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SOME CAUSES OF STRUCTURAL MALADJUSTMENT IN THE AUSTRALIAN ECONOMY

by

Peter B. Dixon, B.R. Parmenter and John Sutton

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TABLE 4 : List of Exogenous Variables

Variable(s)	Subscript Range	Number of Components	Description[1]
p^m_{j2}, p^m_{g+1}	$j = 1,\ldots g$.	$g+1 = 110$	C.i.f. foreign currency import prices.
t_j	$j = 1,\ldots,g+1$.	$g+1 = 110$	One plus the ad valorem tariffs.
ϕ		1	The exchange rate, $A per $US, say.
ΔB		1	Balance of trade (exports - imports).
s_j	$j \in G$[2]	$g = 109$	One plus the ad valorem export subsidies.
$x^{(4)}_j$	$j \notin G$		Export demands.
$k_j(0)$	$j = 1,\ldots,g$.	$g = 109$	Current capital stocks.
f_R		1	The ratio of real private investment expenditure to real household consumption expenditure.
n		1	Supply of agricultural land.
$f_{(g+2)1m}$	$m = 1,\ldots,M$.	$M = 18$	Wage shift variables.
$f^{(5)}_{is}, f^{(5)}_{g+1}$	$i = 1,\ldots,g$, $s = 1, 2$.	$2g+1 = 219$	"Other" demand shift terms.
$f^{(2)}_j$	$j \notin J$[3] .	$g-J^* = 11$	Exogenous investment.
f^e_j	$j = 1,\ldots,g$.	$g = 109$	Shifts in foreign export demands.
$f_{(g+3)j}$	$j = 1,\ldots,g$.	$g = 109$	Shifts in the real price of "other" cost tickets.
q		1	Number of households.
		TOTAL = $8g + (g-J^*) + M + 8 = 909$	

1. With the exception of ΔB, all variables used in the model are percentage changes in the items listed.

2. G is the set of "export" industries.

3. J is the set of industries with "endogenous" investment. There are $((g-J^*) = 11)$ industries, mainly in the public sector, whose investment is treated exogenously.

APPENDIX : Technical Details of the Simulations

This appendix can be used in conjunction with Dixon, Parmenter, Ryland and Sutton [1977], hereafter Vol. 2.

In the present paper, the data base, values of parameters, and sets of industries G and J are the same as those used in Vol. 2. However, a different division of variables between endogenous and exogenous has been used. The list of exogenous variables is given in Table 4. Compared with Vol. 2, p. 104, the major changes are (i) the inclusion of ΔB and f_R in the set of exogenous variables in place of i_R and c_R and (ii) the use of 18 occupations, instead of 9, by splitting each of the 9 occupations into separate occupations for males and females.

Each experiment was intended to measure the independent effect of a particular shock. Consequently, for each experiment, only the components of the variables of interest were given non-zero values. In the mining boom experiment, ΔB was set equal to -0.5 ($ billion) and all other exogenous variables were set to zero. For the terms of trade experiment, the values of the 110 import prices and the 109 shifts in world demands were set equal to the two-year percentage changes given in Table 3. For the wage explosion experiment, all wage shift variables were set equal to 6.7 . For the wage relativity experiment, the 9 male components of the wage shift variable were set equal to -1.4 and the 9 female components were set equal to +6.5 .

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adverse effects may well have been offset by favourable movements in Australia's terms of trade.

The most serious problem appears to be the wage explosion. In our simulations this has a severe effect on overall employment and a generally depressing effect on domestic industries. By comparison, the change in wage relativities appears to have been minor in its effects in all respects except its adverse implications for female employment.

The above simulations and the observations based on them, we stress, have no official status.

boom relative to the changes in the terms of trade and in real wages which actually have occurred in the period under consideration.

A second problem with using the short run mode is that within any experiment the output effects alone are not a complete indication of the relative effects of the exogenous changes on different industries. High capital intensity limits the ease with which certain industries can expand or contract in the short run simulations. In the cases of industries with low capital intensity, the gap between the short and long run consequences of exogenous changes is lower than in highly capital intensive industries. Thus as a guide to the relative sizes across industries of the total effects of the exogenous shocks, these short-run simulations will underestimate the impacts on the more highly capital-intensive industries.

