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# FORECASTS OF AGRICULTURAL INCOMES FOR THE SOUTH-WESTERN REGION OF VICTORIA 1988-1990

by

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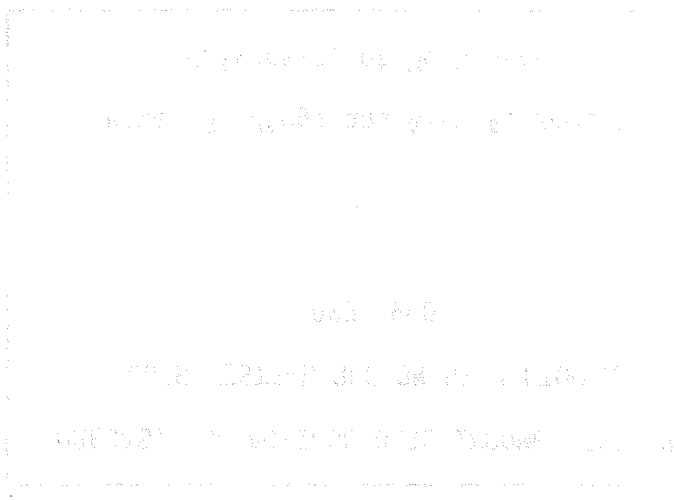

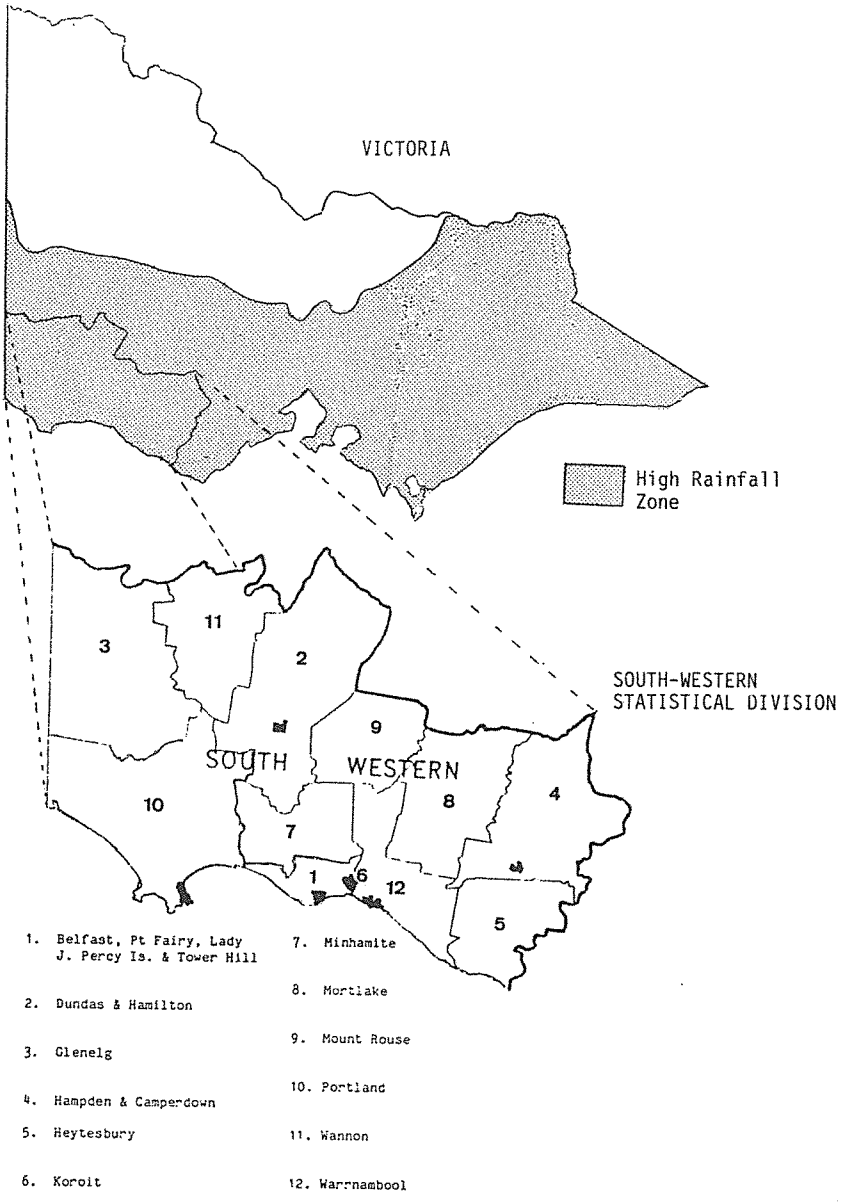


GEOGRAPHICAL LOCATION OF THE SOUTH-WESTERN STATISTICAL DIVISION AND ITS LOCAL GOVERNMENT AREAS

ABSTRACT

In this paper a tops-down approach is used to generate forecasts of agricultural incomes for the south-western region of Victoria. The ORANI model is first solved for the effects of an economic scenario on commodity output responses in the High Rainfall Zone, which encompasses the region. These responses are then used to generate output indexes in local government areas in the region according to their base-period commodity mixes. Finally, these projections are converted into real farm income forecasts. Our findings suggest that real farm incomes in the south-western region of Victoria will increase by about 12 per cent per annum over the period 1988 to 1990.

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# Forecasts of Agricultural Incomes for the South Western Region of Victoria, 1988-1990*

by

Peter J. Higgs and Alan A. Powell

## 1. INTRODUCTION

The Institute of Applied Economic and Social Research at the University of Melbourne (hereafter, "the Institute") has pioneered forecasting applications of the ORANI model (e.g., Dixon and Parmenter (1987) and Parmenter (1988)). In this recent work, the focus has been strongly on long-term adjustment to Australia's external debt problem. In the present paper we take as given a forecast by the Institute (Parmenter (1988)) of Australian economic conditions through 1992. Onto this we graft some shorter-term perspectives through 1989-90. On this basis we make "short-term" forecasts which are broadly consistent with the Institute's longer-term forecasts, and which take into account some commodity forecasts aired at the January 1988 National Agricultural Outlook Conference organised by the Australian Bureau of Agricultural and Resource Economics (ABARE). We cover a selection of macroeconomic variables, and agricultural activity (i.e., production) in the High Rainfall Zone, in our forecasts.

The High-Rainfall Zone is one of the four geographically defined industries in the ORANI model. The South Western Statistical Division of Victoria, which is the special regional focus of this paper,

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* The authors are indebted to Paul Gretton, Brian Parmenter, and Maurice Wright for comments and assistance.

is contained within the High Rainfall Zone. Thus the results from a standard version of ORANI most likely to capture agricultural and pastoral activity in south western Victoria are those for the High Rainfall Zone.

Can we be more specific than this? There are twelve local government areas (LGAs) in the South Western Statistical Division. On the basis of tabulations of gross values of production, by product category, supplied for these LGAs by the Australian Bureau of Statistics (ABS), it is possible to disaggregate the production forecasts for the South Western Statistical Division into separate forecasts for each of the twelve south western Victorian LGAs. This in turn enables forecasts to be made of real net farm incomes in each of these LGAs.

The balance of this paper is structured as follows. In Section 2 we briefly review the forecasting methodology adopted for variables at the national level. Then, in Section 3, we present our forecasts for these variables. In Section 4 we provide details of how the national results are regionalized, and present our forecasts for the southwest of Victoria. In Section 5 we offer concluding remarks and a perspective for future regional work of this kind.

## 2. FORECASTING METHODOLOGY

The Institute's long-term forecasts answer questions of the following form:

> relative to a datum (which is a 'normalized' version of a recent year of record), by how much will capital stocks in various industries, and other variables of interest,

have grown by 1992 (or some other relatively distant nominated future year)?

