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The Medium Term Outlook for Labour Demand: An Economy Wide Assessment

by

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The Centre of Policy Studies (COPS) is a research centre at Monash University devoted to quantitative analysis of issues relevant to Australian economic policy. The Impact Project is a cooperative venture between the Australian Federal Government, Monash University and La Trobe University. COPS and Impact are operating as a single unit at Monash University with the task of constructing a new economy-wide policy model to be known as *MONASH*. This initiative is supported by the Industry Commission on behalf of the Commonwealth Government, and by several other sponsors. The views expressed herein do not necessarily represent those of any sponsor or government.

ABSTRACT

This paper presents a detailed assessment of the medium term outlook for the demand for labour in Australia. Forecasts are reported for employment by industry, by occupation, by State and Territory, by hours worked and by skill level. The forecasts are driven, in the first instance, by a fully articulated view about the outlook for the macroeconomy. This macro view is then combined with projections for various industry specific variables prepared by relevant expert organisations. Coherence between the different sources is ensured by incorporating them in a single simulation using the MONASH model, a large applied general equilibrium model of the Australian economy. In deriving the forecasts, attention has been paid to the effect of technological and social change on the structure of the economy in recent years , and to the implications of that change for future labour demand. The paper deals particularly with technical change which affects the distribution of employment across occupations within industries, and the distribution across different categories of hours worked within occupations. Tables are included to illustrate how the forecasting system can be interrogated to reveal

- the contributions of various industries to employment growth for a selected occupation, and
- the relative importance of output growth, capital growth and labour saving technical change to industry employment growth.

The paper concludes with a review of some issues associated with making a proper assessment of the forecasts.

J.E.L. Classification Numbers: C68, D58, E47, J21.

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1. Introduction

The demand for labour depends on many factors. It depends on the state of macroeconomic health of the domestic economy and of the economies of trading partners. It depends on the amount of capital investment and on its allocation between industries. It depends on the pace of technical change and on changes in government policy. Moreover all these factors are interconnected. Developments in one industry (the introduction of computers in the service sector, for example) affect the demand for labour in other industries (in this case, in the manufacturing industry that produces computers). In this paper we provide an assessment of the medium term prospects for labour demand that incorporates all these factors in the form of a set of formal economy-wide forecasts. The forecasts are derived using the *MONASH* forecasting system.

Labour market forecasting is an uncertain activity, but few historical analyses are conducted purely for the sake of understanding what has happened in the past. Rather, the past is generally of interest because it provides a guide to what will happen now or in the future and, in that case, any uncertainty associated with extrapolating from historical experience cannot be avoided. This imperative is well illustrated by the role of labour market analysis in determining an efficient allocation of resources for training. For training purposes, it is mandatory that the future demand for labour of different types be forecast in one way or another. It takes time to conduct a training course. Furthermore, the skills that result are generally expected to retain their social usefulness for an extended period after the completion of the course. A decision to implement a training program *must* be informed by a view about the future, either explicitly or implicitly.

Three other features of the provision of training have been influential in the development of the methodological approach adopted in the present study. Firstly, many types of training are vocationally specific at a high level of detail, so the labour market forecasts must be highly disaggregated. Secondly, training must be undertaken now. Whatever the deficiencies of the existing methods for projecting future labour demand, many decisions about training simply cannot await the creation of new methods to rectify those deficiencies. Hence efficiency in the provision of training services requires not only an ongoing commitment to improving our forecasting systems, but also a commitment to making the best use of the systems that are actually available at any point of time. Thirdly, when disaggregated forecasts of labour demand by occupation and industry are added together, the resulting forecast of aggregate demand must be consistent with some plausible scenario for the macroeconomy. That is, disaggregated forecasts of labour demand must be made with an economy-wide perspective.

The balance of the paper is organised as follows. Section 2 provides an overview of the *MONASH* system and presents forecasts for various macroeconomic variables, for output and employment by industry, and for employment by occupation, by region, by hours worked and by skill level. An important determinant of the demand for labour by occupation is the occupational share effect, that is, changes in the distribution of employment across occupations within industries. Section 3 describes how forecasts of this effect are derived. The final section considers the question of how to assess the forecasts. In particular, it argues that the forecasting system should be regarded as an analytical tool of considerable power, and not simply as a black box whose efficacy can only be determined by comparing its predictions with actual subsequent outcomes. While we consider the effects of a wide range of factors on the demand for labour, we do so only from the perspective of our chosen methodology. For a recent review of other literature on labour demand, the reader is referred to Lewis and Seltzer (1996).

2. The *MONASH* Forecasting System[1]

2.1 An Overview

Since 1993, the Centre of Policy Studies (COPS) at Monash University has been preparing year-by-year forecasts for the Australian economy extending over a total planning horizon of eight years. An important purpose of the forecasts is to provide a coherent framework for planning the distribution of resources for vocational education and training. Hence, the forecasting system must be very detailed and, in the COPS forecasts, this requirement is achieved via a large dynamic applied general equilibrium model, the *MONASH* model. The elements of the forecasting system are set out in Figure 1.

A *MONASH* simulation takes as inputs:

- information about prospects for the macro economy provided in part by the commercial forecasting agency Syntec Economic Services;
- forecasts for export prices and volumes compiled by the Australian Bureau of Agricultural and Resource Economics (ABARE) and the Bureau of Tourism Research (BTR);
- Industry Commission (IC) estimates of changes in protection implied by the industry policies of the government;
- estimates of future changes in technology and consumer tastes based on research undertaken by COPS.[2]

The results of a *MONASH* simulation include detailed forecasts of output and employment by industry, occupation and region. For the purposes of the national and State training agencies, the forecasts of employment by occupation are of most interest. As we shall see, the factors that influence the employment prospects for particular occupations are many.

The first role of a formal forecasting system is to supply a framework for incorporating relevant data into the forecasting process. Published data accessed by *MONASH* includes the national accounts, input-output tables, State

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[1] The discussion in subsections 2.1, 2.2 and 2.3 draws on Adams et al. (1994) and Dixon and Rimmer (1996).

[2] This research is reported in Dixon and McDonald (1993) and in Section 3 of the present paper. The forecasts presented here contain information from an update of the former study that is unpublished as yet.