Notwithstanding the above caveats, results generated under short run assumptions are likely to be adequate for our primary purpose, which is the assessment of the relative importance of the different exogenous shocks. For example, on taking into account the overstatement in our results of the relative importance of the mining boom, we can conclude that the mining boom is unlikely to be a primary explanation of Australia's economic problems. The model implies that, once the income effects of the boom are accounted for, the overall employment implications are at worst neutral and that comparatively few import competing industries need experience absolute declines as a result of the mining boom alone. The traditional export sector[1] is adversely affected by the new mineral discoveries, but our results suggest that these

1. The traditional export sector in terms of this paper is identified as industries 1, 2, 9, 10, 11, 12, 15, 22, 27, 60 and 61.

SOME CAUSES OF STRUCTURAL MALADJUSTMENT IN THE AUSTRALIAN ECONOMY

by Peter B. Dixon, B.R. Parmenter & John Sutton*

1. INTRODUCTION

During the last ten years the Australian economy has been subjected to several severe shocks. Among these were

(1) the mining boom,

(2) major changes in relative world commodity prices,

(3) an increase in real wages far outstripping increases in productivity, and

(4) a change in wage relativities, especially a rapid closing of the gap between male and female wages, and a relative increase in junior wages.

Commentators on the Australian economy also point to the series of significant exchange rate changes, rapid changes in protection policy and a period of rather wild fluctuations in the rate of growth of the money supply. In this paper, however, we will adopt the view that these policy responses were endogenous; that the fundamental causes of instability were the mining boom, changes in world prices, changes in real wages and changes in relativities; that policy makers were presented with a series of extremely difficult problems, and that the seemingly rapid reversals in exchange rate, commercial and monetary policy merely reflected a rather

* The authors received helpful comments on an earlier draft of the paper from Alan A. Powell.

desperate search for appropriate policy responses. This does not of course rule out the possibility that many of the actual policy responses may have been counter productive. In fact, several commentators[1] have argued that government policy has intensified Australia's economic problems.

Of the four shocks which we have identified as fundamental, to date it has been the mining boom which has attracted the most interest from academic economists. The basic point, made by Gregory,[2] is as follows : if a country is suddenly presented with the opportunity to earn a large amount of foreign currency for very little resource input, then initially its balance of trade will move towards surplus and eventually either the domestic price level will inflate relative to that of the rest of the world or the exchange rate will be revalued, or both. Whether the return to balance of trade equilibrium comes about via domestic inflation or via exchange rate adjustments, the effect will be to reduce the prices of tradeable goods (exports and imports) relative to the prices of non-tradeables. Gregory emphasizes the potentially disruptive effects of this adverse movement in relative prices on those industries whose products are heavily traded. On the other hand, it is possible that the extra income generated by the mining boom might be sufficient to create enough growth in GNP so that the necessary reallocation of resources can be achieved without absolute declines in the sizes of many industries. In other words, before blaming the mining boom for our current difficulties in the import competing and export industries, it is worth

1. See for example, Snape [1977a].

2. Gregory [1976].

3. CONCLUDING REMARKS

Before drawing together the implications of our results, some caveats as to their interpretation ought to be emphasized. As usual in applied work, numerous warnings about problems in the data base and in general aspects of the methodology could be issued. These problems, with respect to ORANI, are discussed at length in Dixon, Parmenter, Ryland and Sutton [1977], and no more will be said about them here. The special problem pertaining to the use of ORANI in our present exercise concerns short-run versus long-run assumptions. Ideally, we would require a long run model for the simulations discussed in this paper. ORANI is adaptable to a long run mode as shown in Dixon, Harrower and Powell [1977]. However, at the present stage of development, the operation of the model under long run assumptions is still comparatively untried. Here we have preferred to use the model in short run mode, because a much greater effort has so far been expended in checking the plausibility of its behaviour in this mode.