Capital stocks are given a special mention in the simplified account above because they have a pivotal role in the long-run closure of ORANI used to produce the Institute's long-term forecasts. In this closure rates of return on capital in Australia are taken as being determined overseas (Australia being a small part of the world capital market). Thus in response to any foreseen change in the model's exogenous variables, the sizes of Australian industries are required to adjust between the datum and the forecast year in such a way as to reequilibrate rates of return. To take an example, suppose that tariffs (which are exogenous variables) are believed by the forecaster to be about to be lowered. An initial effect of the reduced protection will be to lower costs and so to raise rates of return in export industries. However, according to our paradigm above, by 1992 these export industries will have grown relatively to other industries, pushing up their costs in the process sufficiently to lower their rates of return once again to the exogenously given values.

Neither we, nor the Institute, claim to be able to model, formally, the dynamic adjustment path of the economy between the datum and the forecast year. However, if a variable (say the capital stock in industry X) is forecast to grow by (say) 12 percent over a six-year forecast period, then one useful way of reporting the results is to say that we expect this variable to "grow at an average annual rate of two per cent per annum".

To obtain our short-run forecasts we work in another closure of ORANI -- "the neoclassical short run with slack labour markets", which is fully described in Table 23.3 of Dixon, Parmenter, Sutton, and Vincent (1982). In this closure capital stocks in use are exogenous, while rates of return are endogenous. The values of the endogenous variables obtained for given values of the exogenous variables are forecast to obtain "about 2 years" (Cooper (1983)) after a set of sustained (or step-function) shocks have been introduced into the rates at which exogenous variables are changing in the control scenario.

This introduces the first tactical issue to be resolved -- given that the forecaster will rarely write a scenario on his exogenous variables in which each such variable experiences a single step-function jump in its value, we have to decide how to transform other types of shock to make them suitable inputs to ORANI in a short-term closure.

This issue in principle is solved in the work of Cooper and McLaren (1983) (see also Cooper, McLaren, and Powell (1985)). However, the solution involves making empirical inferences about how each of ORANI's endogenous variables responds within the 2-year short run.

In this paper we take a simpler approach which in effect assumes that every ORANI endogenous variable in the short-run closure has a straight-line adjustment path (see Cooper, McLaren, and Powell (1985), Figure 3). As far as the exogenous shocks go, we proceed as follows. If our scenario supposes that an exogenous variable (capital stocks, say) grows at an average of 2.4 per cent per annum between the datum and the forecast year, we convert this to a 4.8 per cent step-function shock injected at the datum point. That is, we suppose

that the shock impinges, within a 2-yearly time frame, as capital stocks assuming a value 4.8 per cent higher than they did in the previous 2-year period.

This scheme introduces a large measure of consistency between the Institute's long-term forecasts and the short-term forecasts made by us. To see this, consider a variable which is endogenous in the long-term closure (e.g., capital stocks) but exogenous in the short-term closure. Then the shock input into the latter is $2\alpha$, where $\alpha$ is the long-term forecast "average annual rate of growth". The output from the short-term forecasting exercise is that some endogenous variable (exports, say) in two year's time will be "$\beta$ per cent higher than its datum value". Given the assumed linear within-short-run adjustment path, the average annual rate of growth of this endogenous variable is "$\beta/2$ per cent per annum". Suppose now that this short-run endogenous variable is also a long-run endogenous variable (which is so in the case of exports). Let the long-run forecast of the annual rate of growth of this variable be $\gamma$ per cent. Then we have the following schema:

Long-run Closure

| Capital Stocks | Exports |
|---|---|
| $\alpha$% p.a. | $\gamma$% p.a. |

Short-run Closure

| Capital Stocks | Exports |
|---|---|
| $\alpha$% p.a. | $\beta/2$% p.a. |

Hence, if the two closures differed only in the selection of endogenous and exogenous variables (and not in the values of parameters), then since an $\alpha$ per cent change per annum (in the long-run closure) in

capital stocks is consistent with a $\gamma$ per cent change per annum in exports, and an $\alpha$ per cent change per annum in capital stocks (in the short-run closure) produces a $\beta/2$ per cent change per annum in exports, we would expect to find:

$$\gamma = \beta/2 \quad .$$

In fact, this is approximately so. It is not exactly so in our application for two reasons. First, some parameter values (e.g., the capital-labour substitution elasticity) differ between closures ($\sigma_{KL}$ = 0.5 in the short-run closure, but $\sigma_{KL}$= 1.28 in the long-run closure). Secondly, in putting together our short-term scenario, whilst we have striven for a consistency with the Institute's long-term scenario, we have not pressed the issue. So, while our scenario replicates all the major features of the Institute's, it does not follow it in every detail.

The above procedure does not introduce as much tension between the two sets of forecasts as might appear to be the case on first sight. In particular, it is still in principle possible for forecast variables to achieve the Institute's nominated <u>average</u> rates of growth over the interval 1986 (their datum) to 1992, but nevertheless to experience a somewhat different average growth rate over the two years 1988-89/1989-90.

To summarize, what we have done above is to adopt timing conventions (they are no more than that) which effectively bring the ORANI story back to Johansen's (1960) treatment of "multisectoral growth". To quote Taylor (1975, p. 100):

> "Basically he [Johansen] proceeds by logarithmically differentiating the equations characterizing a Walrasian competitive equilibrium with respect to time in order to get a simultaneous system of equations which are linear in all growth rates. A set of growth rates is specified exogenously and a matrix inversion then suffices to calculate the other growth rates in the system."

If we ignore the (relatively minor) parameter changes between the short- and long-run closures of ORANI, then (according to the story we have told above) the two closures are related simply by different choices of endogenous and exogenous variables (Dixon, Parmenter, Sutton, and Vincent (1982), Section 36). In either case the variables in the system can be interpreted as "average annual percentage changes".

## 3. MACROECONOMIC FORECASTS

The Institute's long-term scenario for the economy is briefly sketched in part A of Table 1. The key ideas are (a) that an improvement in the balance of trade at an average rate equivalent to about 0.9 per cent of GDP per annum is needed to achieve a surplus trade balance equivalent to about 2 per cent of GDP in 1991-92; (b) that such an improvement is needed if we are to stabilize our foreign debt (as a percentage of GDP) by this date; and (c) that import prices will continue to grow 0.9 per cent per annum faster than export prices. (Note that in the last of these assumptions, 'export prices' means the prices that exports would have attracted if there were no endogenous expansion in the levels of exports.) It is also assumed that technology

Table 1: Main Assumptions Underlying the Forecasts

| | | |
|---|---|---|
| | **A. Background Long-term Scenario[a]** | |
| i. | Surplus in the balance of trade in goods and services as a percentage of GDP in 1991-92 | 2 |
| | Average annual growth rates, December 1986 to June 1992: | (per cent per annum) |
| ii. | Employment and labour force | 2.3 |
| iii. | Labour-saving technology | 1.0 |
| iv. | Improvement in the balance of trade (as a percentage of GDP) | 0.9 |
| v. | Terms of trade [excluding further falls in export prices due to the expansion of exports] | -0.9 |
| | Non traditional exports[b] | |
| vi. | - excluding industries 109-111 | 10.0 |
| vii. | - industries 109-111 | Equivalent to 1 per cent of base-period output |
| viii. | Inflation in CPI | 7.00 |
| ix. | The average annual rates of growth of real private and public consumption are equal | |
| x. | Industries restore normal rates of return on capital by 1991-92 starting from disequilibrium in 1986. | |

... continued

Table 1 (continued)

B. Short-term Scenario[c]

| | | (percentage change sustained for at least 2 years[d]) |
|---|---|---|
| 1. | A substained rise in the foreign-currency price of wool[e] | 20 |
| 2. | A sustained rise in the foreign-currency price of wheat[f] | 5 |
| 3. | A sustained rise in the quantity of live sheep exported[g] | 9.7 |
| 4. | Terms of trade: a sustained rise in the overall price of imports relative to exports[h] | 8.8 |
| | A sustained rise in non-traditional exports[d]: | |
| 5. | - excluding industries 109-111 | 20 |
| 6. | - industries 109-111 | Equivalent to 2 per cent of base-period output |
| 7. | An across-the-board tariff cut[i] | 20 |
| 8. | A reduction in real hourly wages as a cost[j] | 1.6 |
| 9. | Labour-saving technology | 2.0 |
| 10. | An increase in real personal consumption | 4.2 |
| 11. | An increase in real private investment | 0.6 |
| 12. | The percentage changes in private and public consumption are equal. | |
| 13. | The production technology in all LGA's in the South Western Statistical Division of Victoria is approximated by that of the ABARE's High Rainfall Zone. | |
| 14. | Within the ORANI short-run, the percentage changes in all variables are linear in time. | |
| 15. | The Australian dollar devalues, over two years, by 15.24 per cent (relative to a trade-weighted average of other currencies). | |

[footnotes overleaf]

Table 1 (continued)

Footnotes

(a) Source: Parmenter, B.R. (1988): "Notes on the Medium-Run Implications of Real Devaluation", University of Melbourne, Institute of Applied Economic and Social Research, pp. 6 (mimeo).

