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A Microsimulation/Applied General Equilibrium Approach to Analysing Income Distribution in Australia: Plans and Preliminary Illustration

by

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ABSTRACT

Microsimulation (MS) is distinguished from other approaches to distributional analysis in that it relies primarily on a theoretical framework built up from the characteristics - economic, social and demographic - of individuals. However, changes in the incomes of individuals generally depend not only on changes which apply to them directly (such as a change in income tax rates) but also on changes which are mediated by the operation of markets (such as a change in the terms of trade). Applied general equilibrium (AGE) models can be characterised as economy-wide models which include disaggregated commodity and factor markets. For distributional modelling, the disaggregated treatment of factor markets is especially relevant because most individuals receive most of their income in the form of factor payments. Moreover, particular individuals derive their factor incomes from particular industries and occupations, and the implications of a change in the economic environment for different industries and occupations may deviate quite widely from the implications for the economy as a whole.

In this paper we present a research program for integrating MS and AGE approaches to distributional analysis and report results for a preliminary application. In particular, we employ the MONASH dynamic AGE model of the Australian economy to investigate the likely impact of a raft of microeconomic reforms on (inter alia) output and employment in more than 100 industries over the period 1994-95 to 2004-05. By applying the forecast average annual rates of growth for selected variables to income data from the 1990 Income and Housing Survey, an estimate is obtained of the effect of the reforms on the distribution of income between nine groups of persons differentiated by family type.

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A MICROSIMULATION/APPLIED GENERAL EQUILIBRIUM APPROACH TO ANALYSING INCOME DISTRIBUTION IN AUSTRALIA: PLANS AND PRELIMINARY ILLUSTRATION

by

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1 Introduction

At the Centre of Policy Studies (COPS) and the National Centre for Social and Economic Modelling (NATSEM) we are working towards the creation of an integrated microsimulation/applied-general-equilibrium (MS/AGE) framework for analysing income distribution in Australia. This work will be supported over the next three years by an ARC grant to the two Centres.

MS relies primarily on a theoretical framework built up from the characteristics - economic, social and demographic - of individuals. The power of the approach lies in its capacity to handle distributional information at very high levels of disaggregation, typically tens of thousands of individuals. From a policy point of view, this capacity is important because policy makers are often interested in the effects of their proposals on quite small groups in society and because many policy issues of interest are only defined at a very detailed level. From a modelling point of view, the capacity is important because it permits the detailed treatment of demographic developments in society which is essential for forecasting changes in income distribution.

However, changes in the incomes of individuals generally depend not only on changes which apply to them directly (such as a change in income tax rates or a change in the eligibility rules for a government benefit), but also on changes which are mediated by the operation of markets (such as a change in the terms of trade or a change in defence spending). Hence, MS models tend to be restricted both in the range of issues they can address and in the range of adjustment mechanisms they can bring to bear on any particular issue. For this reason, the application of microsimulation models has been largely confined to policy changes originating in the tax and transfer system.

AGE models can be characterised as economy-wide models which include disaggregated commodity and factor markets. The number of such markets is typically of the order of tens or hundreds. AGE models are very versatile in terms of their applicability and incorporate the responses of numerous economic agents (such as producers, consumers, investors, governments, exporters and importers) to any change in their economic

environment. For distributional modelling, the disaggregated treatment of factor markets is especially relevant. Most individuals receive most of their income in the form of factor payments (*i.e.*, wages and profits). Moreover, particular individuals derive their factor incomes from particular industries and occupations, and the implications of a policy change for different industries and occupations may deviate quite widely from the implications for the economy as a whole. However this potential for distributional analysis is difficult to fully realise in AGE models, because they identify only a relatively small number of income recipients (typically about a hundred households).

It follows that there are strong complementarities between the MS and AGE approaches to distributional analysis, and that those complementarities provide an opportunity for an advance in the field. NATSEM and COPS are well placed to take advantage of this opportunity. In microsimulation, substantial new work has been undertaken in the last few years at NATSEM. NATSEM's static model STINMOD (Lambert et al. (1994)) has become the best known and most widely disseminated microsimulation model yet developed in Australia. It is outstanding for the detail of the tax-transfer system it incorporates and for its accessibility to non-expert users. The dynamic model DYNAMOD (Antcliff (1993)) is in an advanced stage of development and is due for public release in 1995.

In AGE modelling, COPS has been working since 1991 on the development of a new dynamic AGE model of the Australian economy, the MONASH model (Adams et al. (1994)). This model builds on earlier experience with the static model ORANI (Dixon et al. (1982)) and its forecasting extension ORANI-F (Horridge et al. (1993)). Although the MONASH model is not yet available to users outside COPS, the list of independent applications of the ORANI model over the years is a long and varied one (Powell and Lawson (1990)). At COPS, the Monash model is used on a regular basis to provide detailed economic forecasts by industry, occupation and region to a variety of clients in the both the public and private sectors.

Our hope, then, is to add a new dimension to existing techniques for modelling changes in the distribution of income by linking the microsimulation models of NATSEM with the applied general equilibrium models of COPS. The resulting systems will be suitable for forecasting and for analysing the distributional implications of a variety of social and economic changes including:

- the internationalisation of the Australian economy;
- regional development policies;
- labour market deregulation;
- environmental taxes; and
- the ageing of the population.

Such complex systems were first envisaged more than 35 years ago by the pioneer of microsimulation (Orcutt (1957)), but they have had to await recent advances in computer technology and modelling theory, as well as the availability of unit record data from large socio-economic sample surveys, before becoming a practical proposition.

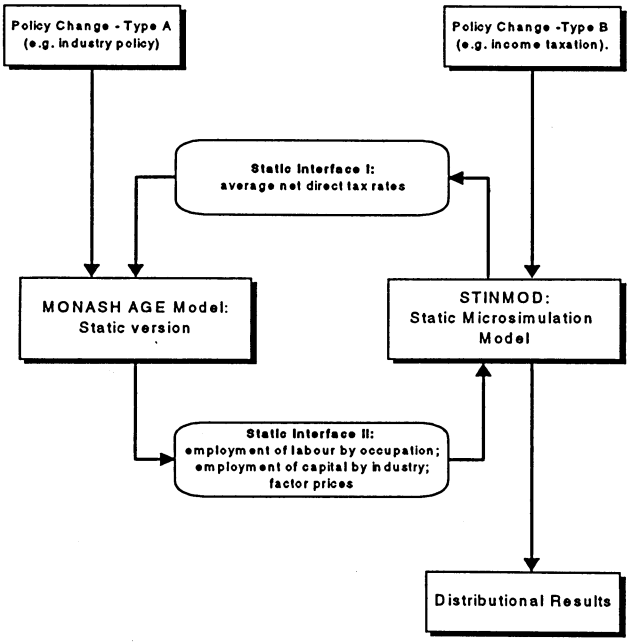
Methodologically, our strategy is to link a microsimulation model and an AGE model into a single integrated system via sets of common interface variables. Two kinds of linked systems will be involved.

(i) The Static System

This system is described schematically in Figure 1. It is designed for comparative static policy analysis and hence it begins with the specification of a change in government policy. Many changes (type A, say) can be accommodated directly by the AGE model. However, because of the limited information about individuals contained in AGE models, some (type B, say) must first be fed through a static microsimulation. Type B changes typically include detailed reforms to the tax-transfer system The results of the microsimulation then form an input to the AGE model via Static Interface I. The interface variables in this case are the changes in average net direct tax rates (*i.e.*, taxes minus transfers) for each of the households identified in the AGE model. Next, the solution of the AGE model provides inputs to a static microsimulation via Static Interface II, the interface variables being the employment of labour by occupation, the employment of capital by industry and factor prices. The microsimulation provides inputs for a second AGE simulation, and the system is solved iteratively until the changes in the interface variables at each round have become sufficiently small to be ignored. The effects of the policy change on the distribution of income are obtained from the final solution of the microsimulation model.

The first advantage of the linked system is that it increases the range of applicability of the AGE model. Policy changes of Type B would be inaccessible to the AGE model in stand-alone mode. Similarly, and more importantly, policy changes which originate outside the tax-transfer system now become accessible to the microsimulation model, via the variables of Static Interface II. Indeed, in the linked system, a model like STINMOD becomes invested with the same range of policy applications and the same range of behavioural responses as the AGE model. The system also allows a time horizon to be added to the STINMOD menu of options. In stand-alone mode, STINMOD computes only the impact or "morning after" effects of a policy change. In the linked system, it can also compute the effects after a short-run adjustment period (capital stocks fixed) or a long-run adjustment period (capital stocks variable). A prototype of Static Interface II already exists in the work of Meagher and Agrawal (1986).

Figure 1: A New Method of Analysis of Income Distribution: The Static System

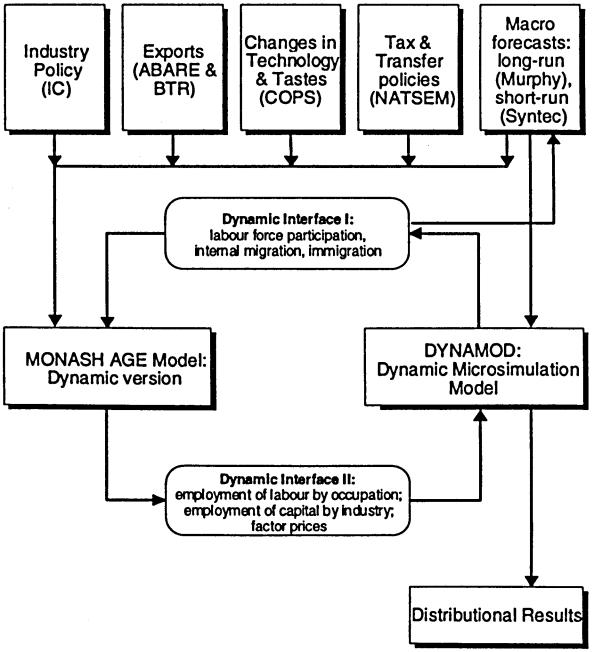


(ii) The Dynamic or Forecasting System

The proposed dynamic system is illustrated in Figure 2. According to this figure, a simulation with the dynamic AGE model MONASH takes as inputs:

- information about prospects for the macro economy provided by a macroeconomic model such as the Murphy model or the Federal Treasury's TRYM model, or by the commercial forecaster Syntec Economic Services, depending on the application;
- Industry Commission (IC) estimates of changes in protection implied by the industry policies of the government;
- forecasts for export prices and volumes compiled by the Australian Bureau of Agricultural and Resource Economics (ABARE) and the Bureau of Tourism Research (BTR);
- estimates of future changes in technology and consumer tastes based on research undertaken by COPS (Dixon and McDonald (1993a and b)); and
- NATSEM estimates of changes in the average net tax rates of households implied by any proposed changes in the tax-transfer system

Figure 2: A New Method of Analysis of Income Distribution:
The Dynamic System



The MONASH solution in its turn provides inputs to the dynamic microsimulation model DYNAMOD via Dynamic Interface II. The interface variables are essentially the same as those of Static Interface II, except that they now come with a time path extending over the forecasting period. The DYNAMOD model also takes as inputs the same set of macro forecasts as the MONASH model. Next, the DYNAMOD solution feeds back into the MONASH model and the macro box via Dynamic Interface I, whose variables include labour force participation, immigration and internal migration. The system is solved iteratively in this manner until its solution has converged to a satisfactory extent. The distributional forecasts are obtained from the final solution of the DYNAMOD model.

