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ORANI PROJECTIONS OF THE SHORT-RUN EFFECTS OF A 50 PER CENT ACROSS-THE-BOARD CUT IN PROTECTION USING ALTERNATIVE DATA BASES

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I. INTRODUCTION

ORANI is a large computable general equilibrium model (CGE) of the Australian economy following the tradition of Johansen (1960) (see Dixon, Parmenter, Sutton and Vincent (1982), hereafter DPSV). The model is now widely used for policy analysis within Australian academic and bureaucratic circles. Among the policy questions analysed, prominent have been the effects of changes in the high levels of tariff and/or quota protection enjoyed by many of Australia's import-competing industries, especially textiles, clothing, footwear and motor vehicles.[1] The main emphasis of the analysis has been on the short-run implications of changes in protection for industrial and employment structure rather than on the long-run welfare benefits from freer trade.

The short-run emphasis has been adopted in ORANI studies of the effects of changes in protection levels because, at least in the

Australian context, it is the short-run consequences which are the contentious policy issue. Even the opponents of reductions in protection have generally conceded that in the long run an industry structure more in line with the economy's comparative advantage would be beneficial. They continue to oppose reform, arguing that the adjustment costs, especially in the labour market, are not sustainable, at least in the current depressed economic climate.

Even if the long-run gains from freer trade were of more immediate policy interest, it is doubtful whether CGE's of the current generation are suitable vehicles for their quantification. Dixon (1978) has argued that economies of scale reaped via intra-industry specialization in industries exposed to increased international competition are potentially much more important than the traditional "welfare triangles". The latter when quantified in a CGE which assumes constant returns to scale and fails to model opportunities for intra-industry specialization account typically for potential gains of only one or two per cent of GDP.

Studies using ORANI have investigated the effects of changes in protection made on both across-the-board (DPSV, 1982, chapter 7) and industry-specific (Industries Assistance Commission (IAC), 1981a, 1983) bases. Those of the latter type have attempted to provide projections of the effects within the sectors subjected to the changes in their protection levels as well as of the economy-wide effects. For this, special-purpose versions of ORANI have often been constructed which treat the sectors of special interest in more detail than is available in the standard version of the model which disaggregates the economy into 112 industries producing 114 commodities.[2] For both across-the-board and industry-specific studies, projections are produced for a wide range of economy-wide variables. In the standard version of ORANI these include output by industry and commodity, employment by industry and occupation, and various macroeconomic indicators. Facilities have also been developed which allow these results to be mapped in more detail into dimensions of the economy which are considered important from the point of view of the short-run adjustment problems thought to be associated with changes in protection policy. Thus Dixon, Parmenter and Powell (1983a) concentrate on labour-market disruption characterized at a 72-category occupational level, much finer than the 9-occupation disaggregation of the labour market used in the standard version of the model; Cook and Dixon (1982) and Bonnell and Dixon (1982) study the impact on the ethnic composition of the workforce; and DPSV (1982, subsection 45.3) and IAC (1981b) highlight regional effects. In all cases results from ORANI have suggested that the disruptive effects of changes in protection policy may be much smaller than is apparently believed by those who oppose such changes on these grounds.

Full details of ORANI's theory are given in DPSV.[3] The core of the data base is an extended set of input-output accounts. The model has now been implemented on two distinct input-output data sets, both derived from official Australian data, one set referring to 1968/69 and the second to 1974/75 (Australian Bureau of Statistics, 1977 and 1980).[4] In this paper we report on ORANI simulations of the short-run effects of a 50 per cent across-the-board cut in protection levels using both data bases. Our strategy is to present the results in such a way as to reveal the features of the model's theory and data which are most crucial for the protection-policy simulations. In section II we outline the main features of ORANI protection-policy projections and show that these survive the data change. In section III we explain how we have decomposed the changes in the projections to highlight the impact of specific aspects of changes in the data. Section IV contains a detailed description of the decomposed results including back-of-the-envelope calculations which show how key features of the theory and data combine to determine the outcomes. Conclusions are offered in section V.

II. THE MAIN EFFECTS OF PROTECTION CUTS IN ORANI

The simulations to be discussed in this paper were conducted with the short-run assumption of fixed industry-specific capital stocks;[5] with fixed real wage rates and slack labour markets for all of the model's nine occupation groups; with domestic absorption (aggregate consumption, investment and government spending) held constant in real terms; and with the nominal exchange rate set as the numeraire. Under these assumptions changes in the relative profitabilities of industries show up in our results as changes in relative rates of return rather than as changes in the relative sizes of industries; changes in labour-market conditions show up as changes in demand-determined exployment levels; changes in the GDP show up as changes in the balance of trade; and changes in domestic prices relative to world prices show up as changes in the domestic price indexes.

The main conclusions to be drawn from the ORANI simulations are illustrated by column I of Table 1. That column contains the short-run effects on some macroeconomic variables of a 50 per cent across-the-board cut in protection rates as projected by ORANI using its standard 1968/69 input-output data base.[6] The cut is projected to increase imports but the increase (3.05 per cent) is by no means great enough to eliminate large sections of the domestic import-competing sector. The reduction in domestic costs relative to world prices caused by the cut under the assumption of fixed real wages significantly increases the profitability of exporting. This generates increases in export receipts and in output and employment in the export sector, notably in employment of the rural occupation. ORANI projects that these expansionary effects in the export

TABLE 1 : ORANI Projections of the Macroeconomic Effects of a 50 per cent Across-the-Board Cut in Ad-Valorem Protection Rates under Different Configurations of 1968/69 and 1974/75 Data