(b) A list of industries used in the ORANI model is given in Appendix Table A1.

(c) Note that items (1), (2) and (4) below are equivalent to two years' change in the terms of trade at the rate specified in (v) above; that, with the exception of live sheep (item (3) below), (5) and (6) below are equivalent in a similar sense to (vi) and (vii) above; and finally that (iii) and (9) are similarly equivalent.

(d) Note that these are not annual rates of change, but rather a sustained change in level; as explained above in (c), in some cases the percentage change in level corresponds to two-year's growth under the long-term scenario.

(e) Based on Dewbre, J., in association with Phil Simons and Greg Connolly (1988): "Issues in Australian Fibre Markets", paper presented to the ABARE's National Agricultural Outlook Conference, January.
[From the chart on p.2 of the paper, it seems that the foreign-currency price of wool increased about 10 per cent per annum in each of 1986-87 and 1987-88; and that the new foreign-currency price level so attained is expected by ABARE to be firm through 1992-93.]

(f) Based on cautiously optimistic statements made in several papers presented at the ABARE's National Agricultural Outlook Conference, including Schmitz, Andrew (1988): "Grain Market Outlook" and Rose, Roger (1988): "International Outlook for Grains and Oilseeds".

(g) Based on Sheales, Terry (1988): "The Prospects for Meat", paper presented to the ABARE's National Agricultural Outlook Conference, January.

(h) Note that the world currency prices of agricultural and minerals products, other than wool and wheat, are assumed to remain stable; it is principally the foreign-currency prices of manufactures that are assumed to experience a sustained 8.8 per cent rise relative to an index of the foreign-currency prices of our exports.

(i) According to political journalist Michelle Grattan ("Age", 30th January 1988) the figure of 20 per cent is that favoured by Senator Button's department.

(j) This assumption is consistent with two years' accumulation of the rate of real-wage fall projected by Parmenter (see footnote(a)) to be needed to achieve the fall in Australia's real exchange rate necessary for stabilization of our external debt by 1992.

improves at such a rate that the same capital input as last year and 99 per cent of last year's labour input are sufficient, this year, to produce an output of last year's size (i.e., there is a steady labour-saving technological improvement of 1 per cent per annum).

The above assumptions imply that continued real wage restraint is needed. In particular, to turn around the trade account in the manner postulated, real hourly wages as a cost will need to decline, on average, by 0.8 per cent per annum.

In part B of Table 1 we sketch our short-term scenario. Most of its elements are taken directly from the Institute's long-term forecasts. The exceptions are that

(i) we used material from the January 1988 National Agricultural Outlook Conference to write scenarios on the prices of wool and wheat, and on exports of live sheep;

and

(ii) we investigated the effects of a 20 per cent tariff cut (which currently is being canvassed by some senior figures in the Federal Ministry).

The resulting forecasts for six macroeconomic indicators are given in Table 2. The separate effects of each exogenous change (in our short-run closure) are recorded, enabling readers to rescale individual columns if they wish, and to recalculate the final forecast in column (14). Notice that, given the scenarios on the prices of wool and wheat, the 8.8 per cent rise in the price of imports in column (3) is

Table 2: Macroeconomic Forecasts for 1990*

| Variable | Increased Foreign Currency Prices of: | | | Increased Exports of: | | | Across-the-Board Tariff Cut | Reduced Real Hourly Wage Costs 1.6% with 2% Labour-Saving Technological Improvement |
|---|---|---|---|---|---|---|---|---|
| | | | | Live sheep | Non-traditional Items: Excluding Industries 109-111 | Non-traditional Items: Industries 109-111 Equiv. to 2% of output | | |
| | Wool 20% | Wheat 5% | Imports 8.8% | 9.7% | 20% | | 20% | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| CPI | 0.06 | 0.05 | 5.06 | 0.04 | 0.99 | 0.25 | -1.86 | -6.23 |
| Real GDP[a] | 0.39 | 0.06 | -1.33 | -0.02 | 0.39 | 0.05 | 0.13 | 1.78 |
| Employment[b] | 0.24 | 0.03 | -0.88 | -0.01 | 0.56 | 0.07 | 0.18 | 0.91 |
| Exports[c] | 2.68 | 0.42 | -3.12 | -0.08 | 4.47 | 0.50 | 2.09 | 8.60 |
| Imports[c] | 0.10 | 0.02 | 5.56 | 0.04 | 1.91 | 0.16 | 1.23 | -3.06 |
| Change in Trade Balance[d] | 0.41 | 0.06 | -1.40 | -0.02 | 0.41 | 0.05 | 0.14 | 1.88 |

Footnotes appear at bottom of next page.

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Table 2 (continued)

| Variable | Increased Real Consumption | Increased Real Private Investment | Increased Capital Stocks | Nominal Exchange Rate Devaluation | Total of Previous 12 Columns | Forecast Annual Growth Rate [(col. 13) +2] |
|---|---|---|---|---|---|---|
| | 4.2% | 0.6% | 4.8% | 15.24% | | |
| | (9) | (10) | (11) | (12) | (13) | (14) |
| CPI | 9.32 | 0.07 | -8.99 | 15.24 | 14.00 | 7.00 |
| Real GDP(a) | 0.70 | 0.08 | 2.43 | 0 | 4.66 | 2.33 |
| Employment(b) | 0.42 | 0.11 | 2.24 | 0 | 3.87 | 1.94 |
| Exports(c) | -10.00 | -0.11 | 11.84 | 0 | 17.51 | 8.76 |
| Imports(c) | 6.76 | 0.22 | -4.06 | 0 | 8.88 | 4.44 |
| Change in Trade Balance(d) | -0.74 | -0.08 | 2.56 | 0 | 3.27 | 1.64 |

* The figures in column (13) are percentage increases relative to 1987-88. In the case of the CPI (a stock variable), the entry 14.00 indicates that the CPI at July 1st 1990 is forecast to be 14 per cent higher than its value two years previously. In the case of the remaining (flow) variables, the comparison is between the flow in the 1989-90 and in 1987-88.

(a) Measured according to a convention which takes account of the effect on Australia's real productive capacity of the change in the terms of trade -- see Higgs (1986, eqn A7.6, p. 268).

(b) Measured using wage-bill weights.

(c) Measured in foreign currency.

(d) Expressed as a percentage of base-period GDP.

calculated so as to be consistent with item (v) in part A of Table 1 (for more details see section A.1 of the Appendix). Similarly, given the 0.8 decline in the real hourly wage rate as a cost, the size of the nominal exchangerate devaluations in columns (13) and (14) have been chosen so to be consistent with CPI inflation running at 7 per cent per annum (item (viii) in part A of Table 1).

The increases in the world prices of wool and wheat stimulate the domestic agricultural industries, which in turn leads to increases in real GDP, employment, and the balance of trade; see columns (1) and (2) of Table 2. Furthermore, they are projected to cause a small increase in the CPI. On the other hand, the increase in the world prices of Australia's imports is projected to increase the CPI significantly; see column (3). This in turn reduces the competitiveness of Australia's export sector which leads to a contraction in exports, real GDP, employment, and the balance of trade.

