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AGRICULTURAL EXPORTS AND THE WESTERN AUSTRALIAN ECONOMY*

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An examination of recently published experimental estimates of the breakdown of gross state product in Western Australia by broad industry categories (Burrell, Daniel, Johnson and Walter 1984) shows the category of 'agriculture, fishing, forestry and hunting' as contributing the proportions of gross state product listed in Table 1. Furthermore, agriculture itself represented 91 per cent and 92.5 per cent of the value of production in this industry category for the years 1977-78 and 1978-79, respectively (Australian Bureau of Statistics 1984, p. 496; figures more recent than 1978-79 are not available). It can be seen from the above that, for the years for which estimates are actually available, agriculture, although a relatively significant sector of the state economy, nevertheless represented less than 9 per cent of gross state product. In addition, an examination of the 1981 census shows employment in agriculture as representing only 7 per cent of total state employment. However, neither of these statistics provides any perspective on the role of agriculture in stimulating activity in the rest of the state economy by means of forward and backward linkages.

The analysis of such linkages has traditionally been the domain of input-output analysis and several attempts have been made to assess the role of agriculture in the state economy using this method (see, for example, Kingwell 1982). However, input-output analysis may be criticised for its failure to take account of these linkages in any more than a crude, mechanical fashion. For example, relative prices and, therefore, industry activities such as input and output substitution play a very limited role in such analyses (Parmenter 1982, pp. 169-83). In response to this criticism, economists have attempted to construct economic models which represent an advance on input-output analysis in that they allow a more precise characterisation of an economy's interdependencies. A particular example of this more advanced model is the ORANI model (Dixon, Parmenter, Sutton and Vincent 1982) developed by the IMPACT Research Centre at the University of Melbourne.

TABLE 1

*Contribution of Agriculture, Fishing, Forestry and Hunting to
Western Australian Gross State Product*

	1977-78	1978-79	1979-80	1980-81
Percentage of total	7.02	9.44	10.21	9.57

* We are greatly indebted to Philip Adams for his extensive and valuable comments on an initial draft of this paper. The efforts of the Editors are also gratefully acknowledged.

The ORANI model is a large, multisectoral model of the Australian economy which identifies 113 industries, 115 commodities, 9 types of labour and 7 types of agricultural land. It contains at this disaggregated level explicit modelling of many types of commodity and factor flows: for example, inputs to current production, household consumption, exports and so on. This general structure means that the ORANI model can be used to analyse both the economy-wide and the more sector-specific effects of numerous policy and other issues. Examples of its application to Australia's agricultural sector include examinations of the implications for Australian agriculture of a growth in trade with newly industrialising countries (Vincent 1980), an increase in energy prices (Vincent, Dixon, Parmenter and Sams 1980) and a change in the real exchange rate (Dixon, Parmenter and Powell 1982).

State level results may also be generated from ORANI by using its regional attachment, ORANI-ORES (Dixon, Parmenter, Sutton and Vincent 1982, pp. 253-84). This procedure, which is an adaptation of a method proposed by Leontief, Morgan, Polenske, Simpson and Tower (1965), takes account of differences in the 'industrial structures of the states and allows the introduction of state income-consumption multipliers, but it explains the intra-national geographic allocation of activity within an activity only for cases in which the geographical pattern of demand is the crucial factor, that is, for industries producing commodities which are not traded between the states' (Parmenter 1983, p. 12). The ORANI-ORES procedure has previously been applied to the Western Australian economy in the context of mining and mining related developments (Fraser 1984, 1986).

The objective in this paper is to provide a new perspective on the role of agricultural exports in the Western Australian economy by making use both of results from the ORANI-ORES model and of the Burrell et al. (1984) experimental estimates of gross state product mentioned above. Bringing together these two sets of data enables, for the first time, the calculation of the output and employment effects of a particular development in the state economy broken down by broad industry category. More specifically, by using the ORANI-ORES model with its latest data base (reflecting the year 1977-78) to simulate an export development in the agricultural sector, the results of that simulation may be combined with the experimental estimates of gross state product for 1977-78 to determine the output and employment implications of this development, not just for the state economy as a whole but also for its broad industry categories. It should be noted at this point, however, that any calculations of the impact on the Western Australian economy of a development in agriculture based on the financial year 1977-78 will be underestimates inasmuch as the contribution to gross state product of the agriculture industry category in that year was well below the average of the four years 1977-78 to 1980-81, for which published data are available.