Variable / Simulation[a]	Projections[b] I	II	III	IV
Consumer Price Index	-4.40	-5.65	-5.57	-4.67
Aggregate Import Bill (Foreign Currency)	3.05	2.90	3.39	3.08
Aggregate Export Receipts (Foreign Currency)	5.05	5.58	7.12	5.86
Balance of Trade (% of GDP)	0.23	0.43	0.60	0.44
Aggregate Employment	0.41	0.84	0.98	0.71
Employment by Occupation:				
1 Professional	0.27	0.47	0.53	0.43
2 Skilled white collar	0.12	0.36	0.43	0.31
3 Semi and unskilled white collar	0.19	0.42	0.54	0.41
4 Skilled blue collar (metal & elect.)	0.00	0.59	0.87	0.49
5 Skilled Blue collar (building)	-0.26	-0.24	0.04	-0.01
6 Skilled Blue collar (other)	0.29	0.41	1.38	0.95
7 Semi and unskilled blue collar	0.61	0.73	0.74	0.44
8 Rural workers	4.20	4.99	6.24	5.21
9 Armed services	0.0	0.0	0.0	0.0

Notes

(a) A key to the different data sets used for each of the four simulations is given in Table 2.

(b) All projections are percentage changes except for the balance of trade the projected change in which is reported as a percentage of GDP.

sector would more than outweigh the contraction in the import competing sector. Thus both aggregate employment and the balance of trade surplus are projected to increase. With the exception of the increase in the employment of rural workers, the projected changes in the occupational structure of the workforce are not particularly large. The 9-order occupational classification is not sufficiently industry-specific to reflect clearly the adverse effect of the protection cut on the import competing sector. However, even at a 72-occupation level, ORANI projections reveal that the extent of labour market disruption generated by protection-policy changes would be small relative to the amount of inter-occupation adjustment normally accommodated in the market (Dixon, Parmenter and Powell, (1983a)).[7]

Column IV of Table 1 contains results of the same simulation, this time conducted using ORANI's standard 1974/75 input-output data. As can readily be seen, all the major conclusions survive the change in data. A decomposition of the changes that are evident in the results, focusing especially on results at the individual industry level, is given in the subsequent section.

Before proceeding to that decomposition we note one further feature of the results in Table 1. According to ORANI, a cut in protection increases the aggregate demand for labour[8] even though it favours relatively capital-intensive activities (exporting) at the expense of relatively labour-intensive activities (import competing). The model differs in some important respects from textbook Heckscher-Ohlin models of international trade which imply that cuts in protection would have adverse effects on labour if import-competing is a relatively labour-intensive activity. Crucial differences are that in ORANI, as configured for these short-run simulations, capital is not mobile between sectors and imports are not perfect substitutes for domestic supplies in the same commodity class. In Dixon, Parmenter and Powell (1983a) we show in detail how the adverse employment effects of a cut in protection depend on the elasticities of substitution between imports and domestic supplies whilst the favourable effects depend just on the extent to which lower import prices reduce the costs of the export sector. With wages indexed to the consumer price index the latter effect depends mainly on the import weights in the price index.

III. A METHOD FOR DECOMPOSING THE EFFECTS OF THE DATA CHANGE

With a data base as large as that used for ORANI[9] it is very difficult to summarize data changes which have occurred between two reference years. One potentially fruitful approach is to use a model compatible with the data to highlight data changes which are important in the sense that they have a significant impact on results derived from the model. For example, changes in input-output tables are often described in terms of their impact on various multipliers calculated from the tables. We have adopted this approach by attempting to show what aspects of the changes observed in the input-output structure of the Australian economy between 1968/69 and 1974/75 are primarily responsible for the changes evident in the results of ORANI protection-policy simulations. The obvious shortcoming of this as a method of summarizing changes in the data is the extent to which it is simulation specific. Experience with ORANI however has indicated that aspects of the data can be identified which are crucial for the results of a wide range of simulations.

General knowledge of the economic history of Australia during the relevant period suggests three developments which would account for differences between the 1968/69 and the 1974/75 data bases, and which would be likely to be significant for the protection simulations. The first is the increased level of import penetration experienced in the domestic markets for many of the most heavily protected importable commodities, especially in the textiles, clothing and footwear sectors. In the ORANI demand equations, the percentage response in the demand for a domestic import-competing commodity following a change in its price relative to the corresponding import price is proportional to the share of imports in the relevant domestic market (see equation (3) in section IV). The second important development is a shift in the shares of labour and capital in value added caused by the rises in real wage rates experienced in the early seventies and the deepening recession which had set in by 1974/75. Given the CES production functions implemented in ORANI, industries' short-run supply elasticities vary directly with the shares of labour in value added (see equation (2) in section IV). Finally, there are the changes in the ad valorem equivalent rates of protection assumed between the two data bases. These rates determine the falls in the domestic-market prices of imports which are assumed to follow any given percentage reduction in the rates (see equation (4) in section IV). For the most heavily protected import competing commodities (i.e., textiles, clothing, footwear and motor vehicles) protection rates in the 1974/75 data base are much higher than in the 1968/69 data, although for the less heavily protected sectors the reverse is true.[10]

In order to isolate the effects of each of these developments, we conducted four simulations in each of which the shock applied to the model was a 50 per cent across-the-board cut in ad valorem equivalent rates of protection. The simulations differed with respect to the reference years for various parts of the data used. Details are given in Table 2. Given the configurations of data described in the table, it is clear that comparing simulation I with simulation II should reveal the effects on the projections of miscellaneous changes in the input-output structure of the economy between 1968/69 and 1974/75. Most important, we

TABLE 2 : Details of Data Employed for Simulations Designed to Decompose the Impact on ORANI Protection Simulations of Differences between the 1968/69 and 1974/75 Data Bases

Simulation	Year Identifying Standard Data Base from which Data are Selected for		
	Input-Output Core	Primary-Factor Shares	Ad-Valorem Protection Rates[(a)]
I	1968/69	1968/69	1968/69
II	1974/75	1968/69[(b)]	1968/69
III	1974/75	1974/75	1968/69
IV	1974/75	1974/75	1974/75

(a) The protection rates incorporated in the standard 1968/69 data base are based on IAC data referring to the same year, while 1980/81 protection rates have been used in conjunction with the 1974/75 data base. See footnote 10.