The increase in exports of live sheep is projected to cause an increase in the CPI; see column (4). This is due to the subsequent rise in the price of processed meat which has a significant weight in the CPI. The increase in the price of processed meat causes a fall in Australia's exports of meat products which dominates the increase in exports of live sheep such that aggregate exports actually fall slightly. As a result there are relatively small projected declines in real GDP, aggregate employment, and the balance of trade. Furthermore, the increase in domestic costs, as reflected by the increase in the CPI, results in a reduction in the competitiveness of the import-competing industries and hence an increase in imports. On the other hand, the increase in non-traditional exports is projected to cause a relatively large

increase in aggregate exports, real GDP, aggregate employment, and the balance of trade; see columns (5) and (6). Again, there is an increase in the CPI which is reflected by an increase in aggregate imports.

An across-the-board tariff cut reduces the price of imported goods. This makes imports relatively more attractive and there is an increase in aggregate imports; see column (7). The reduction in import prices flows onto other prices, wages, etc. These price reductions are reflected by a fall in the CPI. The fall in domestic costs improves Australia's international competitiveness. As a result, aggregate exports are projected to increase, as is real GDP and aggregate employment. Finally, the stimulus to exports dominates the increase in imports and the balance of trade is projected to move towards surplus.

The 1.6 per cent reduction in real hourly wage costs and the 2 per cent labour-saving technological change also improves the international competitiveness of the Australian economy. A significant reduction in costs is projected, as is reflected by the relatively large fall in the CPI; see column (8). This stimulates both the export and import-competing sectors. Aggregate exports are projected to increase and aggregate imports are projected to decrease. This causes the balance of trade to move towards surplus. Finally, the combined effect of a reduction in wage costs and the labour-saving technological change is projected to increase real GDP and aggregate employment.

The next part of our economic scenario concerns an increase in real consumption and real investment; see columns (9) and (10). Both of these aggregate demand shocks cause an increase in real GDP and aggregate employment. However, they also cause an increase in domestic

costs, as reflected by the increase in the CPI. As a result of the increase in domestic costs and the increased activity level in the economy, aggregate imports increase and aggregate exports fall.

An exogenous increase in capital stocks causes a fall in the rental rate on capital. This in turn causes a fall in prices and results in a fall in the CPI; see column (11). An increase in capital stocks also increases the productive capacity of the economy and causes real GDP and aggregate employment to increase. Finally, the increase in capital stocks, and the resulting fall in costs, stimulates exports and reduces imports.

The last component of our economic scenario concerns a nominal exchange rate devaluation. As the nominal exchange rate is the numeraire (and as wages are assumed to be fully indexed to the CPI), a change in the nominal exchange causes all prices to change by the same amount but has no effect on any real variables; see column (12).

The resulting forecasts for the six macroeconomic indicators are given in columns (13) and (14) of Table 2. Given our economic scenario, we expect an annual growth rate of 7 per cent in the CPI. Real GDP is forecast to grow by 2.33 per cent per annum, while aggregate employment is forecast to grow by 1.94 per cent per annum. Finally, a surplus equivalent to 1.64 per cent of GDP is projected for the balance of trade in each year of the forecast. This surplus is brought about by an annual 8.76 per cent increase in exports while imports are only forecast to increase by 4.44 per cent per annum.

# 4. REGIONAL FORECASTS

The methodology used to generate regional forecasts is essentially a tops-down approach. The ORANI model is first solved for the effects of our economic scenario on industry outputs. Two industries which are particularly important in the south-western region of Victoria are the Clothing industry (especially Fletcher Jones and Staff Pty Ltd) and the agricultural High Rainfall Zone industry. In this section we will first discuss the effects on these industries of our economic scenario. Then given the output response of the High Rainfall Zone, we generate real farm income forecasts for the 12 local government areas that make up the South-Western Statistical Division of Victoria. The farm income forecasts are discussed in the second part of this section.

## 4.1 Agricultural and Clothing Industry Output Forecasts

The effects of each component of our economic scenario on the output of the Clothing and High Rainfall Zone industries are given in Table 3. Also reported in the table are the changes in the mix of commodities produced by the High Rainfall Zone. Rather than analyse all of the projections in Table 3, we first explain the results in the initial couple of columns in some detail. Any significant projections occurring elsewhere in the table are then noted.

The increase in the foreign currency prices of wool and wheat cause a contraction in the output of the Clothing industry. Both of these commodity price rises feed into the cost structure of the domestic economy. Recall from Table 2, columns (1) and (2), that in both cases

the CPI is projected to increase. This results in an increase in costs of the Clothing industry. As this industry is trying to compete with imported clothing, the increase in its costs leads to a contraction in output, see Table 3, columns (1) and (2). On the other hand, an increase in the foreign currency price of imports makes domestically produced clothing relatively cheaper. This results in an increase in output of the Clothing industry; see Table 3, column (3).

The High Rainfall Zone is projected to experience an increase in output if there is an increase in the foreign currency price of wool. This is to be expected since approximately half of the output of the High Rainfall Zone consists of wool. The High Rainfall Zone is also projected to increase its output of all the commodities it produces; see Table 3, column (1). This can be explained as follows. The output response of a commodity depends on both an expansion effect and a transformation effect. An increase in the world price of wool, for example, stimulates a general expansion in the output of the High Rainfall Zone However, it also induces a transformation in favour of wool production at the expense of the other commodities produced by the High Rainfall Zone. The transformation parameters which describe the degree of product-mix response by agricultural producers were estimated econometrically by Vincent, Dixon, and Powell (1980). Due to data limitations it was necessary to aggregate some commodities into composites. For example, commodities A3, A4, A5, A7, A8, and A9 constitute a composite commodity and hence their output responses in Table 3 are the same. Given an increase in the world price of wool, both the expansion and transformation effects tend to increase the output of wool. However, for the other commodities the effects work in

Table 3: Agricultural and Clothing Industry Output Forecasts for 1989-90*

| Industry/ Commodity | Increased Foreign Currency Prices of: | | | Increased Exports of: | | | Across-the-Board Tariff Cut | Reduced Real Hourly Wage Costs 1.6% with 2% Labour-Saving Technological Improvement |
|---|---|---|---|---|---|---|---|---|
| | | | | Live sheep | Non-traditional Items | | | |
| | Wool | Wheat | Imports | | Excluding Industries 109-111 | Industries 109-111 Equiv. to | | |
| | 20% | 5% | 8.8% | 9.7% | 20% | 2% of output | 20% | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Clothing | -0.08 | -0.02 | 0.88 | -0.01 | -0.07 | -0.05 | -2.06 | 2.20 |
| High Rainfall Zone | 4.36 | -0.07 | -4.21 | 1.31 | -0.94 | -0.20 | 1.48 | 7.02 |
| A1 Wool | 5.36 | -0.11 | -4.12 | 1.27 | -0.94 | -0.20 | 1.45 | 6.88 |
| A2 Sheep | 3.02 | -0.28 | -4.37 | 2.89 | -1.05 | -0.21 | 1.54 | 7.16 |
| A3 Wheat | 3.16 | 0.39 | -1.14 | 1.09 | 0.23 | -0.05 | 0.38 | 2.38 |
| A4 Barley | 3.16 | 0.39 | -1.14 | 1.09 | 0.23 | -0.05 | 0.38 | 2.38 |
| A5 Other Cereal Grains | 3.16 | 0.39 | -1.14 | 1.09 | 0.23 | -0.05 | 0.38 | 2.38 |
| A6 Meat Cattle | 4.22 | -0.09 | -6.36 | 0.13 | -1.67 | -0.30 | 2.25 | 10.33 |
| A7 Milk Cattle & Pigs | 3.16 | 0.39 | -1.14 | 1.09 | 0.23 | -0.05 | 0.38 | 2.38 |
| A8 Other Farming 1[a] | 3.16 | 0.39 | -1.14 | 1.09 | 0.23 | -0.05 | 0.38 | 2.38 |
| A9 Other Farming 2[b] | 3.16 | 0.39 | -1.14 | 1.09 | 0.23 | -0.05 | 0.38 | 2.38 |