Several problems arise, however, from the use of short run assumptions. First, we were able to simulate the effects of no more than two-year changes in prices and wages. Consequently, in the cases of the terms of trade and the two wage simulations, we are capturing the effects of only part of the relevant changes which have actually occurred during the present decade. For the mining boom experiment, however, the change imposed in the balance of trade is intended to represent the entire annual equivalent of the boom. This distinction between the first and the other three experiments complicates comparisons of the relative magnitudes of the effects of the four exogenous shocks. The results presented above overstate the importance of the mining

$$\mu_M = - \sigma_{FM} S_F (w_M - w_F) \quad . \qquad (2.4.3)$$

This generates

$$\mu_M = 1.6 \quad . \qquad (2.4.4)$$

(2.4.2) and (2.4.4) are closely compatible with the total employment effect, - 1.13, since the latter is computed using shares in total numbers employed[1] rather than wage bill shares as weights. Notice that the percentage change in total number of persons employed (μ) , as implied by (2.4.2) and (2.4.4) , is

$$\begin{aligned} \mu &= 1/3\ \mu_F + 2/3\ \mu_M \\ &= - 2.1 + 1.1 \\ &= - 1.0 \quad . \end{aligned}$$

In summary, the reduction in male relative to female wages has comparatively little effect on the employment of "wage-units," but does, according to ORANI, reduce numbers employed by inducing substitution of higher paid male labour for lower paid female labour.

The effects of changes in relative wages on industry outputs are small. Industries in the textile clothing and footwear group, 27 - 36, are among the main losers, but note that the relative wage change alone generates output reductions smaller than one per cent even for this group.

1. The proportion of females in the workforce was approximately one third in 1974.

investigating whether the adjustment to our mineral wealth could be accommodated by a slowing in the growth of our traded goods industries rather than by their decline.[1]

The second shock, changes in relative world prices, has been largely in Australia's favour. Although Australia is short of oil, it is self-sufficient in energy. Hence, Australia has not suffered and is not likely to suffer serious balance of payments problems arising from the energy crisis. At the same time, the foreign prices of our traditional exports have been increasing more rapidly than those of our imports. As is emphasized by Kasper and McMahon [1977], the terms of trade can be expected to continue to move in Australia's favour as more third world countries compete in world markets for the whole range of "standard-technology" manufactured goods. But just as a mining boom may bring with it some adjustment problems, favourable movements in the terms of trade are also a potential source of maladjustment. Increases in export prices relative to import prices are likely to induce either revaluations or increases in the domestic rate of inflation relative to world rates of inflation. Consequently, import competing industries and those export industries for which world prices are growing slowest may experience difficulties. Once again, however, it is possible that income effects associated with favourable movements in the terms of trade might generate sufficient overall growth for adjustments to occur without the need for absolute declines in adversely affected industries.

1. Snape [1977b] points to this possibility in a theoretical general equilibrium analysis of the effects of mineral developments.

The third major shock in recent Australian economic history is the so-called wage explosion. Unlike the mining boom and the changes in world commodity prices, it is not so clear that this development ought to be regarded as exogenous to macroeconomic policy. Although real wages have, in some periods, been used as an instrument of macroeconomic policy, it seems to us that during the period 1972-75 real wages were primarily a target of social policy and also an instrument for the transfer of resources from the private to the public sector. Hence with respect to macroeconomic policy (narrowly defined), the increases in real wages can be viewed as exogenous, i.e., they were not imposed as part of a policy response to some other stimuli, but rather because of the desire of the government of the day to secure changes in the distribution of income between wages and profits and the distribution of resources between the public and private sectors.

The final item on our list of exogenous shocks is the changes in wage relativities. Again, we believe that the most important of these, the increase in female wages relative to male wages, was social policy rather than economic policy. Similarly, the increase in rates of pay required by inexperienced school leavers was largely beyond the control of economic policy makers. It reflected, among other things, later school leaving ages.[1] Hence, from the point of view of macroeconomic policy, it seems reasonable to treat the increase in the <u>average</u> real costs of employing labour and the changes in the <u>relative</u> costs of different types of labour as exogenous shocks, i.e., shocks requiring appropriate fiscal, commercial, monetary and other economic policy responses.

1. A common complaint among employers is that whereas they used to be able to pay 14 year old school leavers about one third of adult wages, 18 year old school leavers are paid almost adult wages. While 18 year olds may have more formal education than 14 year olds, until they have practical experience, their value to their employers is no greater.

(i) Since average real wages are held constant, real output in the economy shows little movement[1] (real absorption, and thus output, changes by only .08 per cent).