For comparative dynamic analysis, the solution of the linked dynamic system provides a base scenario. The exogenous inputs and/or the parameters of the MONASH or DYNAMOD models are then adjusted to reflect some alternative government policy, say, and the forecasts are recomputed. The effects of the alternative policy are then described in terms of deviations from the base scenario.

From the microsimulation viewpoint, the linked dynamic system delivers significant improvements in the variety of information that can be

brought to bear on the model's forecast. In particular, the industry-specific information prepared by the IC, ABARE, COPS and the BTR become accessible to DYNAMOD via the variables of Dynamic Interface II. From the AGE viewpoint, DYNAMOD supplies demographic information which is essential for plausible distributional forecasting - but which is not currently included in the MONASH model. These issues are discussed in more detail in Meagher (1995).

In the remainder of this paper we provide an illustrative MS/AGE distributional calculation of the effects of productivity improvements of the type that may be generated by microeconomic reform. In both the MS and AGE parts of the calculation we use models built at COPS.[1] In section 2 we outline our methodology. The details of the microeconomic reform experiment are presented in section 3 and the AGE results are presented in section 4. Section 4 is divided into two parts. The first contains a discussion of the macroeconomic results and the second contains the microeconomic results. In section 5 we present the MS results. Concluding remarks are in section 6.

2 *Methodology*

The methodology that we use for this exercise can be divided into two parts. First, we use *MONASH*, a dynamic AGE model of the Australian economy, to compute two sets of projections about the prospects of industries and occupations over the next ten years. The first set of projections is our base forecast and it reflects our best guess about how the economy will evolve over the next decade. In the second set of projections we revise our base forecast to account for additional microeconomic reform.

The second part of our methodology involves using the two sets of projections produced by *MONASH* to estimate distributional effects. For each set of projections, we make an MS calculation of the implications for different types of households. These households are identified from the 1990 Survey of Income and Housing Costs and Amenities (or IHS data, for short) which shows the amounts of income received from various sources in 1989-90 by about 30 thousand persons

In the next two subsections we give an overview of the *MONASH* model and explain how we translate MONASH results into distributional effects.

2.1 *An Overview of the MONASH Model*

MONASH, a descendant of ORANI, has been built at Monash University by the Centre of Policy Studies (COPS) and the IMPACT project. In building *MONASH*, the objective of the COPS/IMPACT team was to provide an enhanced replacement of ORANI for policy analysis and forecasting.

The model is represented schematically in Figure 3. Like its predecessor, the primary focus of *MONASH* is on the microeconomy. This emphasis is reflected by the dissaggregation of occupations, sectors, and

[1] Our collaborative work with NATSEM commences in 1996.

regions. The advances of *MONASH* over ORANI can be summarised in four broad categories:

i Treatment of time,

ii Timeliness of data,

iii Ability to incorporate information from a range of external sources,

and

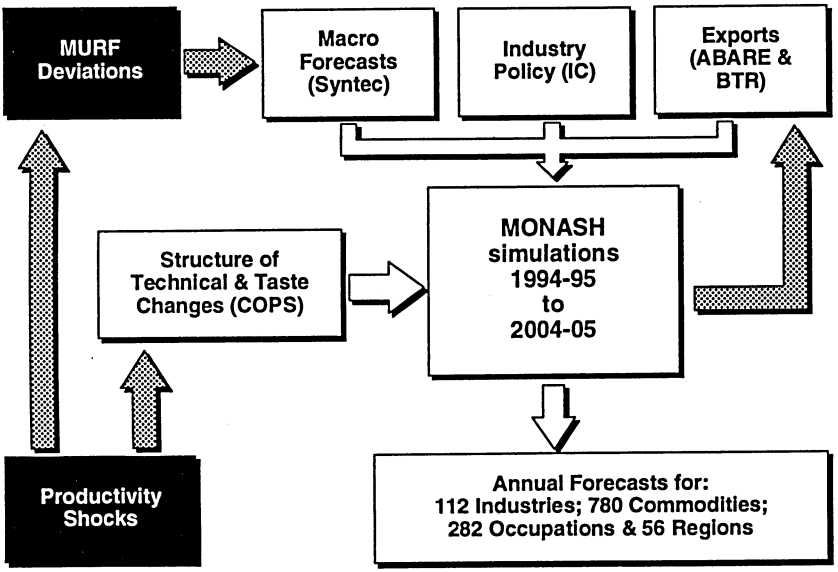
iv Dissaggregation.

In contrast to ORANI, *MONASH* is a dynamic model capable of generating year-to-year time paths for its variables. In its standard form, the model produces annual results (both forecast and comparative-dynamic) for 112 industries, 282 occupations and 56 regions over a ten year time horizon. The time paths projected by a dynamic model depend very much on the initial conditions provided by the data. The initial conditions used by *MONASH* are obtained from an updated version of the 1986-87 input-output tables published by the ABS. The 1986-87 tables are up-dated to reflect the latest available information about the economy (see Dixon and McDonald, 1993a and 1993b).

To date, most applications of *MONASH* have been to forecasting. To enhance its forecasting performance, *MONASH* has been designed to accommodate information from a range of specialists. As depicted in Figure 3, we take on board information about exports, industry policy and the macroeconomy. Information about the prospects of exports are taken mainly from ABARE (Australian Bureau of Agricultural and Resource Economics). The BTR (Bureau of Tourism Research) provides information about exports related to tourism. Our assumptions about industry policy, such as the levels of tariff protection, are taken from the Industry Commission. The macroeconomy and business cycle dynamics are largely exogenous in *MONASH* forecasts and are taken from Syntec Economic Services (1995). Our scenario on technical change and changes in consumer tastes is based on research conducted at CoPS (see Dixon and McDonald, 1993a and 1993b).

For comparative dynamic analysis the forecasting strategy outlined above is modified. The modifications are indicated in Figure 1 by the shaded arrows and dark boxes. We use the Murphy Model (MM), a macro-dynamic model of the Australian economy, (see Murphy 1988, 1992) to inform *MONASH* about the macroeconomic implications of the assumed microeconomic reform. As depicted in Figure 3, results produced by MM are used to revise the forecasts of the macroeconomic aggregates provided by Syntec Economic Services. The industrial structure of the microeconomic reform shocks enter our comparative dynamic calculations as a modification to the COPS technical change assumptions. This is indicated in Figure 3 by the shaded arrow going from the box labelled 'Productivity Shocks' into the box labelled 'Structure of Technical and Taste Changes (COPS)'. With the

Figure 3: The *MONASH* Framework



macro effects of the microeconomic reform shock already accounted for through the MM modifications of the Syntec macroeconomic scenario, we avoid double counting by ensuring that the modifications to the COPS technical change scenario affect sectoral productivity relativities but not overall productivity.

In our forecasting work the quantities and prices of most exports are exogenous. This treatment of exports is inadequate for comparative dynamic analysis. For example, a shock that affects domestic cost conditions should be allowed to influence export volumes. To capture these effects we augment *MONASH* with equations that make the export volume of each commodity sensitive to its costs relative to its domestic currency price. This modification is depicted in Figure 3 by the feedback arrow going into the exports box.

2.2 *Calculation of the Distributional Effects*[2]

The distributional forecasts rely primarily on the 1990 IHS data which shows the amounts of income received from various sources in 1989-90 by about thirty thousand persons. The income sources fall into five broad categories: wages and salaries, income from unincorporated enterprises, property income, government benefits and other income. Using population weights published as part of the survey, the individual income profiles can be

[2] The discussion in this section follows Meagher (1996). However, the treatment of employment in subsection (a) has been extensively revised.

combined to form profiles for various broad income groups of interest. In this paper we consider fifty four such groups (referred to as demographic groups) differentiated by family type and region of residence.

To compute growth rates in the incomes of the selected demographic groups, the distributional model draws partly on population projections of the ABS and partly on the MONASH forecasts . Average annual rates of growth over the forecast period from both sources are used to age the IHS data by one year. A provisional income forecast is obtained by adjusting the IHS population weights by age, sex and region according to the ABS projections. The provisional forecast is then modified in various ways to bring it into line with the MONASH projections. In the remainder of this section, the methods used to determine the income growth rates are discussed for each of the five broad categories of income in turn.

(a) Wages, salaries and supplements

For labour incomes, the computation involves seven steps.

(i) Among the 30,444 respondents to the income survey, 10,849 did not work at all during 1989-90. All persons belonging to the latter group, including 461 who collected some unemployment benefits during the year, are assumed to remain outside the employed labour force during the forecast period.

(ii) The respondents who did work at some time during 1989-90 are divided first into six groups according to their region of residence. Each of the regional groups is then divided into 72 subgroups differentiated by family type and occupation, the latter choice reflecting the view that occupation is more important than industry in determining a person's employment opportunities. Let

$$L^{(0)}_{msg} \quad (m = 1,..,8 \; ; \; s = 1,..,6 \; ; \; g = 1,..,9)$$

represent the number of persons with occupation m who reside in region s and belong to family type g. Here, the eight occupations[3] are the major groups of the Australian Standard Classification of Occupations (ASCO), the six regions are the Australian states[4], and the nine family types are described later in Section 5.

(iii) For the included respondents, the income survey records the number of weeks during 1989-90 that each was employed, unemployed or not in the labour force. Hence the average labour force status over the year, measured in person-years, can be calculated separately for the 648 groups defined at step (ii), i.e.,

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[3] The psuedo-occupation *Defence forces* which appears in the IHS occupational classification is distributed it across the ASCO groups.

[4] The Northern Teritory is included with South Australia and the Australian Capital Territory is included with New South Wales.

$$L^{(0)}_{msg} = E^{(0)}_{msg} + U^{(0)}_{msg} + N^{(0)}_{msg},$$

where the E's represent the numbers of employed persons, the U's represent the numbers unemployed and the N's represent the numbers not in the labour force.

(iv) A provisional forecast for labour market status in 1990-91 is obtained by adjusting the IHS population weights in accordance with ABS population projections, Series D. This yields

$$L^{(1)}_{msg} = E^{(1)}_{msg} + U^{(1)}_{msg} + N^{(1)}_{msg}.$$

(v) MONASH provides forecasts of the demand for labour by industry. They are converted to forecasts of demand by occupation using regional employment matrices from the 1991 Census, updated to 1993/94 on the basis of Labour Force Survey data. In performing this conversion, estimates of the occupational share effect (i.e., of changes in the distribution of employment across occupations within industries) are included[5]. Although the IHS unit record data identifies only the 8 ASCO major groups, supplementary data was obtained for each of the selected demographic groups which enabled the MONASH results to be processed at the minor group level (i.e., for 52 occupations) and then aggregated to the major groups. That is, at the major group level, the labour demand forecasts by occupation are specific to each demographic group, and important distributional information is not lost in the aggregation. These forecasts are denoted E^{*}_{msg}.