... continued

Table 3 (continued)

| Industry/ Commodity | Increased Real Consumption | Increased Real Private Investment | Increased Capital Stocks | Nominal Exchange Rate Devaluation | Total of Previous 12 Columns | Forecast Annual Growth Rate [(col. 13) ÷ 2] |
|---|---|---|---|---|---|---|
| | 4.2% | 0.6% | 4.8% | 15.24% | | |
| | (9) | (10) | (11) | (12) | (13) | (14) |
| Clothing | -0.71 | -0.01 | 2.13 | 0 | 2.83 | 1.42 |
| High Rainfall Zone | -7.10 | -0.07 | 8.06 | 0 | 9.64 | 4.82 |
| A1 Wool | -7.00 | -0.07 | 7.90 | 0 | 10.42 | 5.21 |
| A2 Sheep | -7.24 | -0.08 | 8.17 | 0 | 9.55 | 4.78 |
| A3 Wheat | -2.14 | 0.02 | 2.69 | 0 | 7.01 | 3.51 |
| A4 Barley | -2.14 | 0.02 | 2.69 | 0 | 7.01 | 3.51 |
| A5 Other Cereal Grains | -2.14 | 0.02 | 2.69 | 0 | 7.01 | 3.51 |
| A6 Meat Cattle | -10.60 | -0.13 | 12.03 | 0 | 9.81 | 4.91 |
| A7 Milk Cattle & Pigs | -2.14 | 0.02 | 2.69 | 0 | 7.01 | 3.51 |
| A8 Other Farming 1(a) | -2.14 | 0.02 | 2.69 | 0 | 7.01 | 3.51 |
| A9 Other Farming 2(b) | -2.14 | 0.02 | 2.69 | 0 | 7.01 | 3.51 |

* The figures in column (13) are percentage increases in forecast outputs in 1989-90 relative to 1987-88.

(a) The principal commodities in this category are sugar cane, fruit, and nuts. A detailed breakdown is given in Higgs (1986, Table 1.2).

(b) The principal commodities in this category are vegetables, cotton, oilseeds, and tobacco. A detailed breakdown is given in Higgs (1986, Table 1.2).

opposite directions. It turns out that in column (1) at least, the expansion effect dominates the transformation effect.

The High Rainfall Zone is not a large producer of wheat. The inflationary effects of the increase in the price of wheat and the expansion in other agricultural industries causes a contraction in the output of the High Rainfall Zone. However, the transformation effect in favour of wheat results in a net increase in the output of wheat; see Table 3, column (2). Finally, the increase in the world price of imports causes a relatively large contraction in the output of the High Rainfall Zone. These price increases feed into production costs and cause a reduction in the international competitiveness of Australia's export industries. Note that production levels of meat cattle and sheep contract more than the average for the industry. This is due to a decrease in demand for these commodities by the export-oriented Meat Products industry.

The exogenous increases in exports are projected to cause a contraction in the Clothing industry; see Table 3, columns (4) - (6). The increased exports are inflationary (see Table 2, columns (4) - (6)) which causes a loss in international competitiveness and, as a result, a contraction in import-competing industries such as the Clothing industry. The High Rainfall Zone experiences an increase in output when exports of live sheep are increased. However, it also contracts when non-traditional exports are increased; again this is due to the resulting loss in international competitiveness.

An across-the-board tariff cut will cause a contraction in the Clothing industry. This is to be expected given that the Clothing

industry currently enjoys a relatively high level of tariff protection. On the other hand, the High Rainfall Zone will benefit from an across-the-board tariff cut. The reduction in domestic costs that follow a tariff cut will improve the ability of the High Rainfall Zone to compete on world markets.

A reduction in wage costs and labour-saving technological change are projected to increase the output of both the Clothing and the High Rainfall Zone industries; see Table 3, column (8). A reduction in costs improves the international competitiveness of these industries. However, an increase in real consumption and real investment causes a deterioration in international competitiveness which leads to a contraction in the output of these industries; see columns (9) and (10). Note that contraction is less than it might have otherwise have been due to increased domestic sales resulting from the expansion in the size of the Australian economy.

An increase in capital stocks stimulates the output of both the Clothing and the High Rainfall Zone industries; see Table 3, column (11). In particular, it facilitates substantial increases in the production of wool, sheep, and meat cattle. These commodities are largely sold as exports both directly and indirectly (i.e., after being processed).

Our forecasts for the outputs of the Clothing and High Rainfall Zone industries are given in columns (13) and (14) of Table 3. The Clothing industry is expected to experience a 1.42 per cent annual increase in output over the period 30th June 1988 to 1st July 1990. An even stronger annual growth rate of 4.82 per cent is expected for the

High Rainfall Zone over the same period. The relative strength of this last growth rate can be judged by comparing it with the forecast increase in real GDP of 2.33 per cent per annum; see Table 2, column (14).

## 4.2 Real Farm Income Forecasts for the South-Western Region of Victoria

Forecasts of real farm income in each of the twelve Local Government Areas (LGAs) that make up the South Western Statistical Division of Victoria are given in Table 4. These forecasts are derived from the commodity output projections of the High Rainfall Zone given in Table 3. The technical details of the derivation are given in section A.2 of the Appendix. Briefly, however, the outputs of each LGA are first calculated by weighting the commodity output projections listed in Table 3 by the shares of the commodities in the base-period outputs of the LGAs. These weighted output projections are then used to produce forecasts of real net farm income in each LGA. Note that real net farm income is defined to consist of the CPI-deflated returns to labour, capital, and agricultural land.

Table 4 also disaggregates our forecasts of real farm incomes by each component of our economic scenario. For example, in the absence of other factors, real farm incomes in the Mount Rouse LGA are projected to increase by 12.69 per cent if the foreign-currency price of wool increases by 20 per cent; see Table 4, column (1). This represents the largest increase in response to an increase in the price of wool of all the LGAs. This can be attributed to the fact that production of wool constitutes a higher share of output in Mount Rouse relative to the

Table 4: Real Farm Income Forecasts for 1990*

| Local Government Areas | Increased Foreign Currency Prices of: | | | Increased Exports of: | | | Across-the-Board Tariff Cut | Reduced Real Hourly Wage Costs 1.6% with 2% Labour-Saving Technological Improvement |
|---|---|---|---|---|---|---|---|---|
| | | | | Live sheep | Non-traditional Items | | | |
| | Wool | Wheat | Imports | | Excluding Industries 109-111 | Industries 109-111 Equiv. to | | |
| | 20% | 5% | 8.8% | 9.7% | 20% | 2% of output | 20% | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| 1. Belfast, Pt Fairy, Lady J. Percy Is., & Tower Hill | 10.19 | 0.42 | -8.32 | 2.65 | -1.33 | -0.39 | 2.90 | 10.78 |
| 2. Dundas & Hamilton | 12.60 | -0.19 | -10.85 | 3.72 | -2.39 | -0.52 | 3.81 | 14.55 |
| 3. Glenelg | 12.02 | -0.18 | -11.62 | 3.36 | -2.64 | -0.55 | 4.09 | 15.74 |
| 4. Hampden & Camperdown | 10.61 | 0.36 | -8.09 | 2.97 | -1.27 | -0.38 | 2.82 | 10.42 |
| 5. Heytesbury | 9.56 | 0.61 | -7.35 | 2.42 | -0.94 | -0.34 | 2.55 | 9.32 |
| 6. Koroit | 9.66 | 0.54 | -7.77 | 2.47 | -1.10 | -0.36 | 2.70 | 9.96 |
| 7. Minhamite | 12.06 | -0.13 | -11.09 | 3.39 | -2.44 | -0.53 | 3.90 | 14.92 |
| 8. Mortlake | 11.77 | 0.03 | -9.88 | 3.32 | -1.99 | -0.47 | 3.46 | 13.11 |
| 9. Mount Rouse | 12.69 | -0.19 | -10.83 | 3.70 | -2.38 | -0.52 | 3.81 | 14.52 |
| 10. Portland | 11.45 | -0.04 | -11.19 | 3.06 | -2.44 | -0.53 | 3.93 | 15.10 |
| 11. Wannon | 12.64 | -0.20 | -11.08 | 3.62 | -2.47 | -0.53 | 3.89 | 14.90 |
| 12. Warrnambool | 10.15 | 0.44 | -8.37 | 2.51 | -1.34 | -0.39 | 2.92 | 10.87 |
| Total, S.W. Stat. Division | 11.18 | 0.15 | -9.53 | 3.06 | -1.83 | -0.45 | 3.34 | 12.59 |