(ii) Employment demand for female labour can be represented by[2]

$$\mu_F = - \sigma_{FM} S_M (w_F - w_M) \quad , \tag{2.4.1}$$

where μ_F is the percentage change in female employment, σ_{FM} is the elasticity of substitution between female and male labour (assumed equal to unity[3]), S_M is the male share in total wages (equal in our data base to .8), and w_F and w_M are the percentage changes in female and and male wages ($(w_F - w_M)$ is set at 7.9). By substituting the given values for the variables and parameters into the right hand side of (2.4.1), we obtain

$$\mu_F = - 6.3 \quad . \tag{2.4.2}$$

A similar form to (2.4.1) describes the percentage change in the demand for male labour, i.e.,

1. See footnote on p. 13.

2. (2.4.1) is derived by considering the problem of choosing L_F and L_M (inputs of male and female labour) to minimize

$$W_F L_F + W_M L_M$$

subject to

$$X = f(K, g(L_F, L_M)) \quad ,$$

where W_F and W_M are female and male wages, X and K are the (exogenously fixed) levels of output and of capital, and g is a CES function.

3. At this stage of our research we have no reliable estimates of labour-labour substitution elasticities. The choice of unity is arbitrary and thus the results in this section are particularly speculative.

Industries 16 and 20 are the only other industries experiencing output falls of less than one and a half per cent. The sales of both are heavily concentrated into personal consumption and the price and income elasticity parameters for these industries in ORANI are low.

2.4 The Change in Wage Relativities

Finally, we stimulate the effects of a change in the relative wage rates of females and males. The background assumptions are, again, fixed capital, balance of trade equilibrium and fixed average real wages. We allowed a 7.9 per cent increase in female relative to male wages.[1] This reflects the average two-yearly rate of change of wage relativities actually experienced during the period 1968-75.[2]

The aggregate employment effect of the change in wage relativities, - 1.13 per cent (see Table 1), may at first seem too large in comparison to the percentage change in domestic absorption. Employment in the female categories falls on average by more than 6 per cent and employment in male categories increases on average by about one and a half per cent. These various results are reconcilable, however, as follows:

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1. The change in relative wages was imposed by a 6.5 per cent increase in female wage rates and a 1.4 per cent decrease in male rates. The weighted average of these changes is zero, using as weights the female and male shares in total wages.

2. See Snape [1977a].

While there has been qualitative (and some limited quantitative) analysis of the effects of the mining boom, the shifts in the terms of trade, the real wage explosion and the change in wage relativities, there appears to be an urgent need for more quantitative work. Obviously, if we were to arrive at the conclusion that Australia's economic problems are primarily associated with difficulties in adjusting to our potentially relatively "strong" balance of payments situation, then the policy implications could be quite different from those which would follow if we were to find that real wage costs are the principal difficulty. Adjustment problems associated with a strong balance of payments might justify a policy of temporarily slowing down foreign capital inflow, of encouraging capital outflow or even perhaps of increasing foreign aid. Similarly, some temporary assistance to import competing and ailing export industries might be justified during the period of transition to the new equilibrium, one in which the shares of GNP of some export and import-competing industries would be smaller than in the initial situation. On the other hand, if our problem is simply that real wages are too high to allow a tolerable approximation to full employment, then the appropriate policy response will have little to do with international trade. If average real wages exceed the "full employment" marginal product of labour, then interference with international trade is unlikely to have a significant impact on unemployment unless it either raises labour productivity or lowers the real costs of employing labour. More direct, and more certain, instruments for influencing the real costs of employing labour are available. For example, a strategy of zero wage indexation, if it could be made politically feasible by simultaneous reductions in taxation (or by some other means), would reduce the real costs of employing labour, while not

necessarily reducing take home pay. However, any such policy judgments should be based upon an assessment of the relative strengths of the four exogenous shocks.

2. SOME SIMULATIONS USING THE ORANI MODEL

This section describes an attempt to quantify the relative sizes of the effects of our four exogenous shocks on industry outputs, employment by occupation, aggregate employment, aggregate exports and aggregate imports. Our approach is one of comparative statics, i.e., we ignore leads, lags and dynamics, and compare equilibrium situations. The equilibria we compare are short-run, being based on a two year adjustment period. Because of this short-run focus, the equilibria are somewhat limited, in that we do not require the clearance of the labour market; the markets for commodities, on the other hand, are assumed to clear.