(b) The 1968/69 factor shares were incorporated into the 1974/75 input-output core by computing value-added matrices in which aggregate value-added by industry is set at its 1974/75 level but split into the components accruing to labour, fixed capital and agricultural land according to the shares evident in the 1968/69 data. This creates no obvious problems, in particular it involves no imbalancing of the input-output accounts.

suspect, were the changes in levels of import penetration in domestic markets. Comparing simulations II and III should isolate the influence of changes in industries' supply elasticities implied (given our CES assumptions and short-run focus) by changes in the shares of labour, capital and land in value added. Finally, the role of changes in the rates of protection enjoyed by the import-competing sector should be clear from a comparison of simulations III and IV.

IV. RESULTS

Results from the four simulations described in the previous section (see especially Table 2) are presented in Tables 1 and 3. Reference to parts of Table 1 has already been made in section II. It contains projections for macroeconomic variables and for employment disaggregated by occupation. In Table 3 are projections of the effects of the protection cut on industries' output levels. Not all the industries identified in ORANI are included. We have concentrated on industries in the import-competing and export sectors, which according to ORANI are sensitive to protection changes. To summarize the industry results, we have included for each simulation the range over which the output changes vary (i.e., the largest projected output gain and the largest fall) and a triangle of statistics indicating the degree of rank correlation between the output projections for each pair of simulations.

In this section, as well as explaining the results qualitatively, we provide quantitative explanations[11] of key aspects of the comparisons between the successive simulations. To explain the industry results we rely on equations which summarize the factors in ORANI which influence the supply behaviour of the industries and the demand for their products. The CES production functions implemented in the current version of ORANI imply, for the representative profit-maximizing firms in the model's industries, short-run supply equations of the form[12]:

$$z_i = \eta_i (p_i - \tilde{p}_i) \quad , \qquad (1)$$

where z_i is the percentage change in the output of industry i, p_i and $\tilde{p}_i$

TABLE 3 : ORANI Projections of the Effects on the Output Levels of Selected Industries of a 50 per cent Across-the-Board Cut in Ad-Valorem Protection Rates under Different Configurations of 1968/69 and 1974/75 Data

Industry[a]	Simulation[b]	Projected changes in output (per cent) I	II	III	IV
(i) Import competing sector					
31	Man-made fibres, yarns	-4.62	-5.07	-6.00	-11.42
32	Cotton, silk, flax	-6.33	-5.99	-6.87	-7.63
33	Wool and worsted yarns	-1.29	-2.32	-2.47	-2.97
34	Textile finishing	-1.44	-1.54	-1.64	-2.16
35	Textile floor covers	-1.03	-1.64	-1.89	-2.03
36	Textile products n.e.c.	-1.50	-0.99	-0.76	0.52
37	Knitting mills	-1.30	-6.29	-6.98	-8.42
38	Clothing	-1.55	-2.55	-2.61	-3.06
39	Footwear	-5.22	-11.93	-12.05	-14.54
50	Industrial chemicals	-2.02	-1.70	-2.00	-1.08
67	Metal products n.e.c.	-3.10	-3.04	-3.24	-2.04
68	Motor vehicles & parts	-5.24	-5.49	-7.34	-11.15
73	Electronic equipment	-4.82	-5.25	-5.42	-2.61
74	Household appliances	-1.86	-2.95	-3.06	-1.99
75	Electrical machinery	-1.66	-1.30	-1.32	-0.08
(ii) Export sector[c]					
1	Pastoral zone	1.43	1.97	6.51	5.37
2	Wheat-sheep zone	1.46	1.78	4.11	3.40
3	High rainfall zone	2.81	3.92	8.69	7.20
11	Fishing	5.01	1.20	1.69	1.42
12	Iron ore	0.55	0.84	1.67	1.38
13	Other metallic minerals	3.65	4.77	4.49	3.71
14	Coal	7.18	8.17	4.86	4.03
18	Meat products	2.44	4.58	7.79	6.49
22	Flour and cereal products[d]	0.23	7.68	8.95	7.31
25	Food products n.e.c.	6.66	6.81	8.63	7.09
30	Prepared fibres	2.04	2.49	4.11	2.80
63	Basic iron and steel	4.29	6.39	9.55	7.71
64	Other basic metals	4.44	5.96	6.75	5.61
(iii) Summary					
Range high		7.18	8.17	11.00	9.46
Range low		-6.33	-11.93	-12.05	-14.54
Rank correlation coefficient against simulation I			0.92	0.91	0.84
II				0.99	0.94
III					0.95

Notes

(a) Identification numbers are from the standard ORANI codes. See DPSV, chapter 7.

(b) For details of the differences in data between the simulations see Table 2.

(c) The export sector list includes all industries producing commodities for which export levels are endogenous in ORANI. It includes all industries for which exports account for at least 20 per cent of total sales.

(d) Fishing exports are endogenous in simulation I but not in simulations II - IV. The reverse is true for exports of flour and cereal products.

are, respectively, percentage changes in the price of the industry's output and in the average price of its purchased inputs (materials and labour) and η_i is a supply elasticity given by:

$$\eta_i = \frac{\phi_i S_{Li}}{(1-S_{Li})S_i^V} \quad , \qquad (2)$$

with ϕ_i being the elasticity of substitution between primary factors, S_{Li} the share of labour in value added and S_i^V the share of value added in the gross value of output.