... continued

Table 4 (continued)

| Local Government Areas | Increased Real Consumption | Increased Real Private Investment | Increased Capital Stocks | Nominal Exchange Rate Devaluation | Total of Previous 12 Columns | Forecast Annual Growth Rate [(col. 13) ÷ 2] |
|---|---|---|---|---|---|---|
| | 4.2% | 0.6% | 4.8% | 15.24% | | |
| | (9) | (10) | (11) | (12) | (13) | (14) |
| 1. Belfast, Pt Fairy, Lady J. Percy Is., & Tower Hill | -14.27 | -0.09 | 19.71 | 0 | 22.25 | 11.13 |
| 2. Dundas & Hamilton | -18.38 | -0.17 | 19.71 | 0 | 21.89 | 10.95 |
| 3. Glenelg | -19.61 | -0.19 | 19.71 | 0 | 20.13 | 10.07 |
| 4. Hampden & Camperdown | -13.91 | -0.09 | 19.71 | 0 | 23.15 | 11.58 |
| 5. Heytesbury | -12.70 | -0.06 | 19.71 | 0 | 22.78 | 11.39 |
| 6. Koroit | -13.38 | -0.08 | 19.71 | 0 | 22.35 | 11.18 |
| 7. Minhamite | -18.75 | -0.18 | 19.71 | 0 | 20.86 | 10.43 |
| 8. Mortlake | -16.81 | -0.14 | 19.71 | 0 | 22.11 | 11.06 |
| 9. Mount Rouse | -18.36 | -0.17 | 19.71 | 0 | 21.98 | 10.99 |
| 10. Portland | -18.91 | -0.18 | 19.71 | 0 | 19.96 | 9.98 |
| 11. Wannon | -18.76 | -0.18 | 19.71 | 0 | 21.54 | 10.77 |
| 12. Warrnambool | -14.36 | -0.10 | 19.71 | 0 | 22.04 | 11.02 |
| Total, S.W. Stat. Division | -16.24 | -0.13 | 19.71 | 0 | 21.85 | 10.93 |

* The figures in column (13) are percentage increases in real farm income in 1989-90 relative to 1987-88.

other LGAs; see Appendix Table A2. It is possible to explain all the differences between the LGA projections by appealing to differences in their base-period commodity mixes. However the striking aspect of the forecasts in Table 4 is not their differences, but rather their similarity. This is due to the fact that each of local government areas produces roughly the same mix of commodities; see Appendix Table A2. Thus the prospects for each LGA are roughly the same as that for the region where we expect real farm incomes to increase by about 12 per cent per annum over the period 30th June 1988 to 1st July 1990.

## 5. CONCLUDING REMARKS AND A PERSPECTIVE FOR FUTURE RESEARCH

In this paper we have presented our expected outcomes for a number of macroeconomic and regional variables. It is possible for the reader to rework our forecasts by scaling the projections given in Tables 2, 3, and 4 to correspond with some other economic scenario and thus obtain a feel for the sensitivity of the forecasts. However, we have not calculated the confidence intervals associated with these forecasts. To generate confidence intervals requires an explicit treatment of not only uncertainty with respect to our exogenous forecasts (see, for example, Higgs (1987)) but also with respect to the specification and estimation of our economic model. One avenue for future research is to develop a framework for producing such confidence intervals.

Of all the components of our economic scenario, the one we feel that could benefit most from future work is the across-the-board increase in capital stocks. As the forecasts are relatively sensitive to changes in capital stocks, it would be preferable to have

industry-specific changes in capital stocks (especially for the High Rainfall Zone).

Finally, our study can be interpreted as a first step towards linking short-run and long-run solutions of the ORANI model. Such a link would ensure consistency between forecasts over these time horizons.

# APPENDIX

This appendix is divided into two parts. The first explains some technical details of our economic scenario. The second develops our methodology for generating regional forecasts.

## A.1 Technical Details of the Economic Scenario

There are four aspects of our economic scenario which require a detailed explanation. The first concerns the changes in world prices that make up our terms-of-trade shock. The second, is our exogenous export shocks. The third concerns how we modelled labour-saving technical change. The final aspect involves the shock to the nominal exchange rate. These are discussed in turn.

### Terms of Trade

According to Parmenter (1988, Table 2) there will be an average annual deterioration in Australia's terms of trade of 1.8 per cent over the period December 1986 to June 1992. (Note that this estimate includes the effect on export prices of the endogenous response of Australian exports.) On the basis of Parmenter's estimate we assume that there will be a 3.6 per cent deterioration in the terms of trade over the period 30th June 1988 to 1st July 1990. Furthermore, we follow Dewbre (1988) and assume that world price of wool will increase by 20 per cent over the next two years. Finally, based on cautiously optimistic statements made by Schmitz (1988) and Rose (1988), we assume that the world price of wheat will increase by 5 per cent over the next two years.

The above commodity price projections and the overall change in the terms of trade projected by Parmenter (1988) are reconciled and converted into foreign currency priced shocks as follows. The percentage change in the terms of trade, $\tau$, can be written:

$$\tau = p_X - p_M \quad ; \qquad (A1.1)$$

where $p_X$ and $p_M$ are the percentage changes in the prices of exports and imports, respectively. The percentage change in the price index for exports is given by:

$$p_X = p_{wool}\, W_{wool} + p_{wheat}\, W_{wheat} + p_O\, W_O + p_M\, W_M \quad ; \qquad (A1.2)$$

where $p_{wool}$ and $p_{wheat}$ are the percentage changes in the world foreign-currency prices of wool and wheat, respectively; $p_O$ is the percentage change in the world foreign-currency price of other agricultural and mining exports (i.e., ORANI commodities A2, A4-A10, 12-14, 18, 25, 30, and 64; see Table A1); $p_M$ is the percentage change in the foreign-currency price of imports (i.e., ORANI commodities 9-11, 15-17, 19-24, 26-29, 31-63, and 65-112); $W_{wool}$ and $W_{wheat}$ are the base-period shares of wool and wheat, respectively, in the value of Australia's exports (equal to 0.1051 and 0.0555, respectively); $W_O$ is the share of other agricultural and mining exports (equal to 0.5193); and $W_M$ is the share of "import commodities" in the value of Australia's exports (equal to 0.3201). If it is assumed that $p_O$ equals zero and we substitute -3.6 for $\tau$, 20.0 for $p_{wool}$, and 5.0 for $p_{wheat}$ into equations (A1.1) and (A1.2) we find that $p_M$ is equal to 8.8 per cent. Thus the

Table A1: List of Industries and Commodities in the ORANI Model

INDUSTRIES

| | |
|---|---|
| 1 | Pastoral Zone |
| 2 | Wheat-Sheep Zone |
| 3 | High Rainfall Zone |
| 4 | Northern Beef |
| 5 | Milk Cattle and Pigs |
| 6 | Other Farming (Sugar Cane, Fruit and Nuts) |
| 7 | Other Farming (Vegetables, Cotton, Oilseeds, and Tobacco) |
| 8 | Poultry |

COMMODITIES

| | |
|---|---|
| A1 | Wool |
| A2 | Sheep |
| A3 | Wheat |
| A4 | Barley |
| A5 | Meat Cattle |
| A6 | Other Cereal Grains |
| A7 | Milk Cattle and Pigs |
| A8 | Other Farming (Sugar Cane, Fruit, and Nuts) |
| A9 | Other Farming (Vegetables, Cotton, Oilseeds, and Tobacco) |
| A10 | Poultry |