(vi) If $E^{*}_{msg} \leq L^{(1)}_{msg}$, the provisional forecasts are revised according to

$$E^{(2)}_{msg} = E^{*}_{msg},$$

$$U^{(2)}_{msg} = U^{(1)}_{msg} + (E^{(1)}_{msg} - E^{*}_{msg})\, U^{(1)}_{msg} / (U^{(1)}_{msg} + N^{(1)}_{msg}),$$

$$N^{(2)}_{msg} = N^{(1)}_{msg} + (E^{(1)}_{msg} - E^{*}_{msg})\, N^{(1)}_{msg} / (U^{(1)}_{msg} + N^{(1)}_{msg}),$$

$$L^{(2)}_{msg} = E^{(2)}_{msg} + U^{(2)}_{msg} + N^{(2)}_{msg} = L^{(1)}_{msg}.$$

That is, jobs are allocated on the assumption that the ratio of the number of unemployed to the number without a job remains constant for each demographic group. This approach implies that some persons who are nominally not in the labour force are encouraged to rejoin the labour force if the demand for labour increases sufficiently quickly. If $E^{*}_{msg} > L^{(1)}_{msg}$, the provisional forecasts are revised according to

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[5] The estimation of the occupational share effects is described in Meagher (1995).

$$E^{(2)}_{msg} = L^{(1)}_{msg} ,$$

$$U^{(2)}_{msg} = N^{(2)}_{msg} = 0 .$$

(vii) At the conclusion of step (vi), there is unmet demand of

$$D^{(2)}_{ms} = \Sigma_g (E^{*}_{msg} - E^{(2)}_{msg})$$

for labour of occupation m in region s. These jobs are allocated between family types in proportion to the number of persons (of occupation m in region s) belonging to the family type who are without a job. Hence the final forecasts of labour force status are given by

$$E^{(3)}_{msg} = E^{(2)}_{msg} + D^{(2)}_{ms} (U^{(2)}_{msg} + N^{(2)}_{msg}) / \Sigma_g (U^{(2)}_{msg} + N^{(2)}_{msg}) ,$$

$$U^{(3)}_{msg} = U^{(2)}_{msg} - D^{(2)}_{ms} U^{(2)}_{msg} / \Sigma_g (U^{(2)}_{msg} + N^{(2)}_{msg}) ,$$

$$N^{(3)}_{msg} = N^{(2)}_{msg} - D^{(2)}_{ms} N^{(2)}_{msg} / \Sigma_g (U^{(2)}_{msg} + N^{(2)}_{msg}) ,$$

$$L^{(3)}_{msg} = E^{(3)}_{msg} + U^{(3)}_{msg} + N^{(3)}_{msg} = L^{(2)}_{msg} .$$

It turns out that, in the forecasts reported in this paper, $D^{(2)}_{ms} < \Sigma_g (U^{(2)}_{msg} + N^{(2)}_{msg})$ for all m and s, and hence the available workforce is never exhausted.

(viii) The rates of change in wages, salaries and supplements are then given by

$$\hat{W}_{msg} = \hat{E}_{msg} + \hat{W} \quad (m = 1,..,8 ; s = 1,..,6 ; g = 1,..,9) ,$$

where $\hat{W}$ is the rate of change in the nominal wage rate and $\hat{E}_{msg}$ is the rate of change in $E^{(3)}_{msg}$.

(b) Income from unincorporated enterprises

The computation for this category involves four steps.

(i) The income or net profit Y_n derived by the nth person in the income survey[6] from the operation of unincorporated enterprises can be written

[6] The survey identifies the industry j and the region s in which the nth person conducts her/his enterprise. This information is utilised in the fourth step.

$$Y_n = G_n - D_n - I_n ,$$

where G_n represents gross operating surplus[7] or gross profit accruing to the nth person, D_n represents consumption of fixed capital or depreciation, and I_n represents interest payments. The equation can also be written as

$$y_n K_n = g_n K_n - d_n K_n - i_n r_n K_n ,$$

where K_n is the amount of capital owned by the nth person, y_n is the net rate of profit, g_n is the gross rate of profit, d_n is the rate of depreciation, i_n is the rate of interest and r_n is the debt ratio. To prepare a database suitable for forecasting, we begin by assuming that the rate of depreciation, the rate of interest and the debt to equity ratio are the same for all unincorporated enterprises. Then

$$Y_n = y_n K_n = (g_n - \bar{d} - \bar{i}\,\bar{r}) K_n ,$$

i.e., the variations in Y_n between individuals recorded in the income survey arise only from variations in the amount of capital K_n they own and in the gross rate of profit g_n they earn on that capital.

(ii) Next, an estimate $\bar{y}$ of the average net rate of profit in 1989-90 is deduced from the range of rates published by the ABS. Given $\bar{y}$ and the total values of net profits, gross profits, depreciation and interest payments obtained from the national accounts, the average amount of capital $\bar{K}$ employed per person in unincorporated enterprises can be determined, along with $\bar{d}$, $\bar{i}$ and $\bar{r}$.

(iii) The net profit rates y_n implicit in the income survey are then assumed to be drawn from a normal distribution with mean $\bar{y}$ and standard deviation $\bar{y}$ (i.e., with about two thirds of the observations in the range zero to $2\bar{y}$), and with no y_n greater than 2.5 times $\bar{y}$. Apart from the mean, these parameters are chosen as a matter of economic judgement. The capital stocks K_n are assumed to be drawn from a normal distribution with mean $\bar{K}$ and standard deviation $3\bar{K}$, with no K_n less than zero. This time the standard deviation is chosen to cover the range of the Y_n's reported in the income survey. Twenty thousand values of the product $y_n K_n$ are then selected at random and the nth individual is assigned the capital stock corresponding to the product that most closely approximates value of Y_n reported by that individual.

(iv) The forecast average annual rate of growth of the gross operating surplus earned by all enterprises operating in a particular industry and region is available from MONASH. Incorporated and unincorporated enterprises are not distinguished in the model, so the same growth rate is assumed to apply to both types. Let the average annual growth rate (in per cent) be given by

$$100\Delta G_{js} / G_{js} , \text{ where}$$

$$G_{js} = g_{js} K_{js}$$

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[7] Gross operating surplus consists of imputed wages of owner-operators, and returns to fixed capital, land and working capital.

is the total gross profit earned by all unincorporated enterprises in industry j in region s (or in industry js for short). Then the average annual change in total net profit is given by

$$\Delta Y_{js} = \Delta G_{js} - (\bar{d} + \bar{i}\,\bar{r})\,\Delta K_{js},$$

where ΔK_{js} is the average annual change in the amount of capital owned by the enterprises. Thus we have enough information to determine the average annual rate of growth $\hat{Y}_{js}$ in the total income earned by all unincorporated enterprises in industry js. However, the growth rate $\hat{Y}_{js}$ cannot be simply assigned to all the individual enterprises operating in that industry because some made profits and some made losses in the base period (i.e., in 1989-90). If $\hat{Y}_{js}$ is positive, the incomes of the corresponding individual enterprises ought to increase. But the application of a positive rate of growth to the income of an enterprise originally making losses would increase its losses and reduce its income. Consequently we define the average annual change

$$\Delta y_{js} = \Delta Y_{js} \,/\, K_{js}$$

in net profit expressed as a share of base period capital in industry js. The average annual rate of growth (in per cent) in the income of an individual enterprise n operating in that industry is then given by

$$\hat{Y}_n = 100 \Delta y_{js} K_n \,/\, Y_n .$$

(c) Property income

Property income consists of interest, dividends and rent, with the last category being further subdivided into landlord rent and imputed rent on owner-occupied dwellings. We begin by describing the method for imputing rent, a method that contains the following three steps for most of the income units involved.

(i) The IHS data records the value K_n of an owner-occupied dwelling[8] and the amount M_n of any outstanding debt incurred in its purchase for each income unit n in the survey. If income unit n is not an owner-occupier, both variables have zero values. Hence the total value of the owner-occupied stock of dwellings is given by

$$K = \Sigma_n K_n$$

and the total value of associated debt by

$$M = \Sigma_n M_n$$

(ii) Values for total gross operating surplus G, total depreciation D, total interest payments I and total net income Y associated with owner-occupied

[8] As the meaning is clear from the context we have not introduced specific notation to distinguish between the capital stock of the unincorporated enterprise sector, the housing stock of owner-occupiers and, later, the housing stock of landlords.

dwellings are available from the national accounts. Hence we can obtain the corresponding average rates $\bar{g}$, $\bar{d}$, $\bar{i}$ and $\bar{y}$ from

$$\bar{g} = G / K, \text{ etc.}$$

(iii) The average values $\bar{g}$, $\bar{d}$, and $\bar{i}$ are then assumed to apply to all owner-occupiers, so that the rent imputed to the nth income unit is given by

$$Y_n = (\bar{g} - \bar{d}) K_n - \bar{i} M_n .$$

If the income unit contains two parents, the rent is allocated equally between them.

Some of the survey respondents who own their dwellings outright, i.e., for whom M_n is zero, did not reply to the question concerning the value of their dwellings. For these income units, the following alternative procedure is adopted. The IHS data contains information on the amount of gross rent paid by income units to private landlords. From this data, the average gross rent $G1_{ij}$ by type of dwelling i (separate house, terrace house, flat, etc.) and number of bedrooms j is computed, along with the average rent $G2_k$ by region k. In this regional classification, the capital city in each State is identified separately from the rest of the State. An owner-occupier of a dwelling of type ijk is then imputed the gross rent

$$G_{ijk} = G1_{ij} \times G2_k / G2 ,$$

where G2 is the average for all regions. Assuming the same values of g, d, and i apply as for other owner-occupiers, the corresponding values of the housing stock K and net rent Y can determined for the income units involved.

For landlords, rental income is given directly in the income survey and the task is to impute ownership of the housing stock. We begin by assuming that the debt ratios r_n of the landlords are drawn from a normal distribution with the same mean and standard deviation as the distribution for owner-occupiers. Values of r_n equal in number to the number of landlords are chosen at random from this distribution and ranked in descending order. The landlord with the largest loss in the base period is then assigned the first value, i.e., the largest debt ratio. The same values of g, d and i are assumed to apply to landlords and owner-occupiers, yielding the value

$$K_n = Y_n / (\bar{g} - \bar{d} - \bar{i} r_n)$$

for the housing stock rented out by the nth income unit.

At this stage, the growth rates in the rental incomes of both landlords and owner-occupiers can be calculated in the same manner as the rates for incomes from unincorporated enterprises. In this case, the calculations are based on the rate of growth in the gross operating surplus of the *Ownership of dwellings* industry.

For the two remaining categories of property income, namely, interest and dividends, the provisional forecasts are accepted as final.

(d) Government benefits

Government benefits are divided into four types: unemployment benefits, other taxable benefits, non-taxable benefits and benefits from overseas. Income from unemployment benefits for a selected group depends on the number of benefit recipients and the size of the benefit per recipient. The latter is assumed to be indexed to the national consumer price index while the rate of change in the former is obtained as a by-product of the calculation for wages and salaries already described. For other taxable benefits and non-taxable benefits, the number of recipients is assumed to vary with population growth and the benefit per recipient to vary with the national CPI. Benefits from overseas governments are assumed to be unaffected by developments in the domestic economy.

(e) Other income

The final category, i.e., other income, is divided into taxable and non-taxable components, and includes superannuation, alimony and income provided by relatives. Both components are assumed to vary with population.

Summing over the five broad categories gives gross income. Taxable income is obtained by subtracting from gross income the imputed rent of owner-occupiers, non-taxable government benefits and non-taxable other income. The total amount of income tax paid is taken from the national accounts, while its distribution is determined by IHS data. In calculating the growth rates in net incomes, the average rate of income tax for each demographic group is assumed to remain constant.

3 Details of the Experiment

Our first task is to use *MONASH* to produce base and revised projections. The base scenario that we use in this exercise is the December 1994 CoPS/SYNTEC forecasts reported in Syntec (1995). To compute the revised scenario we modify the base scenario to allow for additional microeconomic reform.