The development in agriculture chosen for this purpose is a small increase in world demand for exports of Australian wool and wheat. These two commodities were chosen because of their dominance of agriculture in Western Australia, both of the value of production and of the value of exports (for example, 67 per cent and 64 per cent, respectively in 1981-82).

Specification of the Simulation

The assumptions underlying the simulation are those for standard short-run simulations of the ORANI model: (a) productive stocks of capital and land are fixed, although investment is allowed; (b) owner-operators of the eight agricultural industries are not free to move to other industries (that is, owner-operators are considered an item of fixed capital); (c) real wages are fixed under the assumption of full wage indexation; (d) the levels of real consumption, real investment and real government expenditure are fixed; and (e) the exchange rate is selected as the price numeraire (that is, a change in the domestic price level alters the competitiveness of Australian traded goods industries). In addition, for the purposes of the regional disaggregation, a strong relationship is assumed between regional labour income and regional consumption demand (that is, the marginal propensity to consume regional consumption goods is assumed to be unity). Finally, the specific simulation performed is a 10 per cent increase in foreign currency receipts per unit of export of wool and wheat (that is, $f^e_{(il)} = 10.0$, $i = 1, 3$; see Dixon, Parmenter, Sutton and Vincent 1982, pp. 104–5).

Results of the Analysis

Macroeconomic effects

The general output, price and employment effects of the export simulation, both in terms of percentage changes and changes in base values, are presented in Table 2. It is clear from these figures that the national export stimulus to wool and wheat is of unambiguous benefit to output and employment in Western Australia. This is in contrast to the Australia-wide effects, where changes to employment and output are both minimal.¹

The small decrease in national output may be traced to a loss of international price competitiveness for export and import competing industries following the consumer price index increase. In particular, the increased demand for Australian wool and wheat exports means increased demands by Australian wool and wheat producers for material and labour inputs. The consequent 'demand-pull' effect on input prices flows, via full wage indexation, into prices generally. It is

TABLE 2

General Effects of Increased Wool and Wheat Export Demand

	Percentage change	\$m (constant 1977–78 prices)	Employment (1977–78 levels)
Consumer price index	0.1374		
Gross national product	–0.0011	–0.88	
Western Australian gross state product	0.1493	10.64	
National employment	0.0108		646
State employment	0.3495		1905

¹ Note, however, that the ORANI real gross national product percentage change figure is not considered to be a reliable estimate of the change in the corresponding Australian Bureau of Statistics estimate.

this domestic inflation which results in a loss of international price competitiveness of other Australian export and import competing industries and which, at the national level, more than offsets the gains made in production by wool and wheat growers. At the level of the Western Australian economy, however, the greater significance of wool and wheat production in total traded goods production means that the stimulus to the state from extra wool and wheat exports dominates the detrimental effect of the loss of price competitiveness among other traded goods.² Furthermore, it is worth noting that, with the conservative assumption that the Western Australian economy was the same proportion of the Australian economy in 1983–84 as it was in 1977–78, a 0.1493 per cent increase in Western Australian gross state product represents \$24.89m in constant 1983–84 prices.³

Microeconomic effects — output

The breakdown by broad industry categories of the \$10.64m increase in Western Australian gross state product brought about by the export expansion is shown in Table 3. This table is calculated from base values contained in Burrell et al. (1984), reproduced as Table A.1 in the Appendix, and from ORANI-ORES estimates representing contributions by industry to the change in gross state product.⁴

TABLE 3

Output Effects in Western Australia of the Export Expansion

Industry category	(1) Percentage change in Western Australian gross state product by broad industry category	(2) Column (1) in \$m (constant 1977–78 prices)	(3) Column (2) as a percentage of value of output (1977–78) of each industry category
1 Agriculture, fishing, forestry and hunting	0.0432	3.0789	0.6158
2 Mining	–0.0217	–1.5466	–0.1859
3 Manufacturing	–0.0053	–0.3777	–0.0362
4 Electricity, water, gas	0.0023	0.1639	0.0911
5 Construction	0.0254	1.8103	0.2963
6 Wholesale and retail trade	0.0263	1.8744	0.1849
7 Transport, storage and communication	0.0126	0.8980	0.1412
8 Finance and other business services	0.0187	1.3327	0.3366
9 Ownership of dwelling	0.0286	2.0383	0.3950
10 Public administration, defence and community services	0.0102	0.7270	0.0645
11 Entertainment and personal services	0.0090	0.6414	0.2350
Total for Western Australia	0.1493	10.6406	

² As a rough guide to the extent of this structural difference between the Western Australian and national economies, Burrell et al. (1984) show that the proportion of the agriculture industry category in the total value of agriculture, mining and manufacturing production in 1977–78 was 16.6 per cent at the national level and 21 per cent in Western Australia.