With the exception of wool, the elasticities of demand for Australian exports on world markets are assumed to be quite high (DPSV, Table 29.5). Hence, for export industries no explicit demand equation is required: our explanations can rely on (1) combined with the assumption that the output price is exogenous ($p_i = 0$). For import-competing industries we add the demand equation[13]:

$$x_i = a_i - \sigma_i S_{iM} (p_i - p_i^M) \quad , \qquad (3)$$

where x_i is the percentage change in the demand for the output of the i^{th} domestic industry, a_i is an activity variable reflecting the percentage change in the demand for commodity i in general (an aggregation of supplies from the domestic and imported sources), p_i^M is the percentage change in the i^{th} import price, σ_i is the elasticity of substitution between imports and domestic supplies of commodity i and S_{iM} is the share of imports in total domestic sales of the commodity. The percentage change in the i^{th} import price (p_i^M) following a change in protection is given by:

$$p_i^M = [T_i/(1 + T_i)]t_i \quad , \qquad (4)$$

where t_i is the percentage change in the ad valorem rate of protection for good i (t_i = -50 for all i in each of our simulations) and T_i is the base-period rate.

In using (1) - (4) to provide the required quantitative explanations of the changes in the industry results between successive pairs of simulations, we use the percentage change in ORANI's index of consumer prices (cpi) as an index of the percentage change in the average price of purchased inputs ($\tilde{p}_i$ in (1)). We explain changes in the CPI by assuming that they are proportional to the direct effect on the index of the changes in import prices which are generated by the tariff change, i.e.,

$$cpi = \gamma W^M p^M , \qquad (5)$$

where W^M is the weight of imports in the CPI, p^M is the average percentage change in import prices and γ is the factor of proportionality. Following (4) this is given by:

$$p^M = [T/(1 + T)]t , \qquad (6)$$

where t is the common percentage change in ad valorem protection rates and T is the average base-period rate using as weights the shares of commodities in the aggregate import component of household consumption.

The coefficients of equations (1) - (6) are sensitive to the changes in the ORANI data base which were made for the purpose of conducting our four simulations (see Table 2). Table 4 gives a summary of

TABLE 4 : Relationship Between Changes in the Coefficients of the Explanatory Equations (1)-(6) and Changes in the Data Bases for the ORANI Simulations[a]

Sector for which output results are explained	Coefficients which change as a consequence of data changes between pairs of simulations		
	I and II	II and III	III and IV
Import-competing[b]	S_{iM}, W^M	S_{Lj}	T_j, T
Exporting[c]	W^M	S_{Lj}	T

(a) For details of the data bases, see Table 2.

(b) See Table 3(i).

(c) See Table 3(ii).

the coefficients for which changes were important in explaining the differences in output results between each successive pair of simulations for the import-competing sector and for the export sector.

IV.1 Comparing simulations I and II: the effect of changing import penetration levels

In section III we hypothesized that most of the difference between simulations I and II could be accounted for by the increase in the shares of imports in domestic markets which occurred between 1968/69 and 1974/75. This is immediately evident for the cpi results. For a simplified explanation of the change in the cpi result we can use (5) while ignoring differences in the average change in import prices between the two simulations. This implies that the percentage changes in the CPI are proportional to the direct weights (W^M) of imports in the index. Although the percentage change in each commodity-specific import price does not change between the two simulations, this is still a severe simplification since it fails to account for changes in the commodity-composition of the imported household-consumption bundle and for changes in the indirect weight of imports in aggregate consumption. Recall from section III that changes in the data between simulations I and II included changes in the whole input-output core, including changes in household budget shares and in industries' input coefficients. Nevertheless, noting that the relevant import weights (W^M) are 0.0505 in simulation I and 0.0703 in simulation II, equation (5) gives values for γp^M of -87 and -80 using the cpi projections for simulations I and II from Table 1. The closeness of these values indicates that a large part of the change in the cpi projection between the two simulations is accounted for by the increased direct import penetration of the household consumption budget (e.g., using

γp^M = -87 from simulation I, (5) predicts a value for cpi in simulation II of -6.12 instead of -5.65 as given in Table 1).

We use equation (3) to confirm our hypothesis that for the import-competing industries changes in import shares in domestic markets account for most of the differences between the output projections in the two simulations. It is clear from (3) that increasing the import shares (S_{iM}) increases the (negative) sensitivity of domestic output to the fall in the relative price of imports induced by the cut in protection. Offsetting this for the case of the comparison between our first two simulations are two factors. The first is that the domestic price level falls more in the second simulation. To the extent that movements in the general price level reflect movements in the costs of the import-competing industries we would therefore expect that imports would gain a smaller relative price advantage over domestic output in the second simulation. The second factor is the fact that domestic activity is higher in the second simulation (cf. the aggregate employment results in columns I and II of Table 1). This increases the values of the activity variables (a_i) in the demand equations.

If the substitution term (the second term on the RHS of (3)) is dominant and if we ignore the first of the offsetting factors discussed in the previous paragraph, we would expect the ratio of the output projections from simulations II and I for import-competing industry i to be approximately equal to the ratio of the import shares. The first pair of columns in Table 5 contain the relevant comparisons. Deviations from the hypothesized pattern can easily be explained by variations in the activity terms in the demand equations, i.e., the first term on the RHS of (3). For example, the spectacular failure is for industry 35 (Textile floor covers). This reflects a change in data classification made by the ABS between the production of the 1968/69 and the 1974/75 input-output tables. In the 1968/69 tables all inter-industry sales of the commodity were treated as intermediate sales: in the 1974/75 tables a significant proportion of these were treated as sales to capital formation. In short-run simulations industries' investment levels are more volatile than their output levels. A large share of the investment goods produced by industry 35 were sold in the 1974/75 tables to industries 89 (Wholesale trade), 90 (Retail trade), 96 (Air transport), 97 (Communication) and 99 (Finance and life insurance), all industries which experience investment declines in the simulations. Hence the activity variable in the equation describing the demand for the output of industry 35 is smaller in simulation II than in I. In this case the change in the activity term more than outweighs the fall in the import share. Industry 31 (Man-made fibres, yarns) is a similar, but less extreme case. Via equation (3) the fall in its import share between simulations I and II should have made its output less sensitive to the tariff cut. But as can be seen in Table 3, in the simulations industry 31 actually fares worse in simulation II. This is accounted for by the fact that its main customers (industries 37 and 38) both do <u>much</u> worse in simulation II than in simulation I because of increases of their own import shares (see Table 5).