We model the additional microeconomic reform in the revised scenario as improvements in labour productivity. The labour productivity shocks that we use are taken from Hargreaves (1994).[9] The sectoral composition of these shocks is diverse and their temporal profile indicates that the microeconomic reforms are assumed to be phased in gradually. The productivity shocks that we use are listed in Table A1 in appendix A. In chart S1 we give a less detailed representation of the productivity shocks. A feature of the shocks is that the aggregate technical efficiency of labour improves gradually (following

[9] The productivity shocks in Hargreaves (1994) are derived from estimates provided by Filmer and Dao (1994). We acknowledge that some of the productivity improvements assumed by Filmer and Dao emanate from reforms that have already been accounted for in our base scenario (e.g., announced tariff reductions). Thus, our revised scenario reflects the implications of *additional* microeconomic reform.

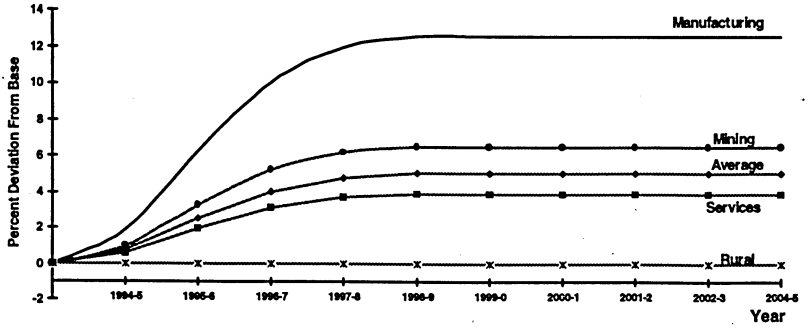
Table S1: Summary of the Output and Employment Projections in the Base and Revised Scenarios

	Sector	Output Projections				Employment Projections			
		Base Scenario		Revised Scenario		Base Scenario		Revised Scenario	
		Average Annual Growth 1994-95 to 2003-04(a)	Rank	Average Annual Growth 1994-95 to 2003-04(a)	Rank	Average Annual Growth 1994-95 to 2003-04(a)	Rank	Average Annual Growth 1994-95 to 2003-04(a)	Rank
1	Agriculture, Forestry and Fishing	2.73	17	3.09	18	1.57	9	1.99	7
2	Mining	3.99	5	4.60	6	-0.06	14	-0.08	14
3	Food, Beverages and Tobacco	2.89	14	3.44	16	-0.20	16	-1.51	18
4	Textiles, Clothing and Footwear	0.79	21	1.43	21	-2.77	21	-3.81	21
5	Wood, Wood Products and Furniture	2.89	13	3.64	11	-0.26	17	-0.82	17
6	Paper, Paper Prods., Printing and Publishing	4.94	3	5.49	3	2.07	8	1.35	8
7	Chemical, Petroleum and Coal Products	3.97	6	4.60	5	0.72	11	0.89	11
8	Non-metalic Mineral Products	1.54	20	2.22	20	-1.67	19	-1.64	19
9	Metallic Mineral Products	3.00	12	3.64	12	0.30	12	0.30	12
10	Transport Equipment	2.52	18	3.46	15	-0.42	18	-0.75	16
11	Other Machinery	5.28	2	6.05	2	1.32	10	0.96	10
12	Other Manufacturing	2.80	15	3.53	14	-0.15	15	-0.65	15
13	Utilities	3.14	10	3.67	10	-2.20	20	-3.07	20
14	Construction	3.28	9	4.01	8	3.04	3	3.22	2
15	Wholesale and Retail Trade	4.37	4	4.81	4	3.67	1	4.04	1
16	Transport and Storage	3.09	11	3.61	13	0.08	13	0.06	13
17	Communication	6.71	1	7.35	1	2.40	6	1.33	9
18	Finance, Property and Business Services	3.40	8	3.91	9	2.35	7	2.78	5
19	Public Administration and Defence	2.51	19	3.02	19	2.53	5	2.37	6
20	Community Services	2.76	16	3.28	17	3.09	2	2.96	4
21	Recreation and Personal Services	3.88	7	4.30	7	2.67	4	3.00	3

NOTES: (a) The numbers in this are growth rates expressed as percentages.

a logistic curve) over the first five years then remains steady for the remaining five years of the experiment. In year five and beyond aggregate labour productivity is 5 per cent higher than it is in the base scenario. The productivity improvement favours the Manufacturing sector; in the long run, labour productivity in this sector is about 12 per cent higher than base. The Mining sector, with about 6 per cent labour productivity improvement in the long run, gets more than the economy-wide average. The Services sector gets about 4 per cent improvement in labour productivity which is a little below the economy-wide productivity shock. Labour productivity for industries in the rural sector is assumed to remain at its basecase values.

Chart S1: Labour Productivity Shocks



The economic environment in which the productivity shocks are to be examined is conditioned by our assumptions concerning the degree to which improvements in labour productivity are passed on to wages, the conduct of monetary policy, the behaviour of the government and the behaviour of the rest of the world.

We assume that the monetary authority does not to accommodate the productivity shock. The supply of money, therefore, is assumed to remain at its basecase levels. Similarly, we assume that the domestic productivity shock does not to affect the behaviour of the rest of the world. The government is assumed to behave in a manner that is broadly consistent with maintaining its expenditure as a constant share of GDP. Government business enterprise investment is assumed to move in line with private investment.

In the first five years, when the *growth* in productivity is greater than in the basecase, only half of each year's productivity shock is immediately passed through to real wages. Full pass-through occurs with a lag.

4 *Results from the MONASH Simulations*

In the following three sub-sections we present a selection of *MONASH* projections. In section 4.1 we discuss the macro results which are obtained from MM. This discussion is confined to those variables that are used to modify the *MONASH* macroeconomic environment. In section 4.2 the sectoral results are, for the most part, analysed at the four-sector level. More detailed sectoral results are discussed in section 4.3

4.1 Macroeconomic Results

The macroeconomic results are summarised in charts M1 to M6. The main features of these results are captured by the time path of the per cent deviations of real GDP from the basecase (Chart M1).[10] In 1994-95, the first year of the simulation, the size of the economy remains almost unchanged (actually contracting slightly) despite labour productivity increasing by almost 1 per cent in that year. In all other years, the economy is bigger than it was in the corresponding year in the basecase. In the long run, the economy is projected to be about 5 per cent bigger than it was in the absence of the productivity improvement. Unlike the time path of labour productivity, the time path of real GDP is not monotonically increasing. The path of real GDP has a trough which bottoms in 1999-00 and two peaks; one occurs in 1997-98 and the other in 2002-03.

To structure our analysis, the macro results are divided into three periods: long run, short run and the transition between the short and long run. The long run in MM is characterised by convergence to optimising behaviour in production and to balanced growth. These features allow the long run results to be interpreted within a well understood paradigm. By indicating the direction in which the economy is tending, the long run resultsalso provide insights about the behaviour of agents in the short and medium run. The short and medium run results are more difficult to explain because the behaviour of agents is not derived from well specified optimisation problems. We regard 2004-05 as representative of the long run and discuss the results pertaining to this year first. Next we discuss the projections relating to 1994-95, the first year of the simulation. For convenience we refer to 1994-95 as the short run. Finally, we discuss the results that relate to the transition of the economy from the short run to the long run.

Long Run Results

A property of the version of MM that we are using is that a 5 per cent increase in labour efficiency (Harrod-neutral technical change) combined with a 5 per cent increase in the size of the rest of the world (more precisely, a 5 per cent increase in the demand for Australian exports) will have the long run effect of increasing all real endogenous variables by 5 per cent. If in addition the money supply is held constant then all domestic price variables will fall by 5 per cent.

[10] Hereafter, a time path which depicts the per cent deviations of a variable from its basecase values will be referred to as 'the path of variable X'. The 'per cent deviation' qualifier will be used only when an ambiguity arises.

Chart M1: Real GDP, Consumption and Government Expenditure

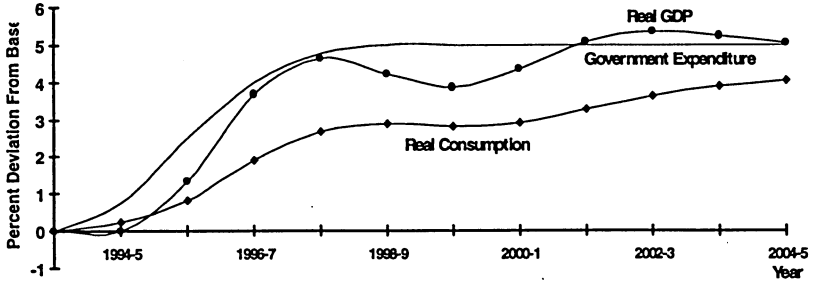


Chart M2: Real Total Investment (Source of Waves)

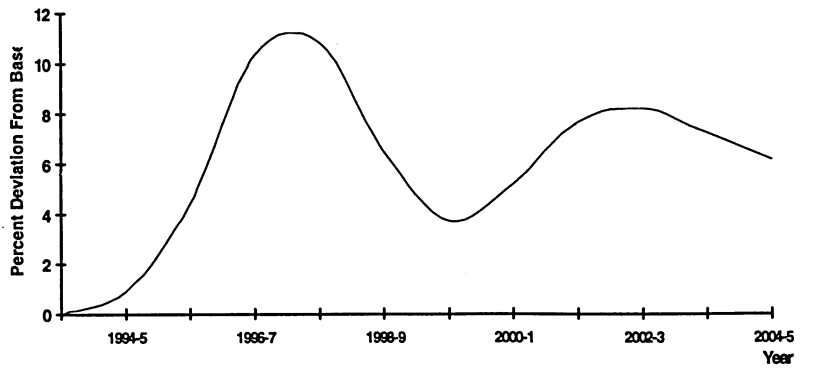


Chart M3: Real Exports, Imports and Real Exchange Rate

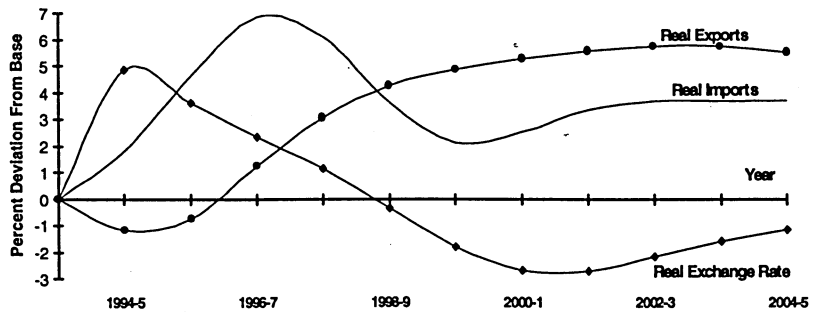


Chart M4: CPI and TWI Exchange Rate ($A/$F)