³ Based on a gross national product of \$187 405m for 1983–84.

⁴ Details of the ORANI-ORES simulation data are available from the authors on

It is clear that the benefits to the state are both direct, in terms of the export expansion stimulus to the production of wool and wheat, and indirect, in terms of the demand stimulus given to local industries by the export expansion. More specifically, despite the loss of production of \$1.92m in mining and manufacturing, the \$3.08m direct output gain in agriculture, fishing, forestry and hunting flows on through the state economy with a more than 300 per cent magnification, resulting in the \$10.6m increase in constant price gross state product. It has already been argued that the loss of output in mining and manufacturing is to a large extent attributable to the decline in international price competitiveness of those industry categories. Nevertheless it should be mentioned that, within the broad industry category of manufacturing, the ORANI-ORES simulation data show that the overall output loss of \$0.38m hides a \$1.52m output gain in the agricultural machinery industry.

Microeconomic effects — employment

The distribution of employment gains across broad industry categories following the export expansion is shown in Table 4.⁵ The estimates in this table are based on a number of implicit assumptions. Most importantly, it has been assumed that labour intensity in a particular industry category is the same in Western Australia as it is nationally. A measure of the inaccuracy of this assumption is that total employment in Western Australia in 1977–78 by this calculation was 545 000 compared with the actual 526 000 (3.5 per cent difference, see Table A.2 in the Appendix). It has also been assumed that simulated changes in employment by industry are equally distributed across states. The inaccuracy of this assumption shows up particularly in the local industry categories, principally electricity, water and gas, construction, wholesale and retail trade, finance and other business services, community services, and entertainment and personal services. In the case of these categories, variations between states in expansion (contraction) levels are not differentiated. Consequently, in the case of the export expansion considered here, where Western Australia is a relatively major beneficiary, estimated state employment gains based on national gains will be underestimates.

Turning to an analysis of the results presented in Table 4, it would seem that the employment gain following the export stimulus of 1950 jobs in the industry category agriculture, fishing, forestry and hunting (representing 3.7 per cent of total employment in that category) is associated with a net loss of 45 jobs elsewhere in the state economy. However, on the basis of previous arguments, the loss of 140 jobs in mining and manufacturing may, to a large extent, be attributed to the decline in the international price competitiveness of these industries, while the loss of 50 jobs in the local industry categories of wholesale and retail trade, finance and other business services, community services, and entertainment and personal services may be attributed to the underestimation inherent in the method of calculating employment

request. In addition, details of the construction of Table 3 are contained in the Appendix.

⁵ Details of the construction of Table 4 are contained in the Appendix.

TABLE 4

Employment Effects in Western Australia of the Export Expansion

Industry category	(1) Percentage change in employment in each industry category	(2) Column (1) as change in number of jobs (^{'000}) in each industry category (1977-78 levels)
1 Agriculture, forestry, fishing and hunting	3.7033	1.9498
2 Mining	-0.4429	-0.0979
3 Manufacturing	-0.0521	-0.0425
4 Electricity, gas and water, public administration and defence ^a	-0.0106	-0.0040
5 Construction	0.2877	0.1349
6 Wholesale and retail trade	-0.0386	-0.0428
7 Transport, storage and communication	0.0612	0.0182
8 Finance and other business services	-0.0068	-0.0029
9 Community services ^a	-0.0018	-0.0016
10 Entertainment and personal services	-0.0183	-0.0061
Total for Western Australia	0.3495	1.9050

^a See Appendix, Table A.2, for definition.

changes. In particular, a comparison of Tables 3 and 4 suggests it is more likely that the total output gain of \$4.58m in these local industry categories would be associated with employment gains rather than employment losses. Unfortunately, it is not possible to establish the extent to which Table 4 does underestimate the employment gains to the various local industry categories following the export stimulus. Nevertheless, it should be noted that, despite this problem of underestimation, the industry category construction shows an employment gain of 135 jobs, suggesting a particularly strong activity link with agriculture. Finally, associated with the output gain mentioned previously, the ORANI-ORES simulation data show the overall employment loss in manufacturing hides a 9 per cent employment gain in the agricultural machinery industry.

Conclusion

An attempt has been made to provide a new perspective on the role of agricultural exports in the Western Australian economy. The approach taken has been to combine results from the ORANI-ORES model with recently published experimental estimates of gross state product. This has been done to produce the output and employment implications for the state economy's broad industry categories of an export development in agriculture. The development chosen for this analysis was that of increased demand at a national level for exports of wool and wheat.