For industries in the export sector, differences in output projections between simulations I and II can be explained using equation (1) together with the approximation that export prices are fixed in both simulations (i.e., $p_i = 0$). On the basis of this we should expect the

TABLE 5 : Explanations of Changes Between Simulations in Output Projections for the Import-Competing Sector

	Industry	Explanation of Changes in Projections Between					
		Simulations I and II Ratios		Simulations II and III Ratios		Simulations III and IV Ratios	
		Import shares (1974-5/1968-9)	ORANI projns (II/I)	Via RHS of eqn (8) (III/II)	ORANI projns (III/II)	Via RHS of eqn (10) (IV/III)	ORANI projns (IV/III)
31	Man-made fibres, yarns	0.95	1.10	1.18	1.11	2.6	1.9
32	Cotton, silk, flax	1.00	0.94	1.15	1.16	1.1	1.1
33	Wool & worsted yarns	1.69	1.79	1.06	1.00	1.7	1.2
34	Textile finishing	-	1.06	1.06	1.00	1.8	1.3
35	Textile floor covers	0.82	1.59	1.15	1.06	1.5	1.1
36	Textile products n.e.c.	0.78	0.68	0.77	1.06	0.3	-0.7
37	Knitting mills	7.14	4.76	1.11	1.11	1.3	1.2
38	Clothing	1.82	1.64	1.02	1.01	1.2	1.2
39	Footwear	2.50	2.27	1.01	1.00	1.2	1.2
50	Industrial chemicals	0.93	0.84	1.18	1.21	0.3	0.5
67	Metal products n.e.c.	1.06	0.98	1.07	1.07	0.4	0.6
68	Motor vehicles & parts	0.93	1.05	1.34	1.24	1.6	1.5
73	Electronic equipment	1.10	1.09	1.03	1.03	0.4	0.5
74	Household appliances	2.63	1.59	1.03	1.02	0.5	0.7
75	Electrical machinery	1.19	0.78	1.02	1.02	0.1	0.1

ratio of the export-sector output changes in the simulations to be approximately equal to the ratio of the input-price projections ($\tilde{p}_i$), which may be approximated in our simulations by the cpi projections. That is, we should expect the export sector to expand more in simulation II than in simulation I because the fall in domestic costs (represented by the fall in the CPI) is greater in the former simulation. From Table 1 we can calculate that the ratio of the cpi projection in simulation II to the corresponding projection in simulation I is 1.28. This together with corresponding ratios of the output projections of export-sector industries are given as the first pair of columns in Table 6. As can be seen these latter ratios cluster closely around 1.28 except for the two industries (11 and 22) whose exports are modelled differently in the two simulations. Of the remaining eleven, the outlier is industry 18 (Meat products), an industry for which the assumption that input prices move with the general price level is inappropriate (see DPSV, Table 45.5).

We can summarize the comparison between the industry projections in simulations I and II by noting that as compared to I the range of results in II is greater but the degree of rank correlation between the two sets of results is high. The expansion in the range is attributable partly to the improved performance of the gainers (export industries) in simulation II but primarily to the increased vulnerability to a tariff cut of the Footwear industry (industry 39) owing to the increased import penetration in its domestic market. A significant amount of the change in ranking between the two simulations is accounted for by the shifts in the two industries 22 (Flour and cereal products) and 11 (Fishing) which change their export status between the simulations.

TABLE 6 : Explanations of Changes Between Simulations in Output Projections for the Export Sector

	Industry	Explanation of Changes in Projections Between					
		Simulations I and II Ratios		Simulations II and III Ratios		Simulations III and IV Ratios	
		cpi projns (II/I)	ORANI projns (II/I)	Supply elasticities (1974-5/1968-9)	ORANI projns (III/II)	cpi projns (IV/III)	ORANI projns (IV/III)
1	Pastoral zone	1.28	1.38	5.9	3.3	0.84	0.82
2	Wheat-sheep zone		1.22	3.0	2.3		0.83
3	High-rainfall zone		1.40	4.5	2.2		0.83
11	Fishing[(a)]		0.24	-	-		-
12	Iron ore		1.53	2.0	2.0		0.83
13	Other metallic minerals		1.31	0.9	0.9		0.83
14	Coal		1.14	0.6	0.6		0.83
18	Meat products		1.88	2.2	1.7		0.83
22	Flour & cereal products[(b)]		33.39	1.3	1.2		0.82
25	Food products n.e.c.		1.02	0.7	1.3		0.82
30	Prepared fibres		1.22	5.2	1.7		0.68
63	Basic iron & steel		1.49	2.0	1.5		0.81
64	Other basic metals		1.39	1.7	1.1		0.83

Notes

(a) Exports from this industry were endogenous in simulation I but exogenous in simulations II-IV.

(b) Exports from this industry were exogenous in simulation I but endogenous in simulations II-IV.

Returning finally to Table 1, we can use our explanations of the industry-output projections to rationalize the remaining macroeconomic results. In simulation II aggregate imports are projected to expand less than in simulation I. The increase in import shares reduces the sensitivity of imports to the relative price changes.[14] The stimulation of aggregate exports is greater in the second of the two simulations compared, a result which is consistent with the greater fall in domestic costs and with the export-industry results explained above. The balance of trade projections follow directly from the aggregate import and export results. In simulation II the trade balance moves more strongly to surplus because exports rise more rapidly and imports less rapidly than in simulation I.

Aggregate employment and employment in each occupation increase more strongly in simulation II than in simulation I. This is due primarily to the increased activity in the export sector - a symptom of this is the particularly large increase in the projected gain in employment in the rural occupation. Reductions in activity in some import-competing industries help to attenuate the employment gains but, as we have seen above, these reductions do not pervade the whole of the import competing sector.