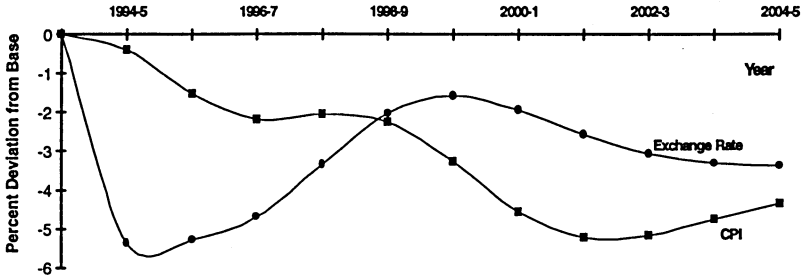


Chart M5: Terms of Trade

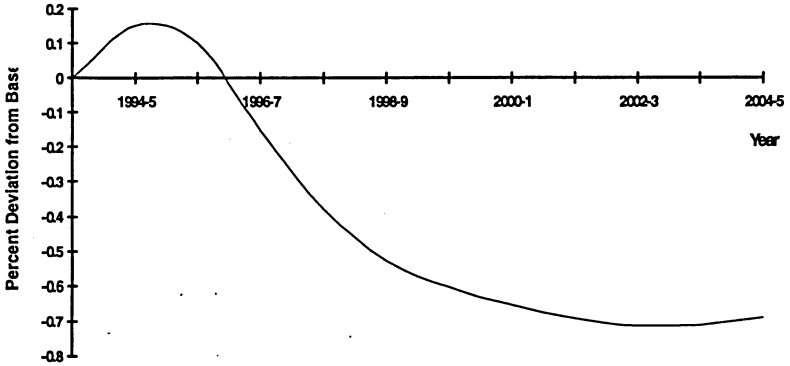
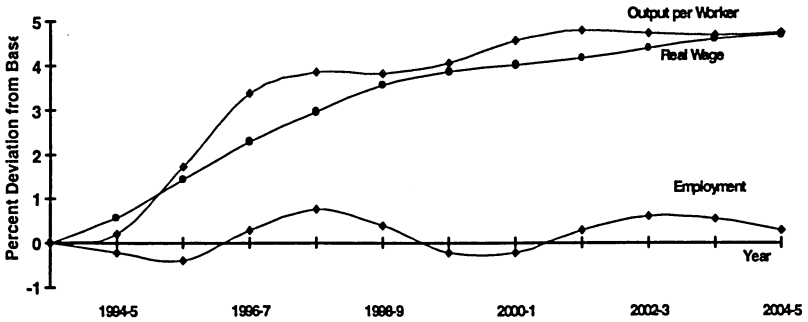


Chart M6: Real Wage, Employment and Average Productivity



In the experiment reported in this paper we do not expand the size of the rest of the world. The productivity shock expands the size of the Australian economy and, as our results show, keeping the size of the rest of the world unchanged results in a deterioration in the terms of trade (see chart M5).[11] The deterioration in the terms of trade implies that the long run expansion of the economy will be less than 5 per cent and not balanced. The assumption that the money supply does not accommodate the productivity improvement means that nominal variables will tend to fall by about, but not exactly, 5 per cent.

In Chart M1 the path of real GDP converges to about 5 per cent in 2004-05. However, inspection of the results in Charts M1 to M3 reveals that the expansion in the size of the economy is not balanced. In 2004-05 real consumption is projected to be about 4 per cent higher than it was in the corresponding year in the basecase; real investment is around 6 per cent higher; real government expenditure is, by design, 5 per cent higher; real exports are 5.5 per real government expenditure is, by design, 5 per cent higher; real exports are 5.5 per cent higher and real imports are about 3.5 per cent higher. The paths of the two nominal variables depicted in Chart M4 indicate that by 2004-05 the productivity shock has the effect of decreasing domestic prices by a little less than 5 per cent.

Given the steady-state properties of MM, it is notable that real GDP in 2003-04 increases by 5 per cent despite the deterioration in the terms of trade. The reason for this is that MM has not converged to its steady state by 2004-05. In this experiment we actually solve MM over 20 years but report results for the first 11 years only.[12] MM projects that real GDP will increase by 4.9 per cent in 2011-12 which, as expected, is slightly less than the increase in productivity.[13] The slight increase in employment in 2004-05 is also attributable to the fact that the model has not reached its steady state. In the steady state the NAIRU and the participation rate do not change. Hence, employment does not change.

Short Run Results

The main feature of the short run results is that real GDP responds sluggishly to the labour productivity improvement. Although not obvious in chart M1, real GDP actually falls by a small amount in 1994-95. The short run in MM is characterised by sticky prices for non-traded goods and labour. The slow response of real GDP to the productivity shock is demand driven. Private consumption rises by about 0.25 per cent, investment rises by about 1 per cent and government expenditure rises by 0.75 per cent. However, as shown in chart M3 export volumes decline by more than 1 per cent and import volumes increase by about 2 per cent in 1994-95. The fall in net

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11 Australia is assumed to have some market power in its export markets.

12 The reason for this is that MONASH uses the first 11 years of results produced by MM. We solve MM for 20 years (80 quarters) to minimise the effects of the terminal conditions on the results used by MONASH.

13 Although not reported, the results that MM produces for the year 2011-12 are almost identical to the results that a steady state version of the model produces.

exports is explained by the large appreciation of the real exchange rate. Agents in the financial markets are assumed to have perfect foresight and hence they anticipate that the productivity improvement will have a deflationary effect in the long run. Arbitrage on financial assets pushes the real exchange rate up to ensure that asset holders cannot profit from the deflation. The nominal exchange rate, shown in chart M4, appreciates by a little over 5 per cent in 1994-95. Domestic prices are sticky in the short run hence the real exchange rate appreciates by about the same amount (see chart M3).

Because output and the capital stock remain largely unchanged in the short run, the productivity improvement results in a fall (about 0.2 per cent) in the number of persons employed.

Transition from Short Run to the Long Run

The paths of the shocked exogenous variables are smooth. Yet chart M1 shows that the transition of the economy from the short run to the long run is not smooth. The wave in the path of real GDP emanates from the behaviour of investors. Given that the capital stock must expand by close to 5 per cent in 2004-05 we expect that investment must grow strongly in the preceding years. However, as chart M2 shows, the growth in investment is not smooth. Real aggregate investment grows strongly between 1994-95 and 1997-98. In 1997-98 investment is about 11 per cent higher than it is in the same year in the basecase. By 1999-00, however, investment is only 4 per cent above its basecase value. After 1999-00 investment again grows strongly so that by 2002-03 it is 8 per cent higher than base.

In MM the key factors influencing investment are the difference between the actual and required rate of return, the natural growth rate of the economy, the tightness of monetary policy and an accelerator mechanism. In the model the natural growth rate of the economy is a function of population growth and labour productivity growth. Because of the productivity shock, the natural growth rate of the economy rises quite sharply between 1994-95 and 1996-97 then falls back to its base value over the next 5 years. The strong growth in investment in the first 4 years is due largely to the influence of the natural growth rate and is reinforced by the accelerator mechanism. The fall in the natural growth rate after 1996-97 slows down investment but after 1999-00 investment again grows strongly. The growth in investment after 1999-00 reflects the rise in the actual rate of return relative to the required rate of return and the effective loosening of monetary policy (reflecting the combination of lower prices and a fixed supply of money).

As depicted in chart M6 the path of aggregate employment does not deviate greatly from the baseline. In chart M6 the path of the real cost of labour, given by the nominal wage deflated by the price of domestic output, is above the baseline and rising over the simulation period. In efficiency units, however, the path of the real cost of labour after 1994-95 is always below the baseline.

Despite the fall in the real cost of using labour, aggregate employment does not always increase. The reason for this is that the growth in output is

not sufficient to accommodate the improvement in labour productivity without the need to reduce the number of workers. In the first two years of the simulation the capital stock and output respond sluggishly to the improvement in labour productivity. This results in the small reductions in aggregate employment in 1994-95 and 1995-96. Similarly, the slowdown in the rate of growth in output between 1997-98 and 1999-00 (see chart M1) results in aggregate employment falling marginally in 1999-00 and 2000-01.

The 1 year lag between the output and employment response is largely due to the modelling of growth in labour demand as a function of the lagged change in the capital-output ratio. In chart M6 the sluggish output response in 1994-95 and the slowdown in output growth from 1997-98 to 1999-00 are reflected in the path of output per worker. Chart M6 also shows the strong association between aggregate employment and, with a lag of 1 year, the difference between the real wage per worker and output per worker.

4.2 Sectoral Results

A selection of sectoral results are presented in charts S2 to S4. Like the analysis of the macro results the order of our discussion of the sectoral results proceeds with the long run first, the short run second and, finally, the results pertaining to the transition between the short and long run.

Long Run Results

The sectoral output results are presented in chart S2. In the long run the Manufacturing sector gets the biggest output boost (i.e., about 6.7 per cent) followed by Mining (about 6 per cent), Services (5.2 per cent) and Rural (almost 3.6 per cent). The ranking of the long run output responses is the same as the ranking of the sectoral productivity improvements. Because of the large productivity improvements the Manufacturing sector gets the largest direct cost reductions. As shown in chart S3 the cost reductions in the Manufacturing sector encourage strong growth in exports of the manufacturing commodity. The Manufacturing sector also benefits from import replacement and the expansion of the domestic market.

The long run output performances of the Mining and Manufacturing sectors are not as disparate as their respective productivity shocks. On average the long run elasticity of demand for the Mining commodity is greater than that of the Manufacturing commodity. This reflects the greater reliance of the Mining sector, compared with the Manufacturing sector, on international markets.

The growth in output of the Manufacturing sector is greater than that of the Mining sector and this is reflected in the long run export results for the two sectors (Manufacturing exports are about 8.3 per cent higher in 2004-05 while Mining exports are 6.2 per cent higher).

The Services sector consists predominantly of firms that supply goods and services to the government as well as goods and services that are used as margins. Government demands are assumed to move in line with the economy-wide productivity improvement while demands for margins move in

line with domestic output. The long run output performance of the Services sector is, therefore, closely related to real GDP.

The Rural sector produces most of the traditional export commodities (e.g., Wool, Wheat, Sheep and Barley) yet, as chart S3 shows, it does not participate in the export boom created by the productivity improvement. The reason for this is that the Rural sector does not get any direct benefits from productivity improvements and it is adversely affected by wage increases that emanate in the sectors that experience productivity improvements. The export performance of the Rural sector is particularly sensitive to its costs and, hence, it loses export share. The increase in the Rural sector's output is largely accounted for by the indirect benefits that it gets via the expansion in the size of the domestic market.

The long run employment results depicted in chart S4 reflect the dominance for employment of the direct impacts of the productivity improvement. The aggregate employment effect is small in the long run and the ranking of the sectors on the basis of employment prospects is the reverse of the sectoral output ranking. *MONASH* projects that the Manufacturing sector, which receives the biggest productivity improvement, will have the poorest long run employment prospects. Employment in this sector falls about 4.6 per cent below the baseline in 2004-05. In contrast, the Rural sector is projected to have the best employment prospects in the long run (about 4.3 per cent above baseline) despite the fact that it does not directly benefit from the productivity shock.

Short Run Results

In the short-run output and employment contract in all sectors except Services. The Mining sector reduces its output and employment in 1994-95 by 0.5 and 0.8 per cent respectively. The main reason for this is that exports of the Mining commodity contract by about 0.4 per cent in that year. Output in the Manufacturing sector contracts by a little over 0.9 per cent while employment decreases by just under 2 per cent. The main reason for the contraction in the Manufacturing sector is the loss of domestic sales. The real appreciation of the exchange rate makes the Manufacturing commodity relatively more expensive than the foreign substitute. The Services sector increases its output slightly (about 0.1 per cent) despite losing about 2.3 per cent of its export sales (mainly Tourism). The Services sector benefits from the small increase in private consumption and government expenditure. The employment response of the Services sector reflects the subdued output result.