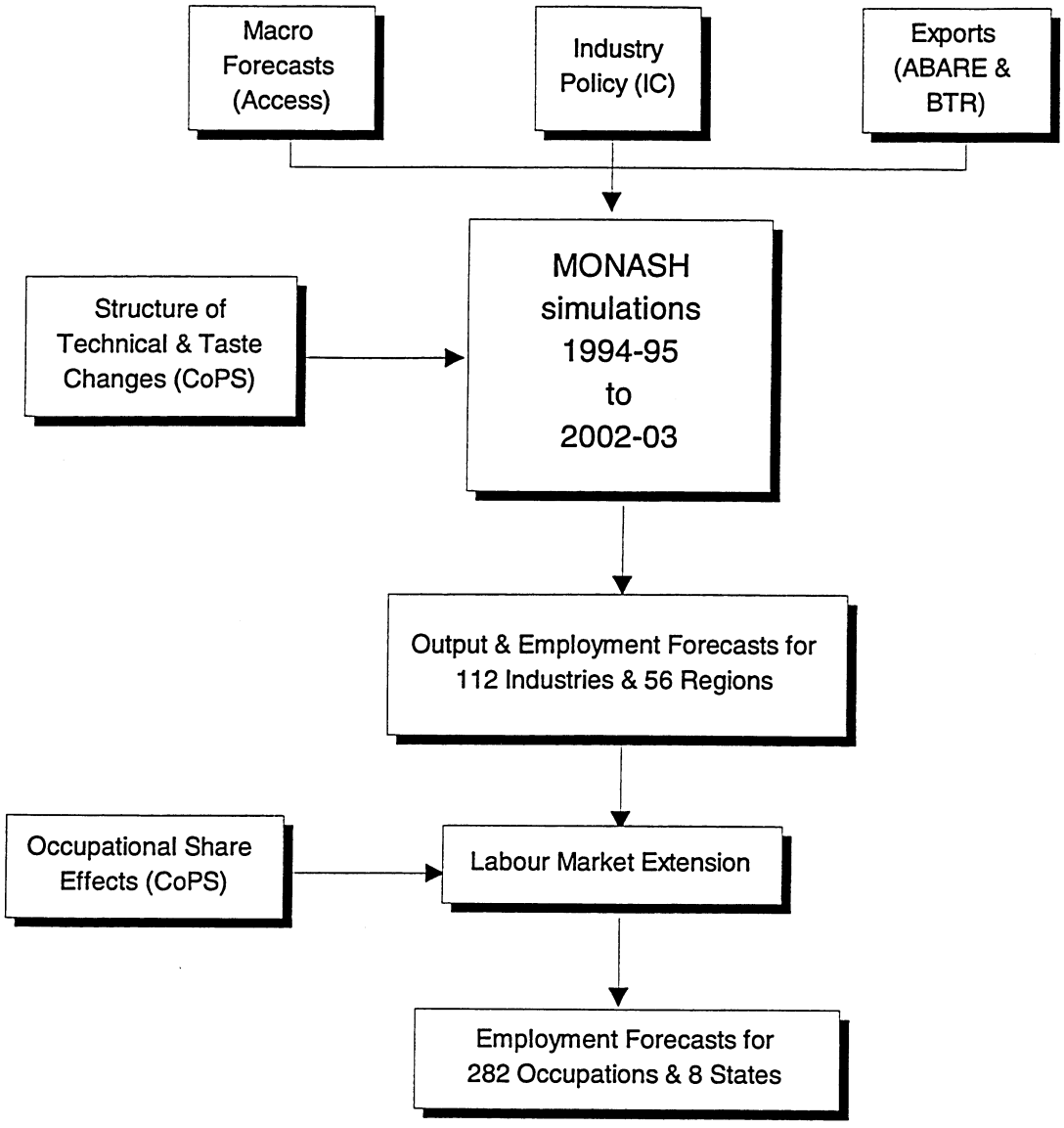

Figure 1. The MONASH Forecasting System

accounts, population censuses, foreign trade statistics, capital stock statistics, and income and expenditure surveys. Additional unpublished material is prepared by the Australian Bureau of Statistics especially for the system. Moreover, as a formally specified system, *MONASH* requires all its data to be consistent. If any inconsistencies do exist in the primary sources, they must be reconciled before the data can be included. This consistency requirement makes the system especially powerful as a framework for organising data.

As well as data about the past, formal or model-based forecasts must rest upon informed opinion about future changes in variables that are *exogenous to* (i.e., determined outside) the model. *MONASH* is quite adaptable in this regard. It already incorporates the views of many expert bodies and can accommodate more detailed exogenous forecasts as they become available. It can also produce alternative forecasts corresponding to competing views about the future. Just as for historical data, all opinions formally incorporated in a particular forecast must be consistent with each other. A forecaster using *MONASH* must either seek a consensus between the expert bodies involved in forecasting the exogenous variables or impose his/her own judgement to resolve any outstanding differences before the forecast can proceed. In other words, the *MONASH* system provides a framework for coordinating both historical data and expert opinion about the future that bear on the training issue.

2.2 Macro Forecasts

A *MONASH* forecast of employment by occupation results from a four stage process. It begins with a macroeconomic outlook derived from regular forecasts published by Syntec Economic Services and Access Economics. As an exporter of primary products, Australia is very dependent on developments in the world economy. According to the macro outlook, world economic growth is likely to continue at a slow but sustained pace in the medium term, with relatively strong growth in the United States eventually stimulating recovery in Japan and Europe. Hence commodity prices are expected to gradually strengthen, generating an improvement in Australia's terms of trade and allowing gross domestic product (GDP) to grow at an average rate of about 2.7% per annum over the period 1994-95 to 2002-03. A feature of the macro forecasts with important structural implications is the rapid expansion of

exports and imports relative to GDP. That is, the trend established during the period 1986-87 to 1994-95 is expected to continue. Investment expenditure is forecast to grow more rapidly than it has in recent years, primarily due to a recovery in private non-dwelling construction from historically low levels in 1994-95. The macro forecasts for GDP and its components are presented in Table 1.[3]

Table 1. Average Annual Growth Rates, Selected Macro Variables, Per Cent

	Variable	Historical Data 1986-87 to 1994-95	Forecast 1994-95 to 2002-03
1	Private consumption	3.3	2.8
2	Public consumption	0.5	1.2
3	Investment	1.9	2.9
4	Exports	7.8	7.6
5	Imports	6.6	7.3
6	Gross Domestic Product	2.8	2.7

2.3 Forecasts of Output by Industry

The second stage in the process is to convert the forecast for aggregate output (or GDP) into forecasts of output by industry. The structural forecasts supplied by the expert bodies indicated in Figure 1 are incorporated at this stage. For Australia's traditional agricultural and mining exports, ABARE forecasts good prospects (i.e., growth rates in excess of 5.0% per annum) for *Wheat*, *Non-ferrous metal ores*, *Black coal* and *Processed metal ores*, middle prospects (in the range 2.5% to 5.0%) for *Coarse grains, Oil and Gas, Iron ore* and *Meat products*, and poor prospects (less than 2.5%) for *Wool, Sheep, Sugar* and *Fishing*. International tourism has grown very rapidly in Australia in recent years and now accounts for more than 10% of aggregate export receipts.

[3] Although *MONASH* generates forecasts on an annual basis, we report only averages over the eight year planning horizon in this paper.

The BTR expects international tourism to continue to grow strongly at about 10.5% per annum during the forecast period, with extra growth in the Olympic year 2000-01. At the industry level, tourism enhances the growth prospects of *Air transport*, *Entertainment and leisure*, *Restaurants and hotels* and *Personal services*. The government's program of phased reductions in barriers against manufactured imports, as interpreted for the *MONASH* model by the Industry Commission, results in poor prospects for *Textiles, clothing and footwear* and *Motor vehicles and parts*. The COPS forecasts of changes in consumer tastes and intermediate input using technical change are also included at this stage. As examples of the effects of these changes, the former type favours growth in the output of *Vegetables* but inhibits growth for *Tobacco* and *Alcoholic beverages*; the latter type favours the use of *Communications*, *Financial services* and *Electronic equipment*. Total factor productivity is forecast to improve in almost all industries.

These considerations are evident in the output forecasts for twenty one industries presented in the first column of Table 2.[4] Among the industries with the best prospects, *Communication*, *Other machinery* (which includes electronic equipment), *Metallic mineral products* and *Finance, property and business services* are all favoured by forecast changes in technology which result in their outputs being used more intensively by other industries. The forecast for *Construction* is driven by the rapid growth in private non-dwelling investment. A large part of the output of *Transport and storage* consists of margins on the activities of other industries and hence this industry benefits from the rapid growth in exports and imports. However, its advantage from this source is partially offset by adverse effects of technical change, such as the miniaturisation of electronic equipment. Among the more slowly growing industries, *Textiles, clothing and footwear* suffers from the phasing out of protection while cuts in public expenditure, especially in 1995-96 and 1996-97, operate against *Public administration and defence* and *Community services*.

It is worth emphasing that much of the information built into our forecasts (such as estimates of future tariff levels or future commodity prices) is simply unavailable from the historical record. The information may well come with its own measure of uncertainty but, provided one is interested in the future

[4] As indicated in Figure 1, *MONASH* produces output and employment forecasts for 112 industries in 56 regions. For reasons of space, we present only forecasts for 21 industries in this paper.

prospects for labour demand and not in economic history, it is relevant information. To eschew a formal forecasting methodology because the future is uncertain serves only to pass up valuable information.

2.4 Forecasts of Employment by Industry

Forecasts of output by industry are converted to forecasts of employment by industry[5] at the third stage, and results of the conversion are shown in the third column of Table 2. The output and employment forecasts are related by production functions which determine the increase in output associated with given increases in inputs (capital and labour) and a given rate of primary factor saving technical change. The influence of capital growth and technical change can produce quite different output and employment forecasts for some industries. The change in capital inputs depends critically on whether an industry was under- of over-capitalised in the base period (i.e., on whether the rate of return in the industry was above or below the average across industries). An industry with a relatively high rate of return attracts investment and enjoys a relatively high rate of capital growth. For a given rate of output growth and technical change, this implies a relatively low rate of employment growth. Similarly, an industry with a relatively rapid rate of technical change will tend to have a relatively low rate of growth in employment. Thus, for *Utilities*, output is forecast to grow at a healthy 3.54% per annum while employment contracts by 0.14% per annum. For this industry, primary factor saving technical change is responsible for significant job losses at the same time as it reduces costs and provides a source of output growth. Note that, as the output of industries in the service sector is often measured by the amount of inputs the industries use, the scope for labour saving technical change is limited, and output and employment growth tend to grow at similar rates.