INDUSTRIES/COMMODITIES

| | |
|---|---|
| 9 | Agricultural Services |
| 10 | Forestry and Logging |
| 11 | Fishing and Hunting |
| 12 | Ferrous Metal Ores |
| 13 | Non-Ferrous Metal Ores |
| 14 | Black Coal |
| 15 | Oil, Gas, and Brown Coal |
| 16 | Other Minerals |
| 17 | Services to Mining |
| 18 | Meat Products |
| 19 | Milk Products |
| 20 | Fruit and Vegetables |
| 21 | Margarine, Oils, and Fats |
| 22 | Flour and Cereal Products |
| 23 | Bread, Cakes, and Biscuits |
| 24 | Confectionery and Cocoa |
| 25 | Other Food Products |
| 26 | Soft Drinks and Cordials |
| 27 | Beer and Malt |
| 28 | Other Alcoholic Drinks |
| 29 | Tobacco Products |
| 30 | Cotton Ginning, etc |
| 31 | Man-Made Fibres, Yarns |
| 32 | Cotton Yarns and Fabrics |
| 33 | Worsted and Woollen Yard |
| 34 | Textile Finishing |
| 35 | Textile Floor Overlays |
| 36 | Other Textile Products |
| 37 | Knitting Mills |
| 38 | Clothing |
| 39 | Footwear |
| 40 | Sawmill Products |
| 41 | Veneers and Boards |
| 42 | Joinery and Wood nec |
| 43 | Furniture and Matresses |
| 44 | Pulp, Paper, and Paperboard |
| 45 | Bags, Fibreboard Boxes |
| 46 | Paper Products nec |
| 47 | Newspapers and Books |
| 48 | Commercial Printing |
| 49 | Chemical Fertilisers |
| 50 | Other Basic Chemicals |
| 51 | Paints, Varnishes |
| 52 | Pharmaceutical Goods |
| 53 | Soap and Detergents |
| 54 | Cosmetics and Toiletries |
| 55 | Other Chemical Goods |
| 56 | Petrol and Coal Products |
| 57 | Glass and Glass Products |
| 58 | Clay Products, Refractories |
| 59 | Cement |
| 60 | Ready Mixed Cement |
| 61 | Concrete Products |
| 62 | Non-Metallic Ore Goods |
| 63 | Basic Iron and Steel |
| 64 | Other Basic Metals |
| 65 | Structural Metal Goods |
| 66 | Sheet Metal Products |
| 67 | Other Metal Products |
| 68 | Motor Vehicles and Parts |
| 69 | Ships and Boats |
| 70 | Locomotives |
| 71 | Aircraft |
| 72 | Scientific Equipment |
| 73 | Electronic Equipment |
| 74 | Household Appliances |
| 75 | Other Electrical Goods |
| 76 | Agricultural Machinery |
| 77 | Construction Machinery |
| 78 | Other Machinery and Plant |
| 79 | Leather Products |
| 80 | Rubber Products |
| 81 | Plastic Products, etc |
| 82 | Signs, Writing Equipment |
| 83 | Other Manufacturing |
| 84 | Electricity |
| 85 | Gas |
| 86 | Water, Sewerage, and Drains |
| 87 | Residential Building |
| 88 | Other Construction |
| 89 | Wholesale Trade |
| 90 | Retail Trade |
| 91 | Mechanical Repairs |
| 92 | Other Repairs |
| 93 | Road Transport |
| 94 | Rail and Other Transport |
| 95 | Water Transport |
| 96 | Air Transport |
| 97 | Communication |
| 98 | Banking |
| 99 | Non-Banking Finance |
| 100 | Investment and Services |
| 101 | Insurance and Services |
| 102 | Other Business Services |
| 103 | Ownership of Dwellings |
| 104 | Public Administration |
| 105 | Defence |
| 106 | Health |
| 107 | Education, Libraries |
| 108 | Welfare and Religion |
| 109 | Entertainment, Leisure |
| 110 | Restaurants, Hotels |
| 111 | Personal Services |
| 112 | Non-Competing Imports |

shocks to foreign currency prices are: for commodity A1, 20.0 per cent; for commodity A3, 5.0 per cent; for commodities A2, A4-A10, 12-14, 18, 25, 30, and 64, zero per cent in each case; and for all other commodities 8.8 per cent.

Exogenous Exports

The growth in exports must be set exogenously for most commodities. On the basis of Sheales (1988), it is assumed that there will be a sustained 9.7 per cent increase in the level of exports of live sheep (commodity A2) over the period 30th June 1988 to 1st July 1990. Following Parmenter (1988) we also assumed that there will be a 20 per cent increase in the exports of commodities A6-A10, 9-11, 15-17, 19-24, 26-29, 31-63, 65-100. Furthermore, Parmenter (1988) assumes that there will be an increase in the exports of services in commodites 109-111 equivalent to 2 per cent of their output. The values of the output of these commodities in the ORANI data base are equal to 2,330.611, 2,731.309, and 797.684 millions of 1977-78 dollars, respectively. Furthermore, the base-period exports of these commodities are equal to 21.523, 4.588, and 0.992 millions of 1977-78 dollars, respectively. Thus, the exogenous shocks to the level of exports for these commodities were 216.56 per cent (i.e., 100 × 0.02 × 2,330.611/21.523), 1,190.71 per cent (i.e., 100 × 0.02 × 2,731.309/4.588), and 1,607.86 per cent (i.e., 100 × 0.02 × 797.684/0.992) for commodities 109, 110, and 111, respectively.

Labour-Saving Technological Change

Following Parmenter (1988), it is assumed that there will be a 2 per

cent labour-saving technological change over the period 30th June 1988 to 1st July 1990. A 2 per cent labour-saving technological change may be thought of as the sum of two components. The first is, for a given level of output, a 2 per cent reduction in the cost of labour used. (Note that this has the same impact on costs as a 2 per cent reduction in the quantity of labour at a fixed real wage rate.) The second is a reduction in the amount of labour used of 2 per cent. (This is required to compensate for the artificial fixity of the quantity of labour assumed in the first component.) Thus, to simulate the effects of a 2 per cent labour-saving technological change we shocked the ORANI model with a reduction in the real hourly wage rate of 2 per cent and then subtracted 2 per cent from the endogenous employment projections.

Nominal Exchange Rate

The nominal exchange rate is used to reconcile our CPI projection with Parmenter's (1988) forecast annual growth in consumer prices of 7.0 per cent. In a closure where wages are fully indexed to the CPI, a one per cent increase in the nominal exchange rate causes a one per cent increase in all prices with no effect on any real variables. The total effect on the CPI of all the components of our economic scenario, with the exception of the change in the nominal exchange rate, is equal to -1.24 per cent (this can be calculated from columns (1) - (11) of Table 2). Thus if the CPI is to increase by 14 per cent over our 2-year forecast period, the nominal exchange rate must devalue by 15.24 per cent (i.e., 14.00 - -1.24).

## A.2 Methodology for Regional Farm Income Forecasts

Our methodology for forecasting regional net farm incomes involves separating the components of our economic scenario into two parts. The first part consists of all the components, with the exception of the change in capital stocks (which comprises the second part). The methodology with respect to each of these parts is discussed in turn below. However, first we define real farm income in a local government area (hereafter LGA). The percentage change in real farm income in the $j^{th}$ LGA, $\psi_j$, is given by:

$$\psi_j = S_{Lj}(\ell_j + w - \xi) + S_{Kj}(k_j + q_j - \xi)$$

$$+ S_{Vj}(v_j + r_j - \xi) \qquad j=1,\ldots,12 ; \qquad (A2.1)$$

where $S_{Lj}$, $S_{Kj}$, and $S_{Vj}$ are the shares of labour, capital, and agricultural land, respectively, in LGA j's total primary factor costs; $\ell_j$, $k_j$, and $v_j$ are the percentage changes in demand for inputs of labour, capital, and agricultural land, respectively, in LGA j; $w$, $q_j$, and $r_j$ are the percentage changes in rental prices paid by LGA j for labour, capital, and agricultural land, respectively; and $\xi$ is the percentage change in the CPI.

### Part One: No Change in Capital Stocks

If it is assumed that the inputs of capital and agricultural land are held constant (i.e., $k_j = v_j = 0$), then following Higgs (1986, Appendix A4) equation (A2.1) can be written:

$$\psi_j = z_j\pi_j + w - \xi \qquad j=1,\ldots,12 ; \qquad (A2.2)$$

where

$$\pi_j = 1 + S_{Fj}/(\sigma(1 - S_{Fj})) \qquad j=1,\ldots,12 \; . \qquad (A2.3)$$

The $z_j$'s are the percentage changes in the LGAs output; $S_{Fj}$ is the share of capital and agricultural land in LGA j's total primary factor costs; and $\sigma$ is elasticity of substitution between primary factors in the LGA's. It is assumed that the share of capital and agricultural land in total primary factor costs is the same in all the LGA's and that it is equal to the share observed in the High Rainfall Zone (i.e., $S_{Fj}$ equals 0.4609 for all j). Furthermore, it is assumed that $\sigma$ equals 0.5 for all of the LGA's. Thus $\pi_j$ is equal to 2.7099 for all of the LGA's.