IV.2 Comparing simulations II and III : the effects of changing primary factor shares

The generally depressed state of the Australian economy in the year 1974/75 is reflected in ORANI's 1974/75 input-output data base by low levels of gross operating surplus in many industries. The shares of labour in value added by industry calculated from this data base are therefore much higher than the corresponding shares calculated from the 1968/69 data. In fact the average labour shares for the economy as a whole are 66 and 73 per cent according, respectively, to the 1968/69 and 1974/75 data. For the import-competing industries identified in part (i) of Table 3 the shares are 79 per cent and 92 per cent, and for the export industries listed in part (ii) of the Table the shares are 44 per cent and 60 per cent. The main implication for our simulations of these changes in labour shares is that, for most industries, supply elasticities (given by equation (2)) are higher in simulations III and IV which use the 1974/75 shares than in simulations I and II using the 1968/69 shares.

The impact of these increased supply elasticities can be seen for industries in the traded-goods sectors by comparing columns II and III of Table 3. Simulations II and III differ only with respect to the change in factor shares. For the export sector, equations (1) and (2) combined with the assumption that export prices are approximately fixed provide a good explanation of the output results. We take the change in the CPI as an initial indicator of the change ($\tilde{p}_i$) in the price of purchased inputs. From Table 1 we see that this is almost identical in simulations II and III. Using (1) and (2) it then follows that the ratios of the output results in simulations III and II should be approximately equal to the ratios of the corresponding supply elasticities. These comparisons are given in the second pair of columns in Table 6. The correspondence is generally quite close. The main exceptions are industries 1-3 and 30 for which raw or slightly processed wool is an important share of total output. For these industries the change in the supply elasticities over-predicts the change in the output response. The reason is that the export demand elasticity assumed for wool is quite low and the supply-elasticity predictor ignores the effect of the fall in world wool prices which occurs as exports expand.

For the import-competing sector output prices cannot be taken as even approximately independent of supply elasticities. In general we would expect import-competing industries to react to the tariff cut by contracting their outputs more sharply when their supply elasticities are higher, correspondingly reducing their prices less sharply. Examination of columns II and III of Table 3(i) supports this expectation. For our quantitative explanation of the impact of the change in primary-factor shares on the import-competing-industry outputs we combine equations (1) and (3) to eliminate the domestic output price, deriving the following expression for z_i:

$$z_i \doteq \left(\frac{1}{1 + \frac{\sigma_i S_{iM}}{\eta_i}} \right) [a_i - \sigma_i S_{iM}(\tilde{p}_i - p_i^M)] \quad . \tag{7}$$

Of the terms on the RHS of (7) only the supply elasticity (η_i) is very sensitive to the change in primary factor shares. Thus for the import-competing industries a good approximation to the ratio of output responses under simulations II and III should be given by:

$$z_i^{III} \Big/ z_i^{II} = \left[1 + \frac{\sigma_i S_{iM}}{\eta_i^{II}}\right] \Big/ \left[1 + \frac{\sigma_i S_{iM}}{\eta_i^{III}}\right] , \qquad (8)$$

where the superscripts on the z_i indicate results drawn from columns II and III of Table 3(i) and those on the η_i indicate supply elasticities calculated with the corresponding primary-factor shares.

Details of comparisons based on (8) are given in the second pair of columns in Table 5. It is clear that the explanation is very accurate except in the case of industry 36 for which the increase in supply elasticity predicts a more severe output contraction in simulation III compared to simulation II whereas the model projects a smaller contraction. The problem is that using (8) ignores an increase in the activity variable (a_i in equations (3) and (7)) which occurs between the two simulations for this industry. About one quarter of the industry's total sales are accounted for by sales to export industries (63 and 64) and to the export-related transport sector. All of these industries are stimulated in simulation III to a significantly greater extent than in simulation II (see, for example, Table 3 (ii)). The consequent expansion in the demand for the commodity produced by industry 36 is more than sufficient to offset its increased sensitivity to the price effects of the cut in protection. Finally note that industry 36 is <u>not</u> an exception to our general expectation that the increase in supply elasticity will reduce the extent to which import-competing industries respond to the protection cut by reducing their selling prices. In simulation III the projected reduction in the price of the industry's output (6.33 per cent) is less than in simulation II (6.52 per cent). Hence the substitution effects implicit in (7) via (3) tend in simulation III to increase the extent to which demand is switched away from the domestic output, but this substitution effect is swamped by the expansion in the activity variable.

The summary variables for the industry results (Table 3 (iii)) indicate that the main effect of the increase in the average share of labour in value added in the data is to expand the range, mainly by increasing the output gains of the export sector, but to leave the ranking more or less constant. In simulation III, the industry which expands most strongly following the tariff cut is the specialist beef-producing industry which is directly linked to exports via industry 18 (Meat products). In our simulations the specialist beef producer increases its share of the expanding beef market as other beef producers (industries 1-3) transform their output mixes towards non-beef exportable commodities.

A comparison of columns II and III of Table 1 shows the implications of the supply-elasticity changes for the macroeconomic projections. As expected from our discussion of the results for the export and import-competing industries both aggregate exports and aggregate imports expand more in simulation III than in simulation II. The expansion in exports dominates in the balance-of-trade projections. The expected effect on the CPI is ambiguous - import-competing prices fall less in simulation III but, since exports expand more, the fall in the prices of exportables is greater. These two competing influences almost exactly offset each other. The positive relationship between the employment-generating effect of the tariff cut and the average supply elasticity is due mainly to the stimulation of activity in the export sector. This can be seen by noting that Rural workers and workers in occupation category 6 (Skilled blue collar (other)) experience the most dramatic improvement in their employment prospects as between simulations II and III. The first of these categories is employed predominantly in the export-oriented agricultural industries whilst a large share (0.19) of the second is employed in the export-oriented Meat products industry.