[5] We shall assume that employment is always demand determined and often refer to employment when, stictly, we mean labour demand

Table 2. Industry Forecasts, 1994-95 to 2002-03, Per Cent Per Annum

	Industry	Growth Rates				Total Factor Productivity	Labour Productivity
		Output	Capital Inputs	Labour Inputs	Factor Inputs		
1	Agriculture, forestry and fishing	3.54	-1.44	-1.33	-1.18	4.71	4.87
2	Mining	4.30	2.26	0.21	1.99	2.31	4.09
3	Food, beverages and tobacco	2.89	-0.13	0.31	0.42	2.47	2.58
4	Textiles, clothing and footwear	0.67	-0.78	-0.65	-0.69	1.37	1.32
5	Wood, wood products and furniture	2.55	-0.21	1.37	0.77	1.79	1.18
6	Paper, paper products, printing, publishing	3.08	3.56	1.27	2.24	0.84	1.81
7	Chemical, petroleum and coal products	5.16	0.13	2.46	2.07	3.08	2.70
8	Non-metallic mineral products	3.81	-1.96	2.08	0.86	2.95	1.73
9	Metallic mineral products	5.56	-2.76	3.61	2.71	2.86	1.96
10	Transport equipment	3.94	-1.64	-1.44	-1.29	5.23	5.38
11	Other machinery	8.19	-0.72	2.69	3.18	5.02	5.51
12	Other manufacturing	3.71	-0.42	1.57	1.22	2.50	2.14
13	Utilities	3.54	-0.22	-0.14	-0.20	3.74	3.68
14	Construction	6.28	0.85	3.76	4.08	2.21	2.53
15	Wholesale and retail trade	3.41	0.53	1.50	1.55	1.86	1.91
16	Transport and storage	4.81	0.55	3.71	3.12	1.69	1.10
17	Communication	7.81	0.70	-1.01	-0.14	7.96	8.82
18	Finance, property and business services	5.41	2.46	3.33	2.76	2.65	2.09
19	Public administration and defence	1.09	-0.58	-0.27	-1.08	2.17	1.35
20	Community services	2.73	0.61	0.93	0.86	1.87	1.80
21	Recreation and personal services	3.60	2.57	2.25	2.42	1.18	1.36
	All industries	4.32	1.59	1.75	1.84	2.48	2.57

2.5 *Forecasts of Employment by Occupation*

The final stage in the process is to convert the employment forecasts from an industry basis to an occupational basis. Results for fifty two occupations are reported in Table 3.[6] Employment growth (measured in hours) for a particular occupation can be decomposed into a component due to the growth in aggregate employment, a component (the *industry share effect*) due to changes in the distribution of employment across industries and a component (the *occupational share effect*) due to changes in the distribution of employment across occupations within industries. The forecast for aggregate employment is already known from Table 2 as 1.75% per annum. The industry share effects can be computed from the growth rates in employment by industry using an industry by occupation employment matrix obtained from the Population Census. The occupational share effects are considered to be primarily due to technical change, and are forecast by extrapolating from historical values. The method is described in some detail in the next section. For the moment, it is sufficient to observe that occupational share effects are generally at least as important as industry share effects in determining employment by occupation.

If the first three columns in Table 3 are added together, one obtains our forecast of employment demand measured in hours. Thus, for example, employment for the occupation *General managers* (code 12) is expected to contract by 4% per annum (1.75 + 0.29 - 6.04). However, from the fourth column of the table, the average hours per worker in this occupation is expected to increase by 0.28% per annum. Hence employment measured in persons is forecast to contract by 4.28% per annum. The last column indicates that the outlook for this occupation is worse than all the others shown except *Legislators and government appointed officials*. The change in average hour hours per worker in each occupation is assumed to be the same as its trend value during the period 1986-87 to 1994-95, the trend being estimated from quarterly Labour Force Survey data.

An exhaustive analysis of the occupational forecasts for the ASCO minor groups is outside the scope of the present paper. Rather we shall illustrate the kind of analysis that is supported by the *MONASH* system with a couple of

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[6] For occupations, *MONASH* produces employment forecasts by State for the 282 unit groups of the Australian Standard Classification of Occupations (ASCO). Here we report only forecasts for the 52 ASCO minor groups.

Table 3. Composition of Occupational Employment Growth, 1994-95 to 2002-03, Per Cent Per Annum

Code	Occupation	Growth Effect (hours)	Industry Share Effect	Occupational Share Effect	Hours Effect	Growth Rate (persons)	Rank
11	Legislators and government appointed officials	1.75	-1.82	-5.17	0.19	-5.05	52
12	General managers	1.75	0.29	-6.04	-0.28	-4.28	51
13	Specialist managers	1.75	0.14	1.57	-0.55	2.91	15
14	Farmers and farm managers	1.75	-2.95	-0.45	0.14	-1.51	47
15	Managing supervisors (sales and service)	1.75	0.18	0.91	0.00	2.84	16
16	Managing supervisors (other business)	1.75	0.85	3.38	-0.25	5.72	1
21	Natural scientists	1.75	-0.66	0.10	-0.64	0.56	29
22	Building professionals and engineers	1.75	0.53	-0.29	-0.89	1.10	27
23	Health diagnosis and treatment practitioners	1.75	-0.72	-1.34	0.41	0.11	35
24	School teachers	1.75	-0.82	-0.20	-0.76	-0.03	37
25	Other teachers and instructors	1.75	-0.64	2.44	0.26	3.81	8
26	Social professionals	1.75	0.39	0.39	0.16	2.70	18
27	Business professionals	1.75	0.54	2.43	-0.46	4.26	3
28	Artists and related professionals	1.75	0.30	-0.30	0.19	1.94	23
29	Miscellaneous professionals	1.75	-0.62	2.32	0.31	3.77	9
31	Medical and science technical officers and technicians	1.75	-0.55	3.83	-0.47	4.57	2
32	Engineering and building associates and technicians	1.75	0.26	-1.68	-1.31	-0.99	40
33	Air and sea transport technical workers	1.75	0.61	-3.84	-0.23	-1.71	48
34	Registered nurses	1.75	-0.81	-1.06	0.15	0.03	36
35	Police	1.75	-0.82	-2.38	0.26	-1.19	44
39	Miscellaneous para-professionals	1.75	-0.31	1.55	-0.06	2.93	14
41	Metal fitting and machining tradespersons	1.75	0.08	-2.25	-0.63	-1.05	41
42	Other metal tradespersons	1.75	0.76	-0.57	-0.58	1.36	26
43	Electrical and electronics tradespersons	1.75	0.35	0.45	-0.42	2.13	21
44	Building tradespersons	1.75	1.51	-0.88	-0.21	2.17	20
45	Printing tradespersons	1.75	-0.34	-2.32	-0.18	-1.09	42
46	Vehicle tradespersons	1.75	-0.22	-0.64	-0.35	0.55	30

Table 3. (continued)

Code	Occupation	Growth Effect (hours)	Industry Share Effect	Occupational Share Effect	Hours Effect	Growth Rate (persons)	Rank
47	Food tradespersons	1.75	-0.21	-1.22	-0.10	0.22	34
48	Amenity horticulture tradespersons	1.75	-0.20	0.88	-0.25	2.18	19
49	Miscellaneous tradespersons	1.75	-0.22	-1.66	0.06	-0.07	38
51	Stenographers and typists	1.75	0.42	-2.45	-0.07	-0.35	39
52	Data processing and business machine operators	1.75	0.13	1.39	-0.01	3.26	12
53	Numerical clerks	1.75	0.29	0.91	-0.20	2.75	17
54	Filing,sorting and copying clerks	1.75	-0.89	-2.25	0.08	-1.31	45
55	Material recording and despatching clerks	1.75	0.14	-1.15	-0.33	0.41	31
56	Receptionists, telephonists and messengers	1.75	-0.03	1.70	0.06	3.49	11
59	Miscellaneous clerks	1.75	-0.61	-3.88	-0.38	-3.12	50
61	Investment, insurance and real estate salepersons	1.75	1.36	0.79	-0.17	3.72	10
62	Sales representatives	1.75	0.06	2.72	-0.34	4.19	4
63	Sales assistants	1.75	-0.20	-0.95	0.78	1.37	25
64	Tellers, cashiers and ticket salespersons	1.75	0.73	0.61	0.96	4.05	5
65	Miscellaneous salespersons	1.75	0.46	0.95	0.65	3.81	7
66	Personal service workers	1.75	-0.49	1.60	0.24	3.10	13
71	Road and rail transport drivers	1.75	1.12	1.35	-0.25	3.97	6
72	Mobile plant operators (excluding transport)	1.75	0.01	0.70	-0.41	2.05	22
73	Stationary plant operators	1.75	0.25	-3.21	-0.93	-2.14	49
74	Machine operators	1.75	-0.60	-2.27	-0.20	-1.32	46
81	Trades assistants and factory hands	1.75	-0.28	-0.03	0.00	1.44	24
82	Agricultural labourers and related labourers	1.75	-2.13	0.29	0.66	0.57	28
83	Cleaners	1.75	0.22	-1.83	0.20	0.35	32
84	Construction and mining labourers	1.75	0.97	-3.55	-0.36	-1.18	43
89	Miscellaneous labourers and related workers	1.75	-0.04	-2.27	0.81	0.24	33
99	All occupations	1.75	0.00	0.00	-0.06	1.69	