2.1 The Mining Boom

In the first set of simulations, we ask what would happen to short-run equilibrium industry outputs, employment, etc., if the economy found a costless resource by which it could generate an additional annual foreign exchange export income equivalent to about 15 per cent[1] of the value of exports in the initial year. Of course, the discovery and exploitation of our mineral resources is not costless. Both domestic capital and labour are absorbed. However, given the objective of trying to work out the economy-wide implications of the mining boom, it is probably reasonable

1. This figure is consistent with Gregory [1976, p. 72].

in the "average" industry arising from a 6.7 per cent increase in real wage costs net of productivity. However, in the actual ORANI computations, the increase in real wages causes increases in the output prices in labour intensive industries relative to those for capital intensive industries. Where industry i is labour intensive, $(p_i - w)$ tends to be greater than - 6.7 whereas for capital intensive industries it tends to be less than - 6.7. Thus there is a strong positive correlation over i between $1/(1 - S_w^i)$ and $(p_i - w)$. Use of average values for these terms in (2.3.1) therefore understates the average value for the μ_i.[1]

By comparison with the industry specific output effects in the other three experiments (see Table 2), the output effects in this case are fairly uniform across industries. All industries experience declines in output. The overall labour intensity of industries and the price and income elasticities of demand facing them are important factors in explaining such inter-industry variation as is present. This can be illustrated by reference to some of the atypical output effects. Industries 10 and 100 are both extremely capital intensive[2] and therefore their outputs are not greatly affected in the short run by the rise in labour costs.

1. Note that

$$\frac{\sum_{i=1}^{n} X_i Y_i}{n} \equiv \bar{X}\bar{Y} + \mathrm{cov}(X, Y) \quad .$$

2. The primary inputs to industry 100 are entirely capital so that it is impossible under the ORANI assumption for this industry to change its output in the short run.

a 6.7 per cent increase in real wages was exogenously imposed on the model. This increase is the equivalent of the two-yearly average rate of increase of real wage costs net of productivity changes experienced over the period 1968-75.[1]

The employment results of this third experiment are presented in Table 1. Aggregate employment falls by 6.06 per cent, a result which can be explained to a first approximation by considering the CES form of the production functions employed in the model. These production functions yield a demand function for labour in industry i of the form[2]

$$\mu_i = \sigma^i_{KL} \frac{1}{1 - S^i_w} \cdot (p_i - w) \quad , \qquad (2.3.1)$$

where μ_i is i's percentage change in its demand for labour, p_i and w are the percentage changes in prices and wages, S^i_w is the share of wages in total fixed capital and labour costs in industry i and σ^i_{KL} is the elasticity of substitution between capital and labour. The S^i_w have typical values of .67 in the ORANI data base, and all the σ^i_{KL} are .5. Thus, at first glance, (2.3.1) appears to give a value of - 10 per cent (- .5 × 3 × (- 6.7)) for the change in employment

1. See Snape [1977a].

2. (2.3.1) is derived by solving the problem set out in footnote 1, p. 13, with f having the CES form.

to ignore the direct resource demands of the mining sector and to concentrate on the indirect effects arising from the earnings of foreign exchange.[1]

We assume that the additional foreign currency is absorbed by reductions in traditional exports (including pre-mining boom mining activities) and by increases in imports, i.e., we assume that the new source of export income induces domestic inflation and/or exchange rate revaluations which are sufficient to return the balance of trade to its initial position. In addition, in our first set of simulations, we assume that the "before" and "after" (short-run) equilibrium situations are the same with respect to

(i) real wages by sex and occupation,

(ii) world commodity prices, and

(iii) capital in each industry.

Variations in the first two items on this "held-constant" list, real wages and world commodity prices, are considered later. In this subsection we are interested in isolating the effects of the foreign currency earnings of the mining boom alone. The final item on the held-constant list, capital by industry, restricts us to short run analysis. An obvious effect of the mining boom (or any other of our "fundamental" exogenous shocks) would be to change relative profitabilities across industries, change the allocation of investment across industries and thus eventually to change the allocation of capital across industries.

1. This is discussed further in Dixon, Harrower and Powell [1977].

We will, however, assume that the time between our two equilibrium situations is short enough for us to ignore changes in capital stocks. As mentioned earlier, we have taken two years as a working approximation to this period.

Our comparative static analysis is carried out with the ORANI model which has been developed as part of the IMPACT project.[1] Rather than attempt to describe ORANI,[2] it might be better to concentrate on the results in Tables 1 and 2. Hopefully, as we work through those results, the principal aspects of the ORANI model will become apparent.