IV.3 Comparing simulations III and IV: the effects of changing nominal rates of protection

We begin by explaining the relative sizes of the effect of the cut in protection on the CPI in the two simulations. In simulation IV the fall in the CPI generated by the cut is smaller than was the case in simulation III indicating that in the 1974/75 data the appropriate average tariff rate is lower than in the 1968/69 data. We assume via (5) that the cpi effect is proportional to the direct impact of the tariff cut on the CPI, that is, to the reduction in the CPI accounted for directly by the consequent fall in import prices. Using (5) and (6) and noting that t = -50 in all our simulations we expect the ratio of the cpi results in columns IV and III of Table 1 to be predicted accurately by :

$$\frac{cpi^{IV}}{cpi^{III}} = \frac{T^{74/75} \Big/ \left(1 + T^{74/75}\right)}{T^{68/69} \Big/ \left(1 + T^{68/69}\right)} , \qquad (9)$$

where the superscripts indicate the simulations and the corresponding protection-rate data sources. In our data bases $T^{68/69} = 0.2715$ and $T^{74/75} = 0.2189$; hence (9) indicates:

$$cpi^{IV} \Big/ cpi^{III} = 0.84 ,$$

which corresponds precisely to the ratio computed from the relevant results in Table 1.

The explanation of the cpi results is the key to comparing the rest of the macroeconomic results in columns III and IV of Table 1. The average rate of protection is lower in simulation IV than in simulation III, hence a given percentage reduction in the rate generates a smaller fall in import prices and less substitution from domestic sources to imports. The domestic price level falls (relative to world prices) less in simulation IV, hence domestic exporters receive less of a price/cost advantage and exports expand less. For the balance of trade, the relative reduction in export receipts is more significant than the relative fall in the import bill with the consequence that the move towards surplus in the trade balance is smaller in simulation IV than in simulation III. The rise in aggregate employment is smaller in simulation IV. This is due partly to the relative reduction in the level of activity in the export sector (note especially the rural occupation) but an important contribution to the employment result comes from increased contraction in some of the more labour-intensive parts of the import-competing sector where rates of protection are higher in the 1974/75 data base than in the 1968/69 data. Details are given below. In Table 1 the main symptoms are the relative reductions in the employment of occupations 4 (Skilled blue collar (metal and electrical)) and 7 (Semi and unskilled blue collar).

In comparing the responses of the import-competing industries in simulations III and IV (see Table 3(i)) we can again use equation (7). In these two simulations the first term (in round brackets) on the RHS is unaltered. Differences in the second term (in square brackets) should therefore provide the required explanation. We ignore the activity term and use the cpi projections as an approximation to the input-cost variable ($\tilde{p}_i$). We then predict the ratio of import-competing industry outputs in the two simulations to be approximated by:

$$z_i^{IV} \Big/ z_i^{III} = \left(cpi^{IV} - p_i^{M,IV}\right) \Big/ \left(cpi^{III} - p_i^{M,III}\right) , \qquad (10)$$

with the $p^{M,k}$ (k = III or IV indicating the relevant simulation) calculated via (4), again noting that each of the t_i takes the value of -50 in all simulations. Results of the comparisons are given in the final pair of columns in Table 5. Equation (10) provides a good guide to the changes in the projections. Industry 36 (Textile products n.e.c.) is the main exception. In moving from simulation III to simulation IV the output projection for this industry changes from negative to positive (see Table 3 (i)) but our explanation fails to pick up this sign change. The problem is twofold. In the first place this industry buys a large share of its intermediate inputs from other industries in the textile sector whose protection rates are higher in the 1974/75 data than in the 1968/69 data. The change in the value of cpi therefore mis-states the change in the costs of this industry as between simulations III and IV. Once the true cost effect is taken into account, the model projects that industry 36 would suffer almost no relative price disadvantages vis-à-vis imports on account of the 50 per cent uniform protection cut when its own tariff rate is as low (0.14) as it is in our 1974/75 data. The substitution term in the demand equation (3) is therefore of no significance in explaining its output performance in simulation IV. Rather its fate is determined almost entirely by the activity term which, as was noted in subsection IV.2 (see p.27), is positive for industry 36 because of the large share of its output sold to export or export-related industries. Our explanation (10) abstracts from the activity term and highlights the substitution effect. Hence it fails in the case of industry 36.

What is notable about the import-competing sector results for these two simulations is the evidence of the increase in the dispersion of rates of protection between the 1968/59 and 1974/75 data. We have already observed that the average rate is lower in the 1974/75 data, both when computed using CPI import weights and in the sense that a given percentage across-the-board tariff cut leads to a smaller increase in aggregate imports. For almost all industries in the highly protected textile, clothing, footwear and motor vehicle sectors, however, the rate of protection is higher in the 1974/75 data than in the 1968/69 data and the fall in output generated by the 50 per cent tariff cut is correspondingly greater.

For the export industries (Table 3 (ii)) the corresponding comparison is more straightforward. Again we can rely on equation (1) alone, taking the selling prices (p_i) of the exporters as approximately constant and using the cpi projections as an index of input prices ($\tilde{p}_i$). Since the supply elasticities (η_i) are the same in both simulations, the ratio of the cpi results should give a good indicator of the ratio of export-industry output projections in simulations III and IV. These ratios are given in the final pair of columns in Table 6. The simple explanation for the export sector is very good except for the case of industry 30. The reason for the exception is that our method fails to account for the fact that the domestic sales of industry 30 collapse sharply in moving from simulation III to simulation IV because its main domestic customers are import-competing textile industries whose protection rates are higher in the 1974/75 data base than in the 1968/69 data.