examples. The occupation with the best employment growth prospects is *Managing supervisors (other business)* (code 16). Of the total forecast growth of 5.98% per annum (measured in hours), 3.38 percentage points are accounted for by the occupational share effect and the remainder, i.e., 2.60 percentage points, can be attributed to changes in employment by industry. The contribution of each industry can be identified separately using the method set out in Table 4. The first column of the table shows how the employment (again measured in hours) of *Managing supervisors (other business)* was distributed across industries in 1994-95, the base period for the *MONASH* simulation. The second column shows the average employment growth rate for each industry over the eight year planning horizon (i.e., the growth rate reported in Table 2), and the third column shows the total growth rate over the planning horizon. The fourth and fifth columns show the corresponding information for the occupational share effect. If the employment share (from the first column) is multiplied by the total growth rate (the sum of the third and fifth columns), one obtains the contribution (in the sixth column) made by the industry to the employment growth of the occupation. Thus, over the period 1994-95 to 2002-03, employment of *Managing supervisors (other business)* is forecast to increase by 59.10%. Of this amount, 27.21 percentage points, or 46 per cent, can be attributed to changes in employment in the *Construction* industry. Moreover, 12.93 (i.e., 0.377 x 34.33) percentage points can be attributed to employment growth in *Construction* as a whole and 14.28 (i.e., 0.377 x 37.93) percentage points to a redistribution of employment within *Construction* in favour of *Managing supervisors (other business).* The other industry of particular significance for *Managing supervisors (other business)* is *Transport and storage*; it accounts for nearly 20 (i.e., 11.44 / 59.10) per cent of the employment growth of the occupation, although this time the contribution of redistribution within the industry is about twice as large as the contribution of industry growth.

At the other end of the scale of employment prospects, but still within the general category of managers, is *General managers.* From Table 5, the occupational share effect mitigates against the employment of *General managers* in most industries, with particularly large negative contributions from *Wholesale and retail trade* and a number of service industries in which employment of the occupation is concentrated. Indeed, the occupational share effect is larger for this occupation than for any other, and comfortably outweighs the mostly positive contributions from industry employment growth.

Table 4. Industry Contributions to Occupational Employment Growth, Managing Supervisors (Other Business), Hours, 1994-95 to 2002-03

	Industry	Employment Share	Industry Growth Rate (per cent)		Occupational Share Effect (per cent)		Contribution (percentage points)	Rank
		1994-95	Average Annual	Total	Average Annual	Total		
1	Agriculture, forestry and fishing	0.010	-1.33	-10.16	5.34	47.16	0.37	14
2	Mining	0.022	0.21	1.68	6.71	69.06	1.55	7
3	Food, beverages and tobacco	0.028	0.31	2.50	3.70	34.46	1.05	11
4	Textiles, clothing and footwear	0.042	-0.65	-5.06	3.79	33.14	1.19	9
5	Wood, wood products and furniture	0.048	1.37	11.51	3.18	31.23	2.05	5
6	Paper, paper products, printing, publishing	0.031	1.27	10.62	3.77	37.59	1.50	8
7	Chemical, petroleum and coal products	0.008	2.46	21.42	2.25	23.05	0.36	15
8	Non-metallic mineral products	0.015	2.08	17.92	4.54	49.14	0.99	12
9	Metallic mineral products	0.039	3.61	32.77	3.43	39.47	2.80	4
10	Transport equipment	0.008	-1.44	-10.96	2.67	21.22	0.08	20
11	Other machinery	0.017	2.69	23.61	-0.55	-5.18	0.31	17
12	Other manufacturing	0.031	1.57	13.25	2.47	23.96	1.16	10
13	Utilities	0.003	-0.14	-1.12	8.79	95.37	0.26	19
14	Construction	0.377	3.76	34.33	3.28	37.93	27.21	1
15	Wholesale and retail trade	0.155	1.50	12.64	1.17	10.86	3.64	3
16	Transport and storage	0.089	3.71	33.82	7.14	94.09	11.44	2
17	Communication	0.001	-1.01	-7.80	5.44	49.21	0.03	21
18	Finance, property and business services	0.048	3.33	29.92	0.80	8.31	1.82	6
19	Public administration and defence	0.005	-0.27	-2.10	5.90	57.14	0.28	18
20	Community services	0.009	0.93	7.67	2.99	28.37	0.34	16
21	Recreation and personal services	0.015	2.25	19.47	2.74	28.15	0.69	13
	All industries	1.000	2.60	22.77	3.38	36.33	59.10	

Table 5. Industry Contributions to Occupational Employment Growth, General Managers, Hours, 1994-95 to 2002-03

	Industry	Employment Share	Industry Growth Rate (per cent)		Occupational Share Effect (per cent)		Contribution (percentage points)	Rank
		1994-95	Average Annual	Total	Average Annual	Total		
1	Agriculture, forestry and fishing	0.009	-1.33	-10.16	2.87	23.12	0.11	17
2	Mining	0.010	0.21	1.68	-11.85	-64.54	-0.60	12
3	Food, beverages and tobacco	0.017	0.31	2.50	-16.93	-79.13	-1.33	8
4	Textiles, clothing and footwear	0.014	-0.65	-5.06	1.34	10.77	0.08	18
5	Wood, wood products and furniture	0.016	1.37	11.51	1.34	12.33	0.39	13
6	Paper, paper products, printing, publishing	0.067	1.27	10.62	-9.58	-60.65	-3.35	4
7	Chemical, petroleum and coal products	0.013	2.46	21.42	-14.27	-84.83	-0.81	10
8	Non-metallic mineral products	0.007	2.08	17.92	-9.90	-65.80	-0.35	15
9	Metallic mineral products	0.031	3.61	32.77	-0.46	-4.66	0.87	9
10	Transport equipment	0.009	-1.44	-10.96	-1.09	-7.58	-0.16	16
11	Other machinery	0.037	2.69	23.61	-1.48	-13.60	0.37	14
12	Other manufacturing	0.018	1.57	13.25	-1.68	-14.14	-0.02	20
13	Utilities	0.006	-0.14	-1.12	-1.41	-10.65	-0.07	19
14	Construction	0.055	3.76	34.33	1.10	11.78	2.53	5
15	Wholesale and retail trade	0.241	1.50	12.64	-9.13	-59.67	-11.31	1
16	Transport and storage	0.059	3.71	33.82	-5.07	-44.18	-0.61	11
17	Communication	0.006	-1.01	-7.80	0.94	7.24	0.00	21
18	Finance, property and business services	0.198	3.33	29.92	-5.97	-49.20	-3.81	3
19	Public administration and defence	0.053	-0.27	-2.10	-6.52	-40.89	-2.29	6
20	Community services	0.087	0.93	7.67	-13.23	-72.70	-5.63	2
21	Recreation and personal services	0.050	2.25	19.47	-8.03	-57.35	-1.89	7
	All industries	1.000	2.04	17.53	-6.04	-45.41	-27.89	

2.6 *Forecasts of Employment by Region* [7]

The *MONASH* system produces forecasts of employment by industry for each of the 56 regions that make up the Statistical Divisions classification of the Australian Bureau of Statistics. The factors that are taken into account in converting the national forecasts into regional forecasts include:

- differences in industrial structures,
- region-specific industry effects, such as mine closures,
- population movements, especially of retirees,
- State government expenditures, and
- local multipliers.

In Table 6, we report a more limited set of regional forecasts, namely, those for employment by occupation in the States and Territories. They are derived from the corresponding industry forecasts using State-specific occupational shares derived, in turn, from Census and Labour Force Survey data. These shares are assumed to change over time at the same rate as the national occupational shares, subject to the requirement that they sum to unity in each industry in each State in each period. The dispersion of employment growth rates across the States is much more limited than the dispersion across industries or occupations, reflecting the diversification of the State economies. New South Wales, Queensland and Western Australia are forecast to do better than the national average while the other States are expected to do worse. In general, the regional distribution of employment growth in an occupation tends to follow the regional distribution of aggregate employment.

2.7 *Forecasts of Employment by Hours Worked*

During the last ten years, the Australian labour market has undergone a significant change in the number of hours per week people work, with the distribution shifting away from the traditional range of 30 to 44 hours per week in favour of both shorter and longer working hours. In Table 7, we report forecasts of employment by hours worked based on the assumption that this trend will continue.

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[7] A more detailed discussion of regional forecasting with the MONASH model than that presented here can be found in Adams and Dixon (1995).

Table 6. Employment Forecasts by Region, Persons, 1994-95 to 2002-03, Per Cent Per Annum

	Occupation	NSW	VIC	QLD	SA	WA	TAS	NT	ACT	All States
11	Legislators and government appointed officials	-4.71	-6.18	-4.78	-2.33	-5.08	-6.33	-6.25	-7.83	-5.05
12	General managers	-4.22	-4.47	-4.04	-4.46	-3.46	-4.79	-5.34	-6.90	-4.28
13	Specialist managers	3.16	2.60	3.23	2.60	3.70	2.40	2.28	0.02	2.91
14	Farmers and farm managers	-1.50	-1.15	-1.76	-1.58	-2.01	-0.17	-2.36	-2.06	-1.51
15	Managing supervisors (sales and service)	3.10	2.46	2.95	2.28	3.45	2.17	2.26	1.09	2.84
16	Managing supervisors (other business)	5.96	5.34	5.79	5.23	6.48	5.42	4.52	3.63	5.72
21	Natural scientists	1.04	0.16	0.74	-0.09	0.46	0.92	-1.08	-1.37	0.56
22	Building professionals and engineers	1.39	1.09	0.82	1.38	1.16	0.62	-1.20	-1.46	1.10
23	Health diagnosis and treatment practitioners	0.53	-0.34	0.33	-0.56	0.25	-0.55	0.08	-0.76	0.11
24	School teachers	0.31	-0.55	0.35	-0.62	0.22	-0.39	0.01	-0.86	-0.03
25	Other teachers and instructors	4.19	3.28	4.24	3.07	4.03	3.24	3.39	2.68	3.81
26	Social professionals	3.01	2.42	2.89	1.67	3.18	2.19	2.16	1.32	2.70
27	Business professionals	4.56	4.00	4.37	3.72	4.76	3.73	3.11	2.09	4.26
28	Artists and related professionals	2.07	1.49	2.20	1.72	2.57	1.70	1.74	0.41	1.94
29	Miscellaneous professionals	4.23	3.47	3.96	3.42	4.17	3.01	2.89	1.71	3.77
31	Medical and science technical officers and technicians	5.02	4.61	4.46	3.75	4.70	4.01	2.42	1.74	4.57
32	Engineering and building associates and technicians	-0.48	-1.39	-0.90	-1.51	-0.44	-1.47	-2.39	-3.67	-0.99
33	Air and sea transport technical workers	-1.65	-1.47	-1.76	-2.24	-1.47	-2.18	-0.98	-3.84	-1.71
34	Registered nurses	0.43	-0.45	0.25	-0.51	0.18	-0.38	0.23	-0.62	0.03
35	Police	-0.96	-1.79	-0.80	-1.35	-0.82	-1.61	-1.34	-2.24	-1.19
39	Miscellaneous para-professionals	3.30	2.63	3.08	2.65	3.39	2.04	1.60	0.45	2.93
41	Metal fitting and machining tradespersons	-0.77	-0.94	-1.21	-1.15	-1.26	-1.19	-3.39	-2.72	-1.05
42	Other metal tradespersons	1.27	1.01	1.79	1.03	2.20	1.25	1.34	-0.55	1.36
43	Electrical and electronics tradespersons	2.36	1.79	2.12	1.71	3.00	1.61	0.25	0.52	2.13
44	Building tradespersons	2.46	1.94	2.05	1.44	3.11	1.28	-0.12	-0.19	2.17
45	Printing tradespersons	-1.31	-0.93	-1.42	-0.86	-0.10	-0.80	-1.98	-3.36	-1.09
46	Vehicle tradespersons	0.78	0.20	0.57	0.07	1.18	-0.07	-0.05	-1.19	0.55

Table 6. (continued)

	Occupation	NSW	VIC	QLD	SA	WA	TAS	NT	ACT	All States
47	Food tradespersons	0.41	-0.70	0.89	-0.73	1.22	-1.11	1.21	-0.05	0.22
48	Amenity horticulture tradespersons	2.73	1.40	2.75	1.32	2.52	0.95	1.03	1.51	2.18
49	Miscellaneous tradespersons	-0.09	-0.14	0.26	-0.33	0.13	-1.00	1.03	-1.97	-0.07
51	Stenographers and typists	0.01	-0.59	-0.25	-0.96	0.11	-1.47	-2.64	-4.81	-0.35
52	Data processing and business machine operators	3.53	2.95	3.41	2.88	3.84	2.90	2.45	1.17	3.26
53	Numerical clerks	2.99	2.45	2.94	2.34	3.44	2.22	2.08	0.52	2.75
54	Filing, sorting and copying clerks	-0.90	-1.64	-1.16	-1.28	-0.93	-2.82	-3.39	-5.88	-1.31
55	Material recording and despatching clerks	0.66	0.18	0.40	0.09	1.18	-0.16	-0.78	-3.16	0.41
56	Receptionists, telephonists and messengers	3.71	3.04	3.84	2.98	4.22	2.92	3.02	1.31	3.49
59	Miscellaneous clerks	-2.78	-3.65	-2.47	-3.88	-2.40	-4.38	-4.14	-7.38	-3.12
61	Investment, insurance and real estate salepersons	3.98	3.41	3.76	3.23	4.43	3.20	2.90	1.67	3.72
62	Sales representatives	4.34	3.89	4.26	3.72	5.04	3.64	3.87	2.60	4.19
63	Sales assistants	1.59	0.98	1.53	0.80	2.12	0.71	0.84	-0.30	1.37
64	Tellers, cashiers and ticket salespersons	4.33	3.64	4.14	3.49	4.79	3.68	3.63	2.09	4.05
65	Miscellaneous salespersons	3.99	3.45	4.03	3.32	4.47	2.75	4.35	2.39	3.81
66	Personal service workers	3.50	2.68	3.39	2.32	3.23	2.45	3.07	1.84	3.10
71	Road and rail transport drivers	4.22	3.54	3.95	3.64	4.76	3.39	3.97	2.58	3.97
72	Mobile plant operators (excluding transport)	2.48	1.78	2.22	1.47	2.43	1.42	-0.42	0.18	2.05
73	Stationary plant operators	-2.07	-2.72	-1.98	-2.46	-1.97	-2.46	-3.89	-3.90	-2.14
74	Machine operators	-1.18	-2.24	-0.07	-1.59	1.77	-2.84	1.75	-0.04	-1.32
81	Trades assistants and factory hands	1.46	1.12	1.73	1.10	2.33	2.07	-0.12	-0.75	1.44
82	Agricultural labourers and related labourers	0.61	0.82	0.36	0.41	0.64	1.13	-1.53	0.58	0.57
83	Cleaners	0.62	-0.17	0.59	-0.15	0.91	-0.38	0.06	-0.57	0.35
84	Construction and mining labourers	-0.76	-1.24	-1.19	-1.67	-0.73	-1.93	-2.93	-2.80	-1.18
89	Miscellaneous labourers and related workers	0.48	-0.05	0.49	-0.49	0.64	-0.58	0.04	-0.95	0.24
99	All occupations	1.93	1.43	1.83	1.09	2.13	1.04	0.89	0.35	1.69

Table 7: Change in Employment by Hours Worked as a Percentage of Total Employment, Persons, 1994-95 to 2002-03

	Occupation / Hours Worked per Week	1-15	16-29	30-34	35-39	40	41-44	45-48	49+	Total
11	Legislators and government appointed officials	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	-0.01
12	General managers	0.00	-0.01	-0.01	-0.01	-0.04	-0.01	-0.02	-0.10	-0.22
13	Specialist managers	0.03	0.03	0.01	-0.08	-0.12	-0.01	-0.03	0.41	0.25
14	Farmers and farm managers	-0.07	-0.03	-0.01	-0.01	-0.02	-0.02	-0.06	-0.38	-0.65
15	Managing supervisors (sales and service)	0.03	0.01	0.01	0.01	0.00	-0.01	0.02	0.28	0.33
16	Managing supervisors (other business)	0.04	0.05	0.02	0.02	0.02	0.01	-0.01	0.39	0.53
21	Natural scientists	0.00	0.00	-0.01	-0.03	-0.02	-0.01	0.01	0.02	-0.05
22	Building professionals and engineers	0.01	-0.02	-0.02	-0.13	-0.04	-0.02	0.01	0.15	-0.06
23	Health diagnosis and treatment practitioners	0.00	-0.01	-0.02	-0.03	0.00	0.00	-0.02	-0.07	-0.15
24	School teachers	-0.05	-0.06	-0.06	-0.26	-0.07	-0.02	0.04	0.12	-0.39
25	Other teachers and instructors	0.13	0.06	0.02	0.00	0.01	-0.02	0.00	0.07	0.25
26	Social professionals	0.00	0.02	0.00	0.00	0.00	-0.02	-0.01	0.07	0.07
27	Business professionals	0.06	0.07	0.04	-0.15	0.07	0.02	0.19	0.47	0.75
28	Artists and related professionals	0.03	0.01	0.00	-0.03	-0.02	0.00	0.00	0.03	0.02
29	Miscellaneous professionals	0.05	0.04	0.02	-0.06	0.00	0.01	0.01	0.05	0.13
31	Medical and science technical officers and technicians	0.03	0.02	0.01	-0.04	0.02	0.02	0.02	0.05	0.11
32	Engineering and building associates and technicians	0.00	-0.02	-0.04	-0.12	-0.03	-0.01	0.02	0.05	-0.19
33	Air and sea transport technical workers	0.00	0.00	0.00	-0.01	-0.01	0.00	0.00	-0.01	-0.05
34	Registered nurses	-0.03	-0.01	0.00	0.01	-0.21	0.01	0.00	0.01	-0.23
35	Police	0.00	0.00	0.00	0.00	-0.06	-0.01	-0.01	-0.01	-0.10
39	Miscellaneous para-professionals	0.05	0.02	0.00	0.01	-0.03	0.00	0.03	0.09	0.17
41	Metal fitting and machining tradespersons	0.00	-0.01	-0.05	-0.05	-0.11	-0.02	-0.02	0.02	-0.26
42	Other metal tradespersons	0.00	-0.01	-0.03	0.01	-0.05	-0.02	0.01	0.07	-0.03
43	Electrical and electronics tradespersons	0.03	0.01	-0.06	-0.04	-0.02	0.01	0.02	0.15	0.08
44	Building tradespersons	0.06	0.06	-0.09	-0.08	-0.14	-0.02	0.00	0.31	0.13
45	Printing tradespersons	0.00	-0.01	-0.01	-0.02	-0.03	-0.02	-0.01	0.00	-0.10
46	Vehicle tradespersons	0.01	-0.01	-0.03	0.11	-0.20	-0.03	-0.03	0.05	-0.15

Table 7. (continued)

	Occupation / Hours Worked per Week	1-15	16-29	30-34	35-39	40	41-44	45-48	49+	Total
47	Food tradespersons	-0.02	-0.02	-0.03	0.04	-0.10	-0.02	-0.02	0.00	-0.17
48	Amenity horticulture tradespersons	0.00	0.03	0.00	0.00	-0.04	0.00	0.01	0.03	0.03
49	Miscellaneous tradespersons	0.01	0.00	-0.02	-0.03	-0.15	-0.05	-0.02	0.01	-0.26
51	Stenographers and typists	0.00	-0.08	-0.06	-0.18	-0.14	-0.01	0.02	0.03	-0.45
52	Data processing and business machine operators	0.04	0.04	0.03	0.04	-0.01	0.02	0.03	0.02	0.20
53	Numerical clerks	0.19	0.10	-0.05	-0.10	-0.06	0.01	0.16	0.26	0.52
54	Filing, sorting and copying clerks	-0.02	0.00	-0.01	-0.12	-0.04	0.00	0.00	0.01	-0.20
55	Material recording and despatching clerks	0.01	0.01	-0.03	-0.08	-0.09	0.00	0.03	0.05	-0.10
56	Receptionists, telephonists and messengers	0.09	0.14	0.06	0.02	-0.03	0.03	0.05	0.05	0.42
59	Miscellaneous clerks	-0.07	-0.05	-0.07	-0.12	-0.06	-0.02	0.00	-0.01	-0.42
61	Investment, insurance and real estate salespersons	0.03	0.02	0.00	0.00	-0.02	0.01	0.01	0.14	0.19
62	Sales representatives	0.04	0.03	0.00	0.00	-0.12	0.02	0.11	0.25	0.33
63	Sales assistants	0.20	0.21	-0.01	0.11	-0.46	-0.20	-0.03	0.02	-0.16
64	Tellers, cashiers and ticket salespersons	0.26	0.21	0.02	-0.02	-0.07	-0.01	0.02	0.02	0.43
65	Miscellaneous salespersons	0.17	0.24	0.06	0.07	-0.12	-0.01	-0.01	0.03	0.45
66	Personal service workers	0.03	0.14	0.04	0.11	-0.10	0.01	0.01	0.02	0.28
71	Road and rail transport drivers	0.19	0.11	0.00	0.02	-0.22	0.02	0.07	0.46	0.65
72	Mobile plant operators (excluding transport)	0.02	0.02	0.00	-0.02	-0.08	-0.01	0.03	0.09	0.04
73	Stationary plant operators	0.00	-0.01	-0.02	-0.03	-0.06	-0.01	-0.01	-0.01	-0.18
74	Machine operators	0.00	-0.03	-0.04	-0.09	-0.14	-0.01	-0.03	-0.01	-0.38
81	Trades assistants and factory hands	0.09	0.03	-0.07	0.07	-0.26	0.01	0.00	0.10	-0.07
82	Agricultural labourers and related labourers	0.02	0.02	0.00	0.03	-0.12	0.00	-0.01	-0.07	-0.15
83	Cleaners	0.00	-0.05	-0.05	-0.01	-0.14	0.00	0.00	0.02	-0.27
84	Construction and mining labourers	0.02	-0.01	-0.04	-0.07	-0.14	-0.02	-0.02	0.01	-0.28
89	Miscellaneous labourers and related workers	0.19	-0.01	-0.09	-0.06	-0.44	-0.05	-0.04	-0.02	-0.59
99	All occupations	1.90	1.30	-0.72	-1.42	-4.31	-0.47	0.46	3.80	0.00

2.8 Forecasts of Employment by Skill Decile

In Table 8, we present forecasts of the demand for labour with different skill levels. Following DEET (1995, p.48), a ranking of the ASCO unit groups was constructed with those at the top having large proportions of workers with education and training qualifications and those at the bottom having few persons with any formal qualifications. The occupations were then divided into ten groups such that, in the 1991 Census, each group contained about one tenth of the employed workforce. The MONASH occupational forecasts were then converted into forecasts for the ten skill deciles by simple addition.

The construction of Table 8 follows that of Table 7. In 1994-95, the share in total employment of workers in the first, i.e., the most skilled, decile was 10.57% ; in 2002-03, this share is forecast to be 10.39%. The reduction of 0.18 percentage points is reported in the first column of the last row of the table. The other rows of the table indicate that the first decile includes, *inter alia*, all of the minor groups *Legislators and government appointed officials* and *Natural scientists* but only part of the minor group *Health diagnosis and treatment practitioners*, the remainder of the last group being allocated to the second decile.

The forecasts offer some support for the proposition that future employment opportunities will favour more skilled workers, as the employment share of the first five deciles increases by 1.54 percentage points at the expense of the last five deciles. However, the general result is not maintained for every decile. The highly skilled workers in the first decile are fairly evenly distributed between (relatively) expanding and contracting occupations with, as noted above, a net contraction in the decile share of 0.18 percentage points. Workers in the third skill decile, on the other hand, are mostly employed in contracting occupations. Among the relatively unskilled workers, the eighth decile increases is employment share because it contains the expanding occupation *Road and rail transport drivers*. The last result can be explained as follows. From Table 1, international trade is forecast to grow much faster than domestic production, and transport services are used intensively to facilitate the flows of imports from ports of entry and exports to ports of exit. Hence the output of the industry *Transport and storage* has better than average growth prospects. Furthermore, capital growth in the industry is expected to be below average, with the result that employment growth is forecast to be well above

Table 8: Change in Employment by Skill Decile as a Percentage of Total Employment, Persons, 1994-95 to 2002-03

	Occupation / Skill Decile	1	2	3	4+5	6+7	8	9	10	Total
11	Legislators and government appointed officials	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.01
12	General managers	0.00	-0.22	0.00	0.00	0.00	0.00	0.00	0.00	-0.22
13	Specialist managers	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.25
14	Farmers and farm managers	0.00	0.00	0.00	0.00	-0.65	0.00	0.00	0.00	-0.65
15	Managing supervisors (sales and service)	0.00	0.00	0.00	0.33	0.00	0.00	0.00	0.00	0.33
16	Managing supervisors (other business)	0.00	0.00	0.00	0.53	0.00	0.00	0.00	0.00	0.53
21	Natural scientists	-0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.05
22	Building professionals and engineers	0.00	-0.06	0.00	0.00	0.00	0.00	0.00	0.00	-0.06
23	Health diagnosis and treatment practitioners	-0.19	0.04	0.00	0.00	0.00	0.00	0.00	0.00	-0.15
24	School teachers	-0.39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.39
25	Other teachers and instructors	0.09	0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.25
26	Social professionals	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07
27	Business professionals	0.42	0.33	0.00	0.00	0.00	0.00	0.00	0.00	0.74
28	Artists and related professionals	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.02
29	Miscellaneous professionals	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13
31	Medical and science technical officers and technicians	0.00	0.00	0.00	0.11	0.00	0.00	0.00	0.00	0.11
32	Engineering and building associates and technicians	0.00	-0.19	0.00	0.00	0.00	0.00	0.00	0.00	-0.19
33	Air and sea transport technical workers	0.00	-0.01	-0.04	0.00	0.00	0.00	0.00	0.00	-0.05
34	Registered nurses	-0.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.23
35	Police	0.00	0.00	0.00	0.00	-0.10	0.00	0.00	0.00	-0.10
39	Miscellaneous para-professionals	0.00	0.01	0.06	0.10	0.00	0.00	0.00	0.00	0.17
41	Metal fitting and machining tradespersons	0.00	0.00	-0.26	0.00	0.00	0.00	0.00	0.00	-0.26
42	Other metal tradespersons	0.00	-0.01	0.00	-0.02	0.00	0.00	0.00	0.00	-0.03
43	Electrical and electronics tradespersons	0.00	0.09	-0.08	0.07	0.00	0.00	0.00	0.00	0.08
44	Building tradespersons	0.00	0.00	-0.05	0.17	0.00	0.00	0.00	0.00	0.13
45	Printing tradespersons	0.00	0.00	-0.10	0.00	0.00	0.00	0.00	0.00	-0.10
46	Vehicle tradespersons	0.00	0.00	-0.19	0.04	0.00	0.00	0.00	0.00	-0.15

Table 8. (continued)

	Occupation / Skill Decile	1	2	3	4+5	6+7	8	9	10	Total
47	Food tradespersons	0.00	0.00	0.00	-0.16	-0.01	0.00	0.00	0.00	-0.17
48	Amenity horticulture tradespersons	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.03
49	Miscellaneous tradespersons	0.00	0.00	-0.19	-0.08	0.00	0.00	0.00	0.00	-0.26
51	Stenographers and typists	0.00	0.00	0.00	0.00	-0.45	0.00	0.00	0.00	-0.45
52	Data processing and business machine operators	0.00	0.00	0.00	0.00	0.00	0.20	0.00	0.00	0.20
53	Numerical clerks	0.00	0.00	0.00	0.52	0.00	0.00	0.00	0.00	0.52
54	Filing, sorting and copying clerks	0.00	0.00	0.00	0.00	-0.20	0.00	0.00	0.00	-0.20
55	Material recording and despatching clerks	0.00	0.00	0.00	0.00	0.02	-0.12	0.00	0.00	-0.10
56	Receptionists, telephonists and messengers	0.00	0.00	0.00	0.00	0.42	0.00	0.00	0.00	0.42
59	Miscellaneous clerks	0.00	0.00	0.00	0.00	-0.42	0.00	0.00	0.00	-0.42
61	Investment, insurance and real estate salespersons	0.00	0.00	0.00	0.07	0.00	0.13	0.00	0.00	0.19
62	Sales representatives	0.00	0.00	0.00	0.33	0.00	0.00	0.00	0.00	0.33
63	Sales assistants	0.00	0.00	0.00	0.00	0.00	0.00	-0.16	0.00	-0.16
64	Tellers, cashiers and ticket salespersons	0.00	0.00	0.00	0.00	0.00	0.00	0.23	0.20	0.43
65	Miscellaneous salespersons	0.00	0.00	0.00	0.00	0.03	0.00	0.41	0.00	0.45
66	Personal service workers	0.00	0.00	-0.16	0.44	0.00	0.00	0.00	0.00	0.28
71	Road and rail transport drivers	0.00	0.00	0.00	0.00	0.00	0.65	0.00	0.00	0.65
72	Mobile plant operators (excluding transport)	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.04
73	Stationary plant operators	0.00	0.00	0.00	-0.18	0.00	0.00	0.00	0.00	-0.18
74	Machine operators	0.00	0.00	0.00	0.00	0.00	-0.38	0.00	0.00	-0.38
81	Trades assistants and factory hands	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.07	-0.07
82	Agricultural labourers and related labourers	0.00	0.00	0.00	0.00	0.00	-0.15	0.00	0.00	-0.15
83	Cleaners	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.27	-0.27
84	Construction and mining labourers	0.00	0.00	0.00	0.00	-0.28	0.00	0.00	0.00	-0.28
89	Miscellaneous labourers and related workers	0.00	0.00	0.00	0.00	0.00	0.00	-0.59	0.00	-0.59
99	All occupations	-0.18	0.41	-1.00	2.31	-1.61	0.32	-0.11	-0.14	0.00

average (see Table 2). But most (about two thirds) of *Road and rail transport drivers* are employed in the *Transport and storage* industry so the employment prospects for the occupation are also buoyant.

3 Estimating the Occupational Share Effect[9]

We noted above that occupational share effects account for a significant share of the forecast changes in employment by occupation reported in Table 3. In this section, we describe how historical estimates of the effect were determined using national data for 88 industries and 282 occupations taken from the Population Census and from the Labour Force Survey, and how those estimates were then employed in arriving at our forecasts.

3.1 Notation

Let $L_{ij}(t)$ be employment in occupation i (i=1,..,282) and industry j (j=1,..,88) in period t. Then

$$L_j^I(t) = \sum_{i=1}^{282} L_{ij}(t)$$

is employment in industry j in period t,

$$L_i^O(t) = \sum_{j=1}^{88} L_{ij}(t)$$

is employment in occupation i in period t, and

$$L^A(t) = \sum_{i=1}^{282} L_i^O(t) = \sum_{j=1}^{88} L_j^I(t)$$

[9] This section is included by way of documentation and can be safely passed over by the non-technically minded reader.

is aggregate employment in period t. In tabular form (and suppressing the time subscript), the employment matrix can be written

$L_{1,1}$	$L_{1,2}$	.	.	$L_{1,88}$	L_1^O
$L_{2,1}$	$L_{2,2}$	.	.	$L_{2,88}$	L_2^O
.	.	.	.	.	.
.	.	.	.	.	.
.	.	.	.	.	.
$L_{282,1}$	$L_{282,2}$			$L_{282,88}$	L_{282}^O
L_1^I	L_2^I			L_{88}^I	L^A

3.2 *Methodology*

The estimation method proceeded via the following steps:

(i) Data was assembled on employment in industry j (j=1,..,88) for 33 quarters (May 1986 to May 1994) from the Labour Force Survey.

(ii) The employment data was converted into 30 four quarter moving averages extending from September 1986 (t=1) to December 1993 (t=30).

(iii) A linear time trend was estimated for each industry j, yielding the series $L_j^I(t)$ of trend employment levels.

(iv) Steps (i) to (iii) were repeated for occupation i (i=1,..,282), that is, for the ASCO unit groups, generating the employment series $L_i^O(t)$.

(v) A provisional (282 x 88) employment matrix for each period t was computed from

$$L_{ij}(1986) + t * [\, L_{ij}(1991) - L_{ij}(1986) \,] / 20 , \qquad (t=1,..,20)$$

$$L_{ij}(1991) , \qquad (t=21,..,30)$$

where $L_{ij}(1986)$ and $L_{ij}(1991)$ are the corresponding employment matrices from the 1986 and 1991 Censuses, respectively.

(vi) Employment matrices $L_{ij}(t)$ were derived from the provisional matrices of step (v) by imposing the row totals $L_j^I(t)$ and the column totals $L_i^O(t)$ using the RAS method.

(vii) A quarterly time series of 30 occupational shares vectors for industry j was assembled from

$$L_{ij}(t) \; / \; \sum_{i=1}^{282} L_{ij}(t) \, .$$

(viii) A linear time trend was estimated for each industry j, yielding the *annual* changes ΔS_{ij} in the trend occupational shares.

(ix) Within the forecast period, employment is treated on an annual rather than a quarterly basis. Hence it is convenient to restart our convention for labelling time periods such that the base period 1994-95 corresponds to t=0 and the terminal period 2002-03 corresponds to t=8.

Employment levels $L_j^I(0)$ (j=1,..,88) and $L_i^O(0)$ (i=1,..,282) were obtained by taking the average of the four quarterly Labour Force Survey values for 1994-95. The corresponding employment matrix $L_{ij}(0)$ was then computed by imposing these row and column totals on $L_{ij}(1991)$ using the RAS method. The occupational shares $S_{ij}(0)$ were then determined as at step (vii).

(x) The industry growth rates $\ell_j^I(1)$ for 1995-96 were obtained from the MONASH forecast. Industry employment levels were then computed from

$$L_j^I(1) \; = \; [\, 1 + \ell_j^I(1) \,] \; L_j^I(0) \; ,$$

occupational shares from

$$S_{ij}(1) \; = \; S_{ij}(0) + \Delta S_{ij} \; ,$$

and the employment matrix from

$$L_{ij}(1) = S_{ij}(1)\ L_j^I(1)\ .$$

Summing the employment matrix gives employment by occupation $L_i^O(1)$ and aggregate employment $L^A(1)$.

(xi) Step (x) was repeated for t=2 to t=8.

(xii) Total employment growth rates were computed from

$$\ell^A(T) = [\ L^A(8) - L^A(0)\ ] / L^A(0)\ ,$$

$$\ell_j^I(T) = [\ L_j^I(8) - L_j^I(0)\ ] / L_j^I(0)\ \ ,\ \text{and}$$

$$\ell_i^O(T) = [\ L_i^O(8) - L_i^O(0)\ ] / L_i^O(0)\ \ .$$

(xiii) The total *industry share effect* for occupation i was computed from

$$e_i^I(T) = [\ \sum_{j=1}^{88} L_{ij}(0)\ (\ 1 + \ell_j^I(T)\ ) - L_i^O(0)\ ] / L_i^O(0)\ -\ \ell^A(T)\ .$$

That is, the sum

$$\ell^A(T) + e_i^I(T)$$

is the growth rate for occupation i that would have occurred if there had been no change in the occupational composition of employment within industries during the forecasting period.

(xiv) The total *occupational share effect* for occupation i was computed from

$$e_i^O(T) = \ell_i^O(T) - \ell^A(T) - e_i^I(T)\ .$$

That is, $e_i^O(T)$ is the amount of employment growth in occupation i that can be attributed to changes in the occupational composition of employment within industries during the forecast period.

(xv) Finally, average annual industry and occupational share effects were computed from the total effects in the standard way.

4 Assessing the Forecasts

One obvious method of assessing the value of a forecasting methodology is to consider its track record: did forecasts made in the past come to fruition? In the four years since the Centre of Policy Studies began using the *MONASH* model to produce regular labour market forecasts, no formal evaluation of the system has been attempted.[10] However, Borghans *et al.* (1994) have undertaken a comprehensive assessment of a broadly similar forecasting system for the Netherlands. Their evaluation revealed mixed success and has been summarised by the OECD (1994) as follows:

> "The differences between the projections and the outcomes were assessed in terms of a standard loss function. The conclusions were that 'the lowest average loss was for the replacement demand per type of education, and the average loss for the forecasts of replacement demand per occupational class was also quite low.' On the other hand, the forecast for the expansion demand per occupational class had 'by far the lowest reliability'. A comparison of the projections with a variant assuming no change in the labour market since the base year suggested that most components of the projections were 'mediocre'. However, a qualitative indicator, designed to characterise the labour market prospects per type of education, was found to give 'especially good results'. The general conclusion was that 'despite the errors, the forecasts seem to be reasonably good'." (p.85) [11]

Borghans *et al.* go to considerable lengths in the study to identify the reasons behind the deviations of their forecasts from actual outcomes, and hence to identify those aspects of the system most in need of improvement. In other words, they believe their system is worth persevering with.

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[10] This situation reflects research priorities in an environment of scarce resources. The *MONASH* forecasting system remains a system under development, and the pressure to incorporate methodological improvements in current forecasts tends to outweigh the pressure to provide evaluations of forecasts made in the past.

[11] The forecasts under review here are concerned with identifying job openings for newcomers to the labour market, and hence they need to take account of replacement demand. The forecasts presented in the present paper are concerned only with expansion demand.

In any case, the usefulness of a forecast is only partly determined by how well it conforms to subsequent developments as long as decision makers understand the assumptions on which the forecast is based (that is, as long as decision makers do not treat the forecasting system as a black box). For example, in 1994, many areas of rural Australia were in the grip of a severe drought. In preparing its labour market forecasts at that time, the Centre of Policy Studies was obliged to adopt a position on when the drought would break even though reliable meteorological information on the matter was not available. Hence COPS forecasts showed a rapid increase in output and employment in some rural industries in 1995-96, reflecting the assumption that the drought would end in that year. An informed decision maker is not committed to accepting the COPS position on changes in the weather and could usefully have adapted the 1994 forecasts to reflect other views about the end of the drought.

This suggests a second, less demanding, level for evaluating the performance of a system like *MONASH*: if the model is provided with the actual values of all the exogenous variables (that is, if all the expert opinion incorporated in a *MONASH* forecast turns out to be correct), does the model accurately determine the values of all the endogenous variables? Such an exercise has been conducted by Polo and Sancho (1993) for an applied general equilibrium model of Spain. Again, the results were mixed, with some major indicators being "adequately captured" but with some sectoral variables being accounted for "less satisfactorily". Moreover, they were unable to determine whether the errors resulted from a misspecification of the model or from measurement errors and poor data. One reason for this kind of uncertainty can be deduced from Figure 1, namely, that technical change appears among the exogenous variables of a *MONASH*-type forecast. As technical change cannot be observed directly, the idea that the model can be provided with the "correct" values of all the exogenous variables is somewhat problematic. Indeed, Dixon and McDonald (1993) have used the deviations from observed values of the results of a suitably configured *MONASH* simulation as a means of estimating technical change.

The forecasts we have reported in this paper are to be distinguished from projections in the sense that, where choices have been made between alternative specifications, the specification considered most applicable to expected future conditions has been preferred. In a projection, one is not necessarily concerned

with the most likely future outcome but with hypothetical outcomes of interest from some analytical point of view. In assessing forecasts, as just defined, it is always relevant to apply the accuracy test. However, on its own, it is too narrow a criterion for forming a judgement about the usefulness of a formal forecasting system like *MONASH*. There are two reasons for this assertion. Firstly, reasonable people may well disagree about the relevance of alternative specifications, and a formal system affords the possibility of sensitivity testing. Secondly, because a formal system can be interrogated, one can trace the origin of a particular forecast back to the embodied theory and data to whatever level of precision one desires. Thus the forecasts of employment by occupation in Table 3 can be understood in terms of industry contributions as set out in Tables 4 and 5; the forecasts of employment by industry can be understood in terms of the contributions to industry output growth set out in Table 2; the forecasts of output by industry can be understood in terms of the growth rates of the various components of GDP set out in Table 1.[12] In other words, a formal forecasting system should be thought of as a powerful analytical tool which can be used to assemble and interpret scenarios about the future that are both detailed and coherent.

Unhappily, the ability to use a system like *MONASH* for detailed forward-looking analyses comes only at the expense of a considerable amount of training in applied general equilibrium modelling. Although the requisite training courses are available at COPS, the cost in terms of time and effort is prohibitive for many prospective users. For that reason, the *MONASH* system is often regarded as a black box and its forecasts are often assessed on the basis of their predictive power alone. Such an appreciation sells the system well short.

[12] Although not shown, Table 1 could itself be decomposed by commodity to allow more detailed interpretation.

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