The most striking feature of the mining boom simulation is the projection for aggregate employment (see Table 1). According to ORANI, the exploitation of a new "costless" source of export revenue will, in an environment of fixed real wages, fixed capital stocks and balance of trade equilibrium, increase aggregate employment. In our particular simulation, where the additional annual export revenue represents 15 per cent of the initial exports, employment in the new equilibrium exceeds the initial level by 1.30 per cent.

This result can be rationalized as follows. First, we note that

$$a \simeq .8y + .2z + 2.25 \qquad (2.1.1)$$

where a is the percentage change (between our two equilibrium situations) in the volume of absorption, y is the percentage change in the volume of "private" output (excluding output of the new costless exports) and

1. For a non-technical (but comprehensive) review of the aims, scope and methods of the IMPACT project, see Powell [1977].

2. The ORANI model is fully described in Dixon, Parmenter, Ryland and Sutton [1977]. The technical specifications for the particular experiments reported in this paper are set out in the Appendix.

two-yearly movements in world commodity prices over the period 1968-75. They represent an average rate of improvement in Australia's terms of trade of 2.15 per cent per annum.

The results shown in Table 1 indicate that a 4.3 per cent (i.e., 2 x 2.15) improvement in the terms of trade generates a 1.8 per cent increase in aggregate employment. This increase in employment can be understood by regarding an improvement in the terms of trade as equivalent to an increase in productivity. (Australia uses less resources to produce the exports required to pay for any given volume of imports.) An increase in the marginal productivity of labour at the assumed constant real wage rate induces an increase in the employment of labour.

The industry specific output results show large differential impacts. In general, the now more profitable export industries and export related industries expand, but industries competing with those imports which have experienced the greatest relative declines in price contract. Industry 12 is the best example of the former group of industries and industry 65 is an example of the latter. As in the mining boom simulations, the increase in domestic absorption helps to cushion industries which are adversely affected by the relative price changes.

2.3 The Wage Explosion

The third experiment reported in this paper explores the effects generated in the ORANI model of a uniform percentage increase in the real wages of all occupation groups. Under the background assumptions of fixed capital stocks and balance of trade equilibrium,

TABLE 3 : Average Rates of Growth of World Prices 1968 to 1975*

	Group of Commodities +	Industry Numbers	Rates of Growth of Prices, Per cent for Two Years
1.	Unprocessed Agricultural Products	1-6,8,9	19.8
2.	Processed Agricultural Products	15-26,76	17.8
3.	Unprocessed Mineral Products	10,11,13	15.2
4.	Processed Mineral Products (including metal products, but excluding machinery)	54-64	17.6
5.	Energy (coal, oil)	12	26.4
6.	Processed Energy	53	23.2
7.	Exports from less developed countries	27-40,77,78,80	13.2
8.	Machinery, Equipment and Appliances	65-75	8.0
9.	Advanced Country Exports n.e.c., and Other	41-52,79	16.6

* The rates are simple log-linear trends in commodity prices from data spanning the period 1968 through 1975. U.S. prices are taken as world prices. An ad hoc reconciliation of the U.S. wholesale price index classification and the Australian input-output classification has been made. Source data is from U.S. Department of Commerce, Bureau of the Census, Statistical Abstract of the United States 1975 (96th edition) (Washington, D.C.: U.S. Government Printing Office, 1975), pp. 418-419.

It should be noted that only differences between the numbers in this table have relevance for our simulations; that is, the absolute external rate of inflation has no effect on our simulations.

\+ Industries not included in these groups are mainly non-traded. For computing purposes "world prices" in these industries were assumed to change at the import weighted average rate for all industries (i.e. 13.6%).