The next step is to calculate the percentage change in output in each of the LGA's. However before we do this, we will first consider the effect on real farm incomes of a 2 per cent labour-saving technological change. Recall from section A.1 of this Appendix that this was simulated by reducing the real wage by 2 per cent. However, a real wage cut of 2 per cent will not generate the correct labour demand or real wage responses. The correct percentage change in labour demand, $\ell_j^*$, can be calculated by subtracting 2 percentage points from the endogenous labour demand projections, $\ell_j$. The correct real wage change, $(w - \xi)^*$, can be calculated by adding 2 percentage points to the real wage shock, $(w - \xi)$. (In other words, in the desired thought experiment there is no observed reduction in real wages (i.e., $(w - \xi)^* = 0$).) The above corrections can be written:

$$\ell_j^* = \ell_j - 2 \qquad j=1,\ldots,12 \; ; \qquad (A2.4)$$

and

$$(w - \xi)^* = (w - \xi) + 2 \qquad . \qquad (A2.5)$$

If we substitute equations (A2.4) and (A2.5) into equation (A2.1) we find:

$$\psi_j = S_{Lj}(\ell_j - 2 + w - \xi + 2)$$

$$+ S_{Kj}(k_j + q_j - \xi) + S_{Vj}(v_j + r_j - \xi) \qquad j=1,\ldots,12 \quad . \quad (A2.6)$$

Since equation (A2.6) is equivalent to equation (A2.1), the derivation of equation (A2.2) holds even in the case of the labour-saving technological change.

The percentage changes in the output of the LGA's can be estimated:

$$z_j = \sum_{k=1}^{7} S_{kj} a_k \qquad j=1,\ldots,12 \quad ; \quad (A2.7)$$

where $S_{kj}$ is the share of ABS commodity k in the output of LGA j; and $a_k$ is the percentage change in the output of ABS commodity k. The shares $S_{kj}$ are given in Table A2.

Table A2: Shares of Commodities in Gross Value of Farm Output in the South-Western Statistical Division of Victoria, 1985-86 by Local Government Areas*

| Local Government Area | Wheat | Other Crops | Livestock | | | Livestock Products | |
|---|---|---|---|---|---|---|---|
| | | | Sheep | Cattle | Other | Wool | Other |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| 1. Belfast, Pt Fairy, Lady J. Percy Is. & Tower Hill | 0 | 0.1724 | 0.0542 | 0.2461 | 0.0202 | 0.1585 | 0.3485 |
| 2. Dundas & Hamilton | 0.0125 | 0.0911 | 0.1440 | 0.0937 | 0.0024 | 0.6414 | 0.0150 |
| 3. Glenelg | 0.0047 | 0.0739 | 0.1605 | 0.2309 | 0.0066 | 0.4788 | 0.0447 |
| 4. Hampden & Camperdown | 0.0627 | 0.1369 | 0.0629 | 0.1602 | 0.0270 | 0.2712 | 0.2791 |
| 5. Heytesbury | 0 | 0.0954 | 0.0259 | 0.2598 | 0.0081 | 0.0449 | 0.5659 |
| 6. Koroit | 0 | 0.2444 | 0.0422 | 0.2736 | 0 | 0.0552 | 0.3846 |
| 7. Minhamite | 0.0020 | 0.0645 | 0.1420 | 0.1895 | 0.0075 | 0.5051 | 0.0891 |
| 8. Mortlake | 0.0315 | 0.0862 | 0.1057 | 0.1430 | 0.0029 | 0.4767 | 0.1537 |
| 9. Mount Rouse | 0.0250 | 0.0792 | 0.1349 | 0.0875 | 0.0034 | 0.6600 | 0.0099 |
| 10. Portland | 0.0016 | 0.1033 | 0.1377 | 0.2836 | 0.0167 | 0.3576 | 0.0990 |
| 11. Wannon | 0.0079 | 0.0754 | 0.1363 | 0.1179 | 0.0115 | 0.6358 | 0.0151 |
| 12. Warrnambool | 0.0030 | 0.0967 | 0.0395 | 0.2694 | 0.0030 | 0.1401 | 0.4480 |
| Total, S.W. Stat. Division | 0.0155 | 0.0986 | 0.0933 | 0.1980 | 0.0101 | 0.3504 | 0.2341 |

* Source: Australian Bureau of Statistics, Melbourne.

The next step is to calculate the percentage change in the output of the ABS commodities:

$$a_k = \sum_{i=A1}^{A9} H_{ik} x_i \qquad k=1,\ldots,7 \quad ; \quad (A2.8)$$

where $H_{ik}$ is the share of ORANI commodity i in ABS commodity k; and $x_i$ is the percentage change in the output of ORANI commodity i produced in the High Rainfall Zone. Note that the shares $H_{ik}$ represent a mapping from the commodity classifications of the ABS to those used in the ORANI model. These shares can be calculated from Table A3.

We are now able to estimate the output response, and hence the real farm income response, in each of the LGA's due to the first part of our economic scenario. The percentage changes in the output of each of the commodities produced by the High Rainfall Zone (i.e., the $x_i$'s) are given in Table 3. If these are substituted together with the $H_{ik}$ shares in Table A3 into equation (A2.8) we can calculate the percentage changes in output of each of the ABS commodities (i.e., the $a_k$'s). Next the $a_k$'s can be substituted together with the $S_{kj}$ shares in Table A2 into equation (A2.7) to calculate the percentage changes in output of each of the LGAs (i.e., the $z_j$'s). Finally, we can substitute the $z_j$'s into equation (A2.2) to estimate the percentage changes in real farm incomes. Note that with the exception of the 3.6 per cent cut in "real wages" (i.e., $w - \xi = -3.6$), the term $w - \xi$ in equation (A2.2) is equal to zero. The results of these calculations are given in columns (1) - (10) and column (12) of Table 4.

Table A3: Mapping Between the Local-Government-Area Commodity Classifications and the ORANI Commodity Classifications

| Local-Government-Area Commodity | ORANI Commodity | Weight in LGA Commodity (per cent) |
|---|---|---|
| 1. Wheat | A3. Wheat | 100.00 |
| 2. Other Crops[a] | A4. Barley | 27.89 |
| | A5. Other Cereal Grains | 62.76 |
| | A8. Other Farming (Sugar Cane, Fruit, and Nuts) | 9.35 |
| 3. Sheep | A2. Sheep | 100.00 |
| 4. Cattle | A6. Meat Cattle | 100.00 |
| 5. Other Livestock[b] | A9. Other Farming (Vegetables, Cotton, Oilseeds, and Tobacco) | 100.00 |
| 6. Wool | A1. Wool | 100.00 |
| 7. Other Livestock Products | A7. Milk Cattle and Pigs | 100.00 |

(a) The weights in the final column are the weights of these ORANI commodities in the product mix of the High Rainfall Zone.

(b) The ORANI commodity A9 includes goats and horses (stud and other).

Part Two: Exogenous Change in Capital Stocks

If there is an exogenous non-zero change in capital stocks then the derivation of equation (A2.2) no longer holds. Thus the percentage change in real farm income due to a change in the capital stocks must be calculated using equation (A2.1). However, the ORANI model does not explicitly generate projected changes in the variables on the right-hand-side of equation (A2.1) at the LGA level. Thus, due to our tops-down approach, it is assumed that the effect due to the change in capital stocks is the same in each of the LGAs. Furthermore, it is assumed that this constant effect is equal to the effect on real net farm income for the High Rainfall Zone due to the increase in capital stocks; see Table 4, column (11).

To conclude, the total effect on real net farm income in each of the LGA's is given by the sum of the effects in parts one and two above; see Table 4, column (13).

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