figure 1 shows that the average forecast error increases as the number of occupational groups for which forecasts are made increases. A regression of the average errors in Table 3 on the number of occupational groups shows that about half of the increase in the forecasting error can be attributed to an increase in the number of occupational groups. The fact that there is greater uncertainty about the accuracy of the forecasts when the number of occupational groups increases may not be as big a drawback as it appears. A *qualitative* indication of the direction of change in the demand for particular occupational sub-groups may be very useful. Weather forecasters used to produce only general descriptions of the weather before

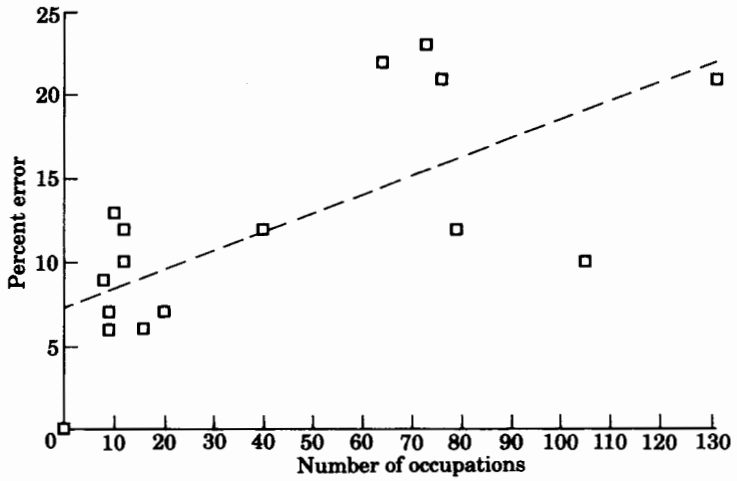

Fig. 1. Relationship between forecasting error and number of occupational groups.

they developed models which would predict when rain would start, how much of it there would be, and when it would stop (see Griffith, 1994). The handbooks which are used in Canada and the United States to provide occupational labour market information to guidance counsellors and job seekers and the labour market reports on education and occupation in the Netherlands give qualitative assessments, rather than precise projections, of the job outlook for specific occupations. The Research Centre for Education and the Labour Market in Maastricht, for example, in its reports on the occupational employment outlook describes job prospects as 'poor', 'moderate', 'reasonable', and 'good' and the National Careers Guidance Information Centre for the Netherlands uses these descriptions in its step-by-step guide for guidance counsellors for diagnosing the employment position and employment prospects of a wide variety of courses of study (see Landelijk Dienstverlenend Centrum, 1993).

7. Conclusions

Occupational employment forecasting has been inhibited by its early association with economic planning. However, labour market analysts have been clear, since at least the mid-1970s, that the initial emphasis which was placed in some OECD countries on the uses of occupational forecasts for such planning was misplaced. They responded to criticisms of the first generation models by reappraising their methods, improving labour market information, and providing forecasts for policy makers to use in developing active labour market policies.

Occupational forecasting has also suffered from unrealistic expectations of the accuracy with which demand and supply in occupational labour markets can be predicted. The performance of forecasts for major occupation groups has been satisfactory according to normal standards of accuracy for economic forecasts but there is considerable room for improvement at the level of occupational sub-groups. There is some evidence of improvement over time in the accuracy of occupational

forecasts. The average error for the United States forecasts at occupational sub-group level did not change as the number of occupations increased between 1960 and 1980 and the average error of forecasts for Canada did not change for major group forecasts made in 1967 and for sub-group forecasts made in 1986. In general, experience during the last three decades with occupational forecasts has been similar to that with macroeconomic forecasts. Assessments by Wallis (1989) and Zarnowitz (1991) of macroeconomic forecasts made in the 1960s and the 1980s show that their performance has been very mixed and that there is considerable room for improvement. Considerably more resources have been devoted in OECD countries to improving macroeconomic forecasts than occupational forecasts. Macroeconomic forecasters recognise that the task of forecasting has become tougher over time as the advantages of better forecasting techniques are eroded by an increasingly complex economic structure (see Greenspan, 1991) and that 'there is little doubt that it will always disappoint the hopes of many, but also a high probability that it can be developed well beyond its present early stage' (Zarnowitz, 1991, p. 25).

Briscoe and Wilson (1993, p. 11) note that 'quite sophisticated systems of demographic accounts were developed in the 1960s to parallel the national economic accounts' but that 'lack of government interest has meant that these have not been developed in line with the financial accounts' and 'as a result, employment models have not flourished to the same degree as the macroeconomic models based upon the economic accounts'. Occupational forecasting work in OECD countries is constrained by a number of factors which inhibit the development of better models and better understanding of the implications of current trends for the occupational structure of employment. Lindley (1994) identifies eleven constraints which inhibit the development of this work. The main data constraints are lack of time-series observations on employment by occupation and information on pay, hours of work, and conditions of employment which correspond with the occupational data, relatively small sample sizes for occupational data, inconsistencies among the occupational classifications used by different sources and by the same source at different times, partial coverage of new occupations and weak coverage of expanding sectors such as services, and, finally, international differences in occupational classifications.

Progress in relaxing the constraints on the development of better occupational forecasting models could be made by giving priority to improving the basic data on which the models are based. If this were done, other constraints relating to resources, dissemination and uses of occupational forecasts might yield more readily in the future to attempts by government agencies and research institutes to meet the needs of decision makers for information which is essential for the formulation of active labour market policies for education, training, and employment.

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