Chart S2: Sectoral Outputs

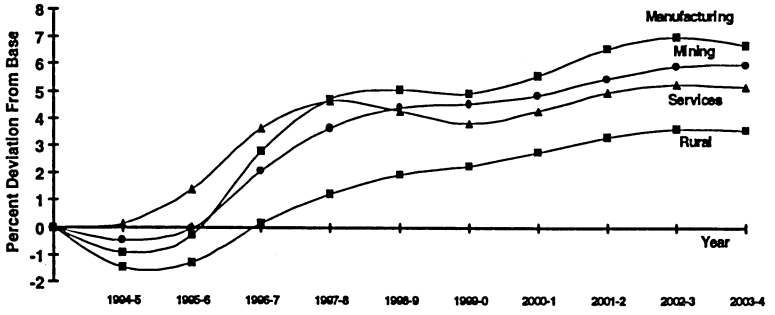


Chart S3: Exports by Sector

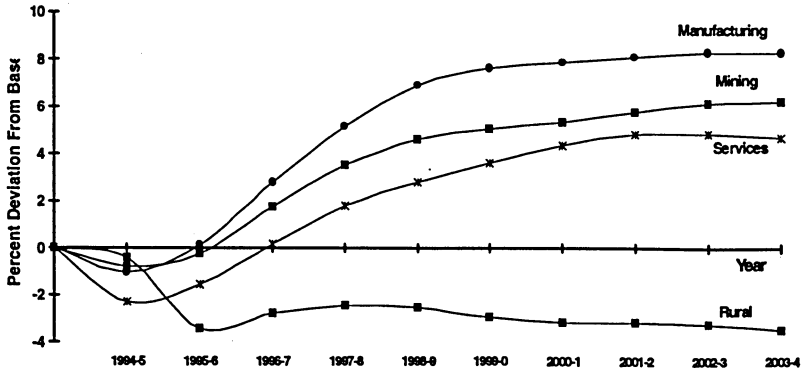
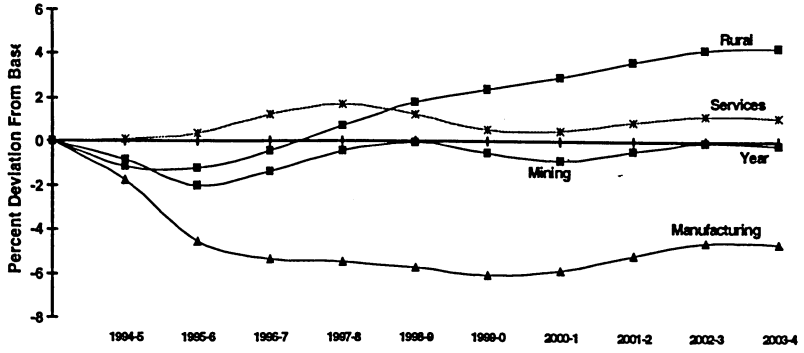


Chart S4: Sectoral Employment



Transition from Long Run to Short Run

In the transition from the short to the long run the time path of output by the Services sector is similar to the path of real GDP. As explained above, because of the nature of its outputs the fortunes of the Services sector are dependent on government expenditure, which is assumed to move in line with the productivity improvement, and on domestic activity. Domestic activity moves very closely with the productivity improvement. The wave in the path of real GDP is evident in the path of output by the Services sector. This reflects the inclusion of the investment-dependent construction industries in the Services sector.

The Rural sector's output moves in line with the expansion in the size of the domestic market. The path of the Rural sector's output does not exhibit the cyclical behaviour evident in the path of GDP largely because its sales structure is not heavily dependent on investment.

The Manufacturing sector grows quite strongly after 1994-95 because the large productivity improvements that it enjoys make it more competitive. Its export performance is very strong as is its performance in replacing imports. The Manufacturing sector also gets a boost from the expansion in the size of the domestic market. The slower growth in Manufacturing output between 1997-98 and 1999-00 reflects the slowdown in domestic demand, particularly investment, over this period.

The output performance of the Mining sector reflects its export performance. The strong growth in Mining exports reflects the comparatively large improvements in the sector's productivity, and hence in its competitiveness.

4.3 More Detailed Sectoral Results

While the sectoral results presented above are instructive, the implications of a productivity improvement on income distribution must be analysed at a more dissaggregated level. For the purposes of this paper the dissaggregated *MONASH* results are too cumbersome to be presented in a meaningful way. Instead, in the following sub-section, we give a flavour of the more detailed results by referring to *MONASH'S* projections of output and employment at the 21 sector level of aggregation. Later, in section 5, we exploit the full sectoral dissaggregation (112 industries) of *MONASH* to evaluate the distributional effects of our assumed productivity changes.

Table S1 contains a summary of our December 1994 forecasts of output and employment growth over the next decade (base scenario) as well as revisions of those forecasts which take into account the productivity shocks (revised scenario). For each scenario we report the average annual per cent growth rates of sectoral output and employment over the decade spanning 1994-95 to 2003-04. On the basis of these averages sectors are accorded a rank which indicates their relative output or employment performance.

The mapping of the 21 sectors listed in Table S1 to the 4 sectors discussed previously is as follows: sectors 1 and 2 in this table map directly to the Rural and Mining sectors; the Manufacturing sector is made up of sectors 3 through 12 and the Services sector consists of sectors 13 through 21.

Key Features of the Base Scenario Sectoral Projections

Table S1 shows that the sectoral results at the 4-sector level of aggregation mask the disparate performances of industries within each sector. For example, in our base scenario, output growth in the Services sector as a whole is about the same as that of the economy but much of the good news comes from the strong growth performance of the Communications sector (average annual growth of 6.71 per cent over the decade). The favorable growth projections for the Communication sector are based on the trend towards communication-using technology throughout the economy.

The output projections for industries in the Manufacturing sector are also very diverse. For example, in our base scenario the Manufacturing sector encompasses the economy's second-best as well as the worst performing industries. The strong performance projected for the Other Machinery sector is related to ongoing technical change involving the use of electronic equipment (especially computers). In the 1980's sales of the Other Machinery commodity were dominated by imports. More recently the Other Machinery sector has enjoyed strong growth in the supply of component parts as well as the servicing of electronic equipment. At the other end of the scale, the poor growth prospects forecast for the Textiles, Clothing and Footwear sector are based mainly on the continuing reductions in protection and strong import competition. We also assume that changes in tastes away from clothing and footwear, estimated for the 1980's, will continue.

The base scenario employment projections in Table S1 are less optimistic than are the output projections and there is a strong bias towards employment growth in the Services sectors. Apart from the Community Services sector, the average annual growth of employment in all other sectors is projected to be less than their output growth. The main reason is that the technical efficiency of primary factors is projected to continue increasing. Primary-factor-augmenting technical change is projected to be rapid in most sectors other than the Services industries. The base scenario output and employment projections for sectors 13 to 21 (the Services sector) are generally less divergent than is the case for the remaining sectors. Among the industries in the Services sector, the Communications and Utilities industries are notable exceptions to this pattern. The employment projections for the Communications sector are far less optimistic than the output projections largely because of continuing labour-saving reforms in Telecom. Similarly, the employment prospects for the Utilities industry are adversely affected by microeconomic-reform initiatives that are in place or planned.

Key Features of the Revised Scenario Sectoral Projections

After the productivity shocks the average annual growth in output over the decade is revised upwards for all sectors. However, the improvements in

the prospects for sectoral outputs are not uniform. The changes in the relative fortunes of the sectors can be deduced by comparing their rank (based on output performance) before and after the shocks. In our revised scenario the biggest winner is the Transport Equipment sector which moves up three positions in the output rankings (from 18th in the base scenario to 15th in the revised forecasts). The smallest winners from the productivity shocks are the Food, Beverages and Tobacco and the Transport and Storage sectors which move down 2 positions in the output rankings.

The Transport Equipment sector benefits most from the productivity shock because its output is dominated by motor vehicles. As is shown in Table A1 in appendix A the Motor Vehicle industry gets a large productivity improvement. The Motor Vehicle industry is very trade oriented and the direct benefits that it gets from the productivity improvement stimulates its output via export growth and import replacement. Motor vehicles have a high expenditure elasticity of demand and, hence, the industry also benefits from the expansion in the size of the domestic economy.

The relatively poor performance of the Food, Beverages and Tobacco sector is related to the low expenditure elasticity of its output as well as subdued export sales. The low expenditure elasticity means that the Food, Beverages and Tobacco sector does not benefit greatly from the expansion in the size of the economy. The increase in export sales by this sector is below average because its key exports, such as meat products, use inputs from the Agriculture, Forestry and Fishing sector which have become relatively expensive. The relatively poor performance of the Transport and Storage sector is also related to the fortunes of the Agriculture, Forestry and Fishing sector. The Agriculture, Forestry and Fishing sector is a big user of the Transport and Storage output and it does not benefit greatly from the productivity improvements.

According to the revised employment projections in Table S1 the productivity shocks do not have a big impact on the employment prospects of most sectors. Relative to our base scenario, employment in the Communication sector is the biggest loser from the productivity shock (dropping 3 positions in the employment rankings). In the base forecasts we projected that the average annual growth rate of employment in the Communication Sector would be 2.40 per cent; after allowing for the productivity shock we revise this forecast down to 1.33 per cent. The reason for this pessimistic forecast is that the Communication sector's output remains largely unchanged despite the very large productivity improvement imposed on this sector (its cumulative productivity gain by 1998-99 is 19.4 per cent). The reason that the productivity shock has so little effect on the Communication sector's output is that the demand for the service that this sector provides is not very price sensitive.

The biggest improvement in employment prospects is in the Finance, Property and Business Services sector (Finance for short). The Finance sector's employment ranking improves by two positions as a result of the productivity shocks. While this sector does not benefit directly from the productivity shock, its output is not adversely affected by cost increases. The

demand for Finance services is not very price sensitive and output in this sector moves roughly in line with the overall growth in the economy.

As mentioned previously, labour productivity improvements can produce conflicting output and employment responses. The output and employment projections for the Textiles, Clothing and Footwear sector provide a good example of this conflict. In the base scenario average annual growth in this sector's output is projected to be 0.79 per cent. Following the productivity shocks this projection is revised up to 1.43 per cent. However, the improvement in the Textiles, Clothing and Footwear sector's output prospects does not help workers in this sector. According to our results the productivity shock lowers employment growth from -2.77 per cent per annum to -3.81 per cent.

5 *The Distributional Implications of Microeconomic Reform*

Table 5.1 shows how the microeconomic reform affects the distribution of income between different income sources for Australia as a whole. In compiling this table we have taken average annual changes in variables of the MONASH model over the period 1994-95 to 2003-04 and applied them to income data for 1989-90 from the Income and Housing Survey. Consider first the results for income from *Wages salaries and supplements*. In the base scenario, the real wage rate is forecast to increase by 1.20 per cent per annum and this increase is taken to apply to all employees. Hence, for the occupation *Managers and administrators*, 2.99 percentage points of the 4.19 per cent increase in real income from wages, salaries and supplements is due to an increase in employment. The occupation which experiences the most rapid employment growth is *Salespersons and personal service workers* (4.26 per cent). This result is due partly to the relative concentration of sales workers in the *Wholesale and retail* trade industry which, from Table S1, is forecast to enjoy employment growth of 3.67 per cent per annum compared with 2.20 per cent for aggregate employment. More specifically, about 35 per cent of workers in this occupation are employed in retail trade and about 9 per cent in wholesale trade. However, the increase in aggregate employment and the changes in the distribution of employment across industries (the industry share effect) account for only 3.34 percentage points of the employment growth for the occupation. The remaining 0.92 percentage points result from the occupational share effect, that is, from changes in the distribution of employment between occupations within industries. The forecasts for the occupational share effect, which are the same in both the base and revised scenarios, are based on historical experience over the period 1986 to 1994 (Meagher 1995).