TABLE 1 : The Macroeconomic Results

Variable	Description	Simulations of Effects of: Mining Boom	World Prices	Average Wage Increase	Relative Wage Change
			(percentage change)		
μ	Aggregate employment	1.30	1.82	-6.06	-1.13
$\ell 1$	Employment (male) - Professional white collar	2.39	1.69	-5.86	1.97
$\ell 2$	- Skilled white collar	2.12	1.73	-6.03	1.39
$\ell 3$	- Semi & unskilled white collar	2.16	1.83	-5.99	1.41
$\ell 4$	- Skilled blue collar (metal & electrical)	1.17	1.51	-6.47	0.71
$\ell 5$	- Skilled blue collar (building)	3.07	1.52	-4.85	0.41
$\ell 6$	- Skilled blue collar (other)	0.68	1.28	-5.69	1.71
$\ell 7$	- Semi and unskilled blue collar	0.55	1.90	-5.81	0.85
$\ell 8$	- Rural workers	-5.50	3.07	-7.18	0.78
$\ell 9$	- Armed services	2.89	1.43	-3.79	0.27
$\ell 10$	Employment (female) Professional white collar	3.34	1.71	-5.48	-5.08
$\ell 11$	- Skilled white collar	3.48	1.78	-6.26	-5.08
$\ell 12$	- Semi and unskilled white collar	2.87	1.86	-6.16	-6.06
$\ell 13$	- Skilled blue collar (metal & electrical)	1.96	-0.00	-6.57	-6.59
$\ell 14$	- Skilled blue collar (building)	3.13	1.16	-6.34	-6.98
$\ell 15$	- Skilled blue collar (other)	1.87	1.13	-5.60	-5.26
$\ell 16$	- Semi & unskilled blue collar	2.28	1.23	-6.32	-5.66
$\ell 17$	- Rural workers	-6.16	3.04	-7.16	-7.15
$\ell 18$	- Armed services	2.89	1.43	-3.79	-7.62
e	Aggregate exports (foreign currency value)	-7.80	19.92	-3.15	0.04
m	Aggregate imports (foreign currency value)	5.19	17.81	-2.81	0.03
c_R	Real aggregate personal consumption	2.98	1.48	-3.92	-0.08
i_R	Real aggregate private investment	2.98	1.48	-3.92	-0.08

TABLE 2 : The Industry Output Results

Industry			Simulations of Effects of:			
ORANI No.	ABS IO Code	Description	Mining Boom	World Prices	Average Wage Increase	Relative Wage Change
			(percentage change)			
1	01.01	Sheep	-4.05	1.95	-3.46	-.10
2	01.02	Cereal grains	-3.52	2.79	-1.98	-.00
3	01.03	Meat cattle	-4.71	.63	-5.80	-.12
4	01.04	Milk cattle & pigs	-1.41	.26	-2.42	-.04
5	01.05	Poultry	- .71	.41	-2.94	-.02
6	01.06	Other farming	- .58	.32	-3.50	-.05
7	02.00	Services to agriculture	-2.84	1.29	-3.52	-.07
8	03.00	Forestry & logging	- .27	2.01	-4.84	.04
9	04.00	Fishing, trapping & hunting	-9.21	6.18	-7.87	.23
10	11.01	Iron	- .71	- .11	- .64	.02
11	11.02	Other metallic minerals	-4.53	- .10	-3.71	.12
12	12.00	Coal & crude petroleum	-7.61	13.88	-6.99	.33
13	14.00	Non metallic minerals, n.e.c.	1.24	.97	-3.41	-.00
14	16.00	Services to mining	1.87	1.97	-4.01	-.05
15	21.01	Meat products	-4.84	.63	-5.86	-.12
16	21.02	Milk products	.40	.06	- .62	.00
17	21.03	Fruit & vegetable products	2.06	.67	-3.21	-.01
18	21.04	Margarine, oils & fats	.43	.95	-3.76	-.04
19	21.05	Flour & cereal products	.04	.27	-1.50	-.02
20	21.06	Bread, cakes & biscuits	.61	.23	-1.15	-.02
21	21.07	Confectionery products	1.75	1.37	-3.83	-.16
22	21.08	Food products n.e.c.	-5.73	.56	-4.93	-.15
23	21.09	Soft drinks, cordials etc.	1.88	.70	-2.84	.02
24	21.10	Beer & malt	2.28	2.20	-2.68	-.02
25	21.11	Alcoholic beverages n.e.c.	.29	1.11	-2.60	-.07
26	22.01	Tobacco products	2.63	2.46	-2.62	.02
27	23.01	Prepared fibres	-4.67	-9.04	-4.83	-.32
28	23.02	Man-made fibres, yarns etc.	-2.80	-2.04	-5.66	-.56
29	23.03	Cotton, silk, flax yarns etc.	-1.52	-1.46	-6.34	-.80
30	23.04	Wool & worsted yarns etc.	1.53	.40	-4.15	-.33
31	23.05	Textile finishing	2.24	.74	-4.93	-.24
32	23.06	Textile floor covering