The comparison between simulations III and IV differs in an important formal sense from the earlier comparisons. A solution to the linearized (percentage change) form of ORANI can be represented as:

$$x = B y \quad , \qquad (11)$$

where x and y are, respectively, vectors of the model's endogenous and exogenous variables and B is a matrix of elasticities (assumed constant in a Johansen-style solution, see DPSV, chapter 5). The data changes made in moving between data bases I and II or II and III alter elements of the matrix B. In moving between data bases III and IV it is the values of the exogenous shocks (elements of y) which are altered. This is because the vector y contains percentage changes in the powers of the protection rates (i.e., one plus the protection rates) rather than percentage changes in the rates themselves. The base-period rates (T_i in (4)) are used only to convert the required changes in the rates into the corresponding changes in the powers in formulating y prior to solution of (11). For our simulations the only non-zero elements in y are percentage changes in the powers of protection corresponding to 50 per cent reductions in all the rates. On average the ratio of the non-zero shocks in simulation IV to those in simulation III is 0.84. As can be seen from (11) there is a proportional relationship between each of the endogenous and each of the exogenous variables. The factors of proportionality are elements of the matrix B which do not change between simulations III and IV.

Many of the endogenous variables (including cpi and outputs in most of the export sector) depend only on the average value of the shock ($\bar{y}_K$). For a typical endogenous variable (x_j) in this category it it legitimate, following (11) to write:

$$x_j = \bar{\bar{y}}_K \sum_{k \in K} b_{jk} \quad , \tag{12}$$

where the b_{jk} are elements of B and K is a set containing the labels of the elements of y which have non-zero values. Since B does not vary between simulations III and IV, it is clear from (12) that, for endogenous variables which are sensitive only to the average value of the shock, the ratios of projections from the two simulations will be identical. This constitutes a formal explanation of why the comparisons in the final pair of columms of Table 6 are so accurate. Endogenous variables whose values depend on the values of the individual shocks as well as their average value (for example, outputs in the import-competing sector -- see Table 5 -- or the output of export industry 30 -- see Table 6) do not of course conform to this neat pattern.

V. CONCLUSION

The most important policy implication to be drawn from ORANI simulations of cuts in protection is that protection does not have much to do with aggregate employment in the short run. Cuts in protection will destroy jobs in the import-competing sector but will stimulate activity and employment in the export sector. The net outcome is an empirical matter which is susceptible to investigation in a multi-sectoral model such as ORANI.

The usefulness of formal models in providing information for policy makers is not in the numerical projections alone but also in the graphic demonstration which the models are capable of providing of the theoretical and empirical factors which are crucial in determining the sensitivity of different sectors of the economy to policy shocks. In this paper we have concentrated on such a demonstration for the case of ORANI protection-policy simulations. We have attempted to show what, according to the model, determines the sensitivity of key industries in the Australian import-competing and export sectors to changes in rates of protection and how the reactions of these sectors combine in the macroeconomic outcome.

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NOTES

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1. The main sponsor of the IMPACT Project which developed ORANI has been the Industries Assistance Commission, a statutory authority with the function of advising the Australian Federal Government on all matters of industry-assistance policy.

2. The first such intervention involved a respecification of the agricultural sector of the model (Dixon, Parmenter, Powell and Vincent, 1983) which has now been incorporated into the standard version of the model. For more recent examples see Meagher, Parmenter, Rimmer and Clements (1983), and IAC (1981a and 1983).

3. Many readers will find DPSV, chapter 2, a useful guide. It sets out a miniature version of the model's theoretical structure abstracting from many details which, although important in rendering the model sufficiently comprehensive to be applicable to a wide range of policy analysis, are inessential for revealing the structural basis.

4. To date input-output accounts for Australia have been produced only infrequently and with considerable delay. Accounts for 1977/78 (ABS, 1983) are now available and the Bureau of Statistics plans to produce annual tables from thereon. A prototype version of ORANI was implemented using 1962/63 data (CBCS, 1971).

5. Empirical work by Cooper and McLaren (1980) and Cooper (1983) indicates that the ORANI short run is best interpreted as a period of about 2 years.

6. A much more detailed presentation of tariff projections made using these data is given in DPSV, chapter 7. The results are to be interpreted as percentage differences between the values which the endogenous variables would take with and without the shock about 2 years after its imposition. See also footnote 5.

7. Although not shown in Table 1, the regional implications of these results are available from ORANI. They show that the industry structure of Victoria is sufficiently concentrated on import competing industries to make that State a net loser from the cut in protection whilst the export oriented states (notably Queensland and Western Australia) enjoy large gains (DPSV, subsection 45.3).

8. In Table 1 this appears as an increase in aggregate employment. Had the model been run with a labour supply constraint, then an increase in the real wage would have been projected.

9. The data distinguish 230 commodities (114 domestically produced and 115 imported), 112 industries and 9 occupational categories of labour. As well as intermediate commodity flows, flows of investment goods and of margins services are accounted for explicitly at this level of disaggregation. For full details see DPSV, chapter 4.

10. In fact the rates used in generating import-price changes following percentage tariff cuts refer to a later period (1980/81) than the reference date for the 1974/75 input-output data base. For a discussion of the role of these rates in ORANI see DPSV, subsection 45.2.1. For a comparison of the agricultural sections of the 1968/69 data base with an about-to-be-available data base for 1977/78, see Adams (1984).

11. The idea of giving quantitative explanations of results from large-scale economic models via relatively simple back-of-the-envelope calculations is explored more fully in Dixon, Parmenter and Powell (1983b).

12. See also DPSV, subsection 45.2.1, especially equations (45.19) - (45.22).

13 See DPSV, sections 12-14.

14. The import demand equations complementary to (3) are of the form:

$$m_i = a_i - \sigma_i \, (1-S_{iM}) \, (p_i - p_i) \quad ,$$

where m_i is the percentage change in the demand for imports of category i.

15. The import-competing industries in ORANI are single-product industries. Consequently, in deriving (7) we can assume that $z_i = x_i$.