Just as the industry share effect and the occupational share effect enhance each other to the benefit of sales workers, they both work against employment of the slowest growing occupation, *Plant and machine operators, and drivers*. Employment prospects for this occupation are diminished by its relative concentration in the *Road transport* (about 25 per cent) and *Clothing* (about 5 per cent) industries, both of which are forecast to contract. The forecast growth rates for these industries are -1.10 and -2.56 per cent per

Table 5.1 Income Components, Australia

Income Component	1989/90 Gross Income Shares (per cent)	Forecast Change in Real Income (per cent)	
		Base Scenario	Revised Scenario
Wages, salaries and supplements -			
Managers and administrators	9.15	4.19	4.85
Professionals	12.37	4.43	4.86
Para-professionals	5.29	3.05	3.40
Tradespersons	9.75	2.37	2.78
Clerks	10.26	3.28	3.75
Salespersons and personal service workers	6.65	5.46	6.13
Plant and machine operators, and drivers	5.46	0.93	1.19
Labourers and related workers	7.50	2.16	2.59
All occupations	66.43	3.36	3.83
Income from unincorporated enterprises -			
Agriculture, forestry, fishing and hunting	1.93	6.73	7.74
Mining	0.05	-2.04	-2.77
Manufacturing	0.15	-2.15	-3.12
Construction	1.36	-3.01	-2.49
Wholesale and retail trade	1.51	6.34	7.02
Transport, storage and communication	0.69	6.10	5.93
Finance, property and business services	1.65	5.19	5.54
Community services	0.25	28.07	28.51
Recreation, personal and other services	0.37	4.73	4.93
All industries	7.97	4.97	5.49
Property income -			
Dividends	0.77	1.73	1.72
Imputed rent on owner occupied housing	1.47	15.45	16.74
Landlord rent	0.45	15.63	16.93
Interest	9.48	1.81	1.80
All property income	12.16	3.96	4.15
Government benefits -			
Unemployment benefits	1.35	-3.02	-3.01
Other taxable benefits	8.55	1.72	1.71
Non-taxable benefits	1.90	0.88	0.88
Benefits from overseas governments	0.16	1.79	1.78
All government benefits	11.96	1.05	1.04
Other income -			
Taxable income n.e.c.	1.34	1.90	1.89
Non-taxable income n.e.c.	0.14	0.93	0.92
All other income	1.48	1.81	1.80
Gross income	100.00	3.26	3.64
Income taxes	18.07	3.13	3.50
Net income	81.93	3.30	3.67

annum respectively, and they underpin the rates for the more highly aggregated industries *Textiles, clothing and footwear* and *Transport and storage* reported in Table S1. The occupational share effect contributes and additional reduction of 0.61 percentage points.

The forecasts for *Income from unincorporated enterprises* are somewhat more variable across industries than those for *Wages, salaries and supplements* across occupations in percentage change terms. Income from the former source depends on the amount of capital that a person owns and on the rate of return the person achieves on that capital. It is not true that a person who owns a large amount of capital will necessarily derive a large amount of income from it and, when allocating capital between persons, we have assumed that large profits and large losses are both associated with significant ownership. Furthermore, when the economy expands and rates of return improve, as they do in both the scenarios considered here, we assume that all owners participate in the increase in income (or reduction in losses). Hence, an owner who achieved a zero income from a non-zero holding of capital in the base period (i.e., in 1989-90) will have an infinite increase in income from this source in the forecast. In general, the percentage change in *Income from unincorporated enterprises* will tend to be large when the base period rate of return is small, that is, when income is small relative to the base period capital stock.

Turning to *Property income*, the same kind of considerations lie behind the large percentage increases in income from housing. The owner-occupied housing stock is about 1.5 times as large as the total capital of the unincorporated enterprises and the landlords' stock is about 0.4 times as large. Hence even modest increases in rates of return produce large increases in income. Note that the gross rent imputed to owner occupiers in the base period was $22 billion but, in accordance with the national accounts, this was reduced to an income of only $3.95 billion after deducting depreciation and interest payments. Dividends and interest payments are assumed here to vary with population growth, as given by the series D projections of the ABS. The average growth over the forecast period is 1.19 per cent per annum, but the projections vary from -1.64 per cent to +5.11 per cent across age, gender and region. It is this variation that explains the difference between the forecasts for dividends and interest. The treatment of dividends is quite rudimentary and excludes income from capital gains associated with the retained earnings of the corporate sector. Also, as interest is an income transfer rather than an income source, a thorough treatment of role of the corporate sector would reduce total income from interest to zero.

Government benefits are assumed to be indexed to the CPI which is forecast to increase at 4.98 per cent per annum in the base forecast. As already mentioned, aggregate employment growth (2.20 per cent) exceeds average population growth (1.19 per cent); hence the number of unemployment benefit recipients falls and real income from this source contracts by 3.02 per cent. The growth rates of other types of government benefits and of *Other income* simply reflect population growth.

When the forecasts for the base scenario and the revised scenario are compared, it is immediately obvious that the effects of the microeconomic reform on the distribution of income between income sources is small compared to the differences between the base period and the base forecast. From Table S1, the reform improves the favourable employment outlook for *Wholesale and retail trade* but exacerbates the poor outlook for *Textiles, clothing and footwear* and for *Transport and storage*. Hence it has the effect of increasing, albeit only slightly, the spread of the changes in income from *Wages, salaries and supplements* across occupations. For unincorporated enterprises and housing, the reform introduces largely offsetting increases in capital growth and reductions in the rates of return on capital (especially on capital in the *Construction* industry). As the population projection is the same in each scenario, differences in *Government benefits* and *Other income* are due to rounding errors except for unemployment benefits. The contraction in income from this source is slightly reduced in the revised scenario because the forecast for aggregate employment (2.22 per cent per annum) is slightly higher than in the base scenario.

To illustrate the effects of the microeconomic reform on the distribution of income between different income groups, we consider the nine family types identified in the Income and Housing Survey. The family types are described in Table 5.2 and the distributional results are presented in Table 5.3. As their descriptions are quite involved, we shall refer to the family types by their code numbers. From Table 5.1, we know that earned income (either from wages or self-employment) is forecast to increase more rapidly than income from other sources. For the economy as a whole, earned income as a share of gross income is about 75 per cent. Of the nine family types, the earned income share exceeds the national average for three, namely, types 2, 3 and 4. From Table 5.3, the real gross incomes of these three types grow at a faster rate than the national average. Only two family types have earned income shares of less than 50 per cent, namely, types 5 and 6. These two types also have the smallest growth in real gross income. The effect of the reform is to increase the real gross incomes of all family types but the ranking remains the same.

Table 5.2 Description of Family Types

Code Number	Description
1	Married couple with no dependent and no non-dependent children or other relatives
2	Married couple with dependent children but no non-dependent children or other relatives
3	Married couple with no dependent children but with non-dependent children, and no other relatives
4	Married couple with dependent children and also with non-dependent children or other relatives
5	Lone parent with dependent children but with no non-dependent children or other relatives
6	Lone parent with dependent children and also with non-dependent children or other relatives
7	Lone parent with non-dependent children with or without other relatives
8	One person
9	All other family types

Table 5.3 Distribution of Income between Family Types

Income Category	Family Type									
	1	2	3	4	5	6	7	8	9	All
Income components as shares of gross income, 1989-90, per cent										
1 Wages, salaries and supplements	56.52	77.83	70.97	73.73	44.41	54.07	56.56	58.52	61.53	66.43
2 Income from unincorporated enterprises	7.19	10.69	7.53	10.99	3.02	-6.85	7.83	4.56	0.74	7.97
3 Property income	19.68	5.20	13.31	7.82	2.85	6.60	15.10	15.44	12.62	12.16
4 Government benefits	14.01	5.92	7.16	7.02	46.08	42.60	18.73	19.29	21.68	11.96
5 Other income	2.60	0.36	1.03	0.45	3.64	3.58	1.78	2.19	3.43	1.48
6 Gross income	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
7 Income taxes	16.73	21.17	18.28	19.43	7.99	9.43	15.31	15.90	13.66	18.07
8 Net income	83.27	78.83	81.72	80.57	92.01	90.57	84.69	84.10	86.34	81.93
Real changes in income components, base scenario, per cent										
1 Wages, salaries and supplements	3.44	3.37	3.31	3.12	3.54	2.69	3.21	3.56	2.60	3.36
2 Income from unincorporated enterprises	5.50	4.79	4.76	4.90	6.65	-1.88	2.83	4.78	29.31	4.97
3 Property income	3.46	5.09	4.16	5.14	8.06	5.19	3.92	3.66	4.13	3.96
4 Government benefits	1.58	-0.32	0.97	0.91	0.50	1.06	1.58	1.31	1.45	1.05
5 Other income	1.93	1.45	2.29	1.31	1.10	0.74	2.19	1.67	2.14	1.81
6 Gross income	3.29	3.38	3.36	3.31	2.27	2.40	2.97	3.16	2.72	3.26
7 Income taxes	3.11	3.30	3.20	3.14	2.29	2.21	2.79	2.99	2.56	3.13
8 Net income	3.33	3.40	3.39	3.35	2.27	2.42	3.00	3.19	2.75	3.30
9 Per capita net income	1.75	2.62	1.94	2.22	1.58	1.67	1.67	2.01	1.88	2.10
Real changes in income components, base scenario, per cent										
1 Wages, salaries and supplements	3.91	3.82	3.83	3.57	4.00	3.14	3.66	4.04	3.02	3.83
2 Income from unincorporated enterprises	6.09	5.26	5.26	5.46	6.87	-0.76	3.59	5.28	28.83	5.49
3 Property income	3.62	5.31	4.37	5.49	8.50	5.53	4.17	3.85	4.34	4.15
4 Government benefits	1.57	-0.29	0.93	0.91	0.50	1.06	1.58	1.29	1.47	1.04
5 Other income	1.93	1.44	2.28	1.30	1.10	0.73	2.18	1.66	2.13	1.80
6 Gross income	3.63	3.80	3.79	3.73	2.50	2.60	3.32	3.49	3.01	3.64
7 Income taxes	3.44	3.71	3.63	3.55	2.53	2.39	3.13	3.31	2.84	3.50
8 Net income	3.67	3.82	3.82	3.77	2.49	2.62	3.35	3.52	3.04	3.67
9 Per capita net income	2.10	3.04	2.38	2.64	1.80	1.86	2.02	2.34	2.17	2.48

6 Concluding Remarks

Most individuals receive most of their income in the form of factor payments (i.e., wages and profits). A forecast of changes in the distribution of income, therefore, will be improved if it is informed by a well constructed forecast of changes in factor markets and their associated commodity markets. Forecasts that rely entirely on modelling changes in the personal characteristics of individuals, as is typically the case in microsimulation studies, have a limited capacity to take into account developments that affect individuals only indirectly through the operation of markets. Furthermore, for purposes of distribution, the level of disaggregation at which the markets are modelled is important. Particular individuals derive their factor incomes from particular industries and occupations, and the prospects for different industries and occupations may deviate quite widely from the economy's general macroeconomic prospects.