The output results of the analysis show that the total stimulus to the state economy of this export development includes an indirect component which is more than twice the magnitude of the direct stimulus to agriculture. Estimation problems make precise analysis of the employment gains from the export stimulus difficult. These results do show, however, a direct employment gain of 3.7 per cent in the

agriculture industry category and suggest the likelihood of substantial employment gains in the local industry categories, particularly that of construction.

APPENDIX

Derivation of Data

Construction of Table 3

The ORANI-ORES simulation data includes estimates of the percentage contribution of each industry to the overall percentage change in Western Australian gross state product. Aggregating these individual industry contributions by broad industry category gives column (1) of Table 3. Column (2) of this table is calculated by multiplying each entry in column (1) by Western Australian gross state product for 1977-78 (\$7127m) and shows the change in the value of production in each industry category brought about by the export expansion. Finally, column (3) of this table is calculated by dividing each entry of column (2) by the appropriate value as contained in Table A.1 of this Appendix. Hence, this column shows the value in column (2) as a percentage of the total value of output in each industry category and is a measure of the relative strength of the impact of the export expansion in the various sectors of the state economy.

Construction of Table 4

The figures in column (1) of Table 4 have been calculated using the following method. The ORANI-ORES simulation data include estimates of the percentage change of employment by industry at the national level. Representative estimates of percentage employment change by broad industry category at the national level were calculated by weighting the individual changes by the share of each industry in the total wage bill of the industry category (also given in the ORANI-ORES simulation data). By assuming that both this share and each industry's national percentage employment change also apply at the state level,

TABLE A.1

Gross State Product for Western Australia by Broad Industry Category, 1977-78

Industry category	\$m
1 Agriculture, fishing, forestry and hunting	500
2 Mining	832
3 Manufacturing	1043
4 Electricity, gas and water	180
5 Construction	611
6 Wholesale and retail trade	1014
7 Transport, storage and communication	636
8 Finance and other business services	396
9 Ownership of dwellings	516
10 Public administration, defence and community services	1127
11 Entertainment and personal services	273
Total gross state product	7127

Source: Burrell et al. (1984).

TABLE A.2
Employment Figures for Western Australia, 1977-78 (based on output shares)

Industry category	(1) Employment in Australia 1977 ('000)	(2) Employment in Australia 1978 ('000)	(3) Employment in Australia 1977-78 ('000)	(4) Employment in Western Australia 1977-78 ('000)
1 Agriculture, forestry, fishing and hunting	400.30	377.40	388.85	52.6503
2 Mining	79.80	79.50	79.65	22.1029
3 Manufacturing	1276.80	1185.30	1231.05	81.6186
4 Electricity, gas and water, public administration and defence ^a	520.30	527.60	523.95	37.7768
5 Construction	481.80	485.00	483.40	46.8898
6 Wholesale and retail trade	1184.90	1238.50	1211.70	110.9917
7 Transport, storage and communication	316.00	326.50	321.25	29.8120
8 Finance and other business services	467.20	466.80	466.50	43.0113
9 Community services ^b	895.40	919.00	907.20	87.0912
10 Entertainment and personal services	373.00	364.90	368.95	33.2055
Total	5995.40	5969.60	5982.50	545.1501
Actual Western Australian employment (1977-78)				525.9000

^a From 'Other industries'.

^b Comprises health, education, libraries, welfare and religious institutions, and other community services.

Source: Australian Bureau of Statistics (1978).

these estimates can be interpreted as Western Australian specific percentage employment changes (that is, column (1) of Table 4). It is argued in the paper that this assumption leads to a conservative estimate of employment gains in Western Australia following the export expansion.

The figures in column (2) of Table 4 are calculated as follows. It should first be noted that employment figures by industry either at the state or the national level are not available currently, only employment by industry category as listed in Table 4. Second, to derive figures for national employment by broad industry category for the financial year 1977-78 it was necessary to calculate an average of the published calendar year figures for 1977 and 1978 (see columns (1), (2) and (3) of Table A.2 in this Appendix). Base values for Western Australian employment levels by broad industry category (see column (4) of Table A.2 in this Appendix) were calculated by multiplying this national employment figure by the share of Western Australian value of production by industry category in the national value of production in that category (again using ORANI-ORES simulation data). Finally, the changes in Western Australian employment levels by broad industry category (that is, column (2) of Table 4) were calculated by multiplying these base values by the percentage change figures calculated previously (that is, column (1) of Table 4).

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