In this paper we have described techniques for utilising detailed economic forecasts for the Australian economy to determine likely future changes in the distribution of income, and employed those techniques in a comparative dynamic analysis of the distributional effects of microeconomic reform. The centrepiece of the forecasting system is a large dynamic applied general equilibrium model, the MONASH model. Via the markets incorporated in the MONASH model, a range of otherwise intractable information has been brought to bear on a forecast over the period 1994-95 to 2003-04 of the incomes of groups of individuals belonging to various family types. The range includes detailed scenarios on macroeconomic developments in both the world and domestic economies, changes in the foreign demand for Australia's exports, changes in the world prices of all internationally traded goods, changes in protection, changes in indirect taxes and primary factor saving technical change. To generate the income forecasts, projections of changes in factor prices and factor employment levels from the MONASH model are interfaced with micro data from the 1990 Australian income survey. The key to the interface is an allocation of the ownership of the relevant factors among the individuals identified in the survey.

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Appendix A

Table A1: Sectoral Breakdown of The Productivity Shock[a]

	112 Industry Breakdown	Labour cost $M (1992-93)	Share in total	Cumulative Percentage Productivity Gains by end of 1993-94	1994-95	1995-96	1996-97	1997-98
1	Pastoral Zone	389.3	0.2	0.0	0.0	0.0	0.0	0.0
2	Wheat-sheep zone	2237.4	1.0	0.0	0.0	0.0	0.0	0.0
3	High rain zone	1173.9	0.5	0.0	0.0	0.0	0.0	0.0
4	Northern Beef	373.7	0.2	0.0	0.0	0.0	0.0	0.0
5	Milk Cattle	828.6	0.4	0.0	0.0	0.0	0.0	0.0
6	Other farm (sugar, etc)	1089.3	0.5	0.0	0.0	0.0	0.0	0.0
7	Other farm (veg, etc.)	966.4	0.4	0.0	0.0	0.0	0.0	0.0
8	Poultry	108.9	0.0	0.0	0.0	0.0	0.0	0.0
9	Ag. services	911.0	0.4	0.0	0.0	0.0	0.0	0.0
10	Forestry	439.5	0.2	0.0	0.0	0.0	0.0	0.0
11	Fishing	270.0	0.1	0.0	0.0	0.0	0.0	0.0
12	Iron ore	434.4	0.2	1.0	3.2	5.2	6.2	6.5
13	Non-iron ore	1302.5	0.6	1.0	3.2	5.2	6.2	6.5
14	Black coal	2017.2	0.9	1.0	3.2	5.2	6.2	6.5
15	Oil, gas, etc.	351.5	0.2	1.0	3.2	5.2	6.2	6.5
16	Construction minerals	195.0	0.1	1.0	3.2	5.2	6.2	6.5
17	Mining Services	426.3	0.2	1.0	3.2	5.2	6.2	6.5
18	Meat products	1603.8	0.7	3.3	10.9	17.6	20.9	22.0
19	Milk products	375.8	0.2	3.3	10.9	17.6	20.9	22.0
20	Fruit products	343.6	0.2	3.3	10.9	17.6	20.9	22.0
21	Margarine, etc.	48.4	0.0	3.3	10.9	17.6	20.9	22.0
22	Flour products	244.5	0.1	3.3	10.9	17.6	20.9	22.0
23	Bread, etc.	867.1	0.4	3.3	10.9	17.6	20.9	22.0
24	Confectionery	196.8	0.1	3.3	10.9	17.6	20.9	22.0
25	Seafood	862.7	0.4	3.3	10.9	17.6	20.9	22.0
26	Soft drinks	222.5	0.1	2.5	8.4	13.4	16.0	16.8
27	Bear & malt	318.0	0.1	2.5	8.4	13.4	16.0	16.8
28	Wine & spirits	131.5	0.1	2.5	8.4	13.4	16.0	16.8
29	Tobacco	121.2	0.1	2.5	8.4	13.4	16.0	16.8
30	Cotton ginning	75.2	0.0	2.4	8.0	12.9	15.4	16.2
31	Man-made fibre	153.0	0.1	2.4	8.0	12.9	15.4	16.2
32	Cotton yarns	128.5	0.1	2.4	8.0	12.9	15.4	16.2
33	Worsted fabrics	94.8	0.0	2.4	8.0	12.9	15.4	16.2
34	Textile finishing	83.4	0.0	2.4	8.0	12.9	15.4	16.2
35	Textile coverings	110.3	0.0	2.4	8.0	12.9	15.4	16.2
36	Canvas, ropes	145.1	0.1	2.4	8.0	12.9	15.4	16.2
37	Knitting mills	291.0	0.1	2.4	8.0	12.9	15.4	16.2
38	Clothing	911.0	0.4	2.7	9.0	14.5	17.2	18.1
39	Footwear	182.7	0.1	2.7	9.0	14.5	17.2	18.1
40	Sawmill products	473.8	0.2	2.0	6.8	10.9	12.9	13.6
41	Veneers	157.8	0.1	2.0	6.8	10.9	12.9	13.6
42	Joinery products	545.1	0.2	2.0	6.8	10.9	12.9	13.6
43	Furniture	733.6	0.3	2.0	6.8	10.9	12.9	13.6
44	Pulp, paper	303.0	0.1	2.0	6.8	10.9	12.9	13.6
45	Bags	278.0	0.1	2.0	6.8	10.9	12.9	13.6
46	Sanitary paper prods	120.5	0.1	2.0	6.8	10.9	12.9	13.6
47	Books, newspapers	1310.7	0.6	2.0	6.8	10.9	12.9	13.6
48	Commercial printing	1734.2	0.8	2.0	6.8	10.9	12.9	13.6
49	Chem. fertiliser	104.0	0.0	0.7	2.4	3.9	4.6	4.8
50	Basic chemicals	524.7	0.2	0.7	2.4	3.9	4.6	4.8
51	Paints	204.0	0.1	0.7	2.4	3.9	4.6	4.8
52	Pharm. goods	340.7	0.2	0.7	2.4	3.9	4.6	4.8
53	Soaps	197.9	0.1	0.7	2.4	3.9	4.6	4.8
54	Cosmetics	123.3	0.1	0.7	2.4	3.9	4.6	4.8
55	Explosives	211.2	0.1	0.7	2.4	3.9	4.6	4.8
56	Petrol	418.5	0.2	0.7	2.4	3.9	4.6	4.8

continued ...

Table A1: Sectoral Breakdown of The Productivity Shock (continued)

	112 Industry Breakdown	Labour cost $M (1992-93)	Share in total	Cumulative Percentage Productivity Gains by end of 1993-94	1994-95	1995-96	1996-97	1997-98
57	Glass products	273.3	0.1	1.0	3.2	5.2	6.2	6.5
58	Clay products	431.8	0.2	1.0	3.2	5.2	6.2	6.5
59	Cement	76.0	0.0	1.0	3.2	5.2	6.2	6.5
60	Concrete	79.5	0.0	1.0	3.2	5.2	6.2	6.5
61	Concrete products	213.3	0.1	1.0	3.2	5.2	6.2	6.5
62	Plaster, etc.	136.3	0.1	1.0	3.2	5.2	6.2	6.5
63	Iron & steel	1558.2	0.7	1.0	3.2	5.2	6.2	6.5
64	Non-ferrous metals	1213.3	0.5	1.0	3.2	5.2	6.2	6.5
65	Structural metals	1210.8	0.5	1.0	3.2	5.2	6.2	6.5
66	Sheet metal	710.5	0.3	1.0	3.2	5.2	6.2	6.5
67	Wire products	1221.3	0.6	1.0	3.2	5.2	6.2	6.5
68	Motor Vehicles	2226.2	1.0	1.9	6.4	10.3	12.3	12.9
69	Ships & boats	218.9	0.1	1.9	6.4	10.3	12.3	12.9
70	Railway rolling stock	547.5	0.2	1.9	6.4	10.3	12.3	12.9
71	Aircraft	517.3	0.2	1.9	6.4	10.3	12.3	12.9
72	Scientific equip.	370.9	0.2	1.7	5.6	9.1	10.8	11.3
73	Electronic equip.	446.6	0.2	1.7	5.6	9.1	10.8	11.3
74	Household appliances	757.8	0.3	1.7	5.6	9.1	10.8	11.3
75	Electrical machinery	887.8	0.4	1.7	5.6	9.1	10.8	11.3
76	Ag. machines	148.8	0.1	1.7	5.6	9.1	10.8	11.3
77	Construction mach.	179.4	0.1	1.7	5.6	9.1	10.8	11.3
78	Other machines	1411.2	0.6	1.7	5.6	9.1	10.8	11.3
79	Leather products	77.6	0.0	1.9	6.4	10.3	12.3	12.9
80	Rubber products	284.6	0.1	1.9	6.4	10.3	12.3	12.9
81	Plastic products	991.5	0.4	1.9	6.4	10.3	12.3	12.9
82	Signs	217.1	0.1	1.9	6.4	10.3	12.3	12.9
83	Other manufacturing	320.7	0.1	1.9	6.4	10.3	12.3	12.9
84	Electricity	2377.3	1.1	2.9	9.7	15.5	18.5	19.4
85	Gas	214.8	0.1	0.0	0.0	0.0	0.0	0.0
86	Water	1254.5	0.6	1.4	4.8	7.8	9.2	9.7
87	Residential building	7655.2	3.5	0.0	0.0	0.0	0.0	0.0
88	Non-residential building	14454.8	6.5	1.0	3.2	5.2	6.2	6.5
89	Wholesale trade	14098.0	6.4	0.0	0.0	0.0	0.0	0.0
90	Retail trade	15691.9	7.1	0.0	0.0	0.0	0.0	0.0
91	Mechanical repairs	3521.8	1.6	0.0	0.0	0.0	0.0	0.0
92	Other repairs	1162.8	0.5	0.0	0.0	0.0	0.0	0.0
93	Road transport	6415.6	2.9	0.8	2.6	4.1	4.9	5.2
94	Rail transport	1997.8	0.9	0.8	2.6	4.1	4.9	5.2
95	Water transport	784.3	0.4	0.8	2.6	4.1	4.9	5.2
96	Air transport	1620.6	0.7	0.8	2.6	4.1	4.9	5.2
97	Transport services	3065.7	1.4	0.8	2.6	4.1	4.9	5.2
98	Communication	3151.9	1.4	2.9	9.7	15.5	18.5	19.4
99	Banking	5451.1	2.5	0.0	0.0	0.0	0.0	0.0
100	Non-bank fin.	1776.7	0.8	0.0	0.0	0.0	0.0	0.0
101	Investment services	1039.5	0.5	0.0	0.0	0.0	0.0	0.0
102	Insurance	3664.4	1.7	0.0	0.0	0.0	0.0	0.0
103	Other bus. services	16022.7	7.2	0.0	0.0	0.0	0.0	0.0
104	Dwelling ownership	0.0	0.0	0.0	0.0	0.0	0.0	0.0
105	Public admin.	10105.9	4.6	1.0	3.2	5.2	6.2	6.5
106	Defence	3956.7	1.8	1.0	3.2	5.2	6.2	6.5
107	Health	18363.3	8.3	1.0	3.2	5.2	6.2	6.5
108	Education	18218.2	8.2	1.0	3.2	5.2	6.2	6.5
109	Welfare services	9687.9	4.4	1.0	3.2	5.2	6.2	6.5
110	Entertainment	2475.1	1.1	0.0	0.0	0.0	0.0	0.0
111	Restaurants	5786.3	2.6	0.0	0.0	0.0	0.0	0.0
112	Personal services	1715.6	0.8	0.0	0.0	0.0	0.0	0.0
	TOTALS	221265.4	100.0	0.7	2.5	4.0	4.8	5.0

(a) The sectoral productivity gains for each year between 1997-98 and 2003-04 are identical to those listed for 1997-98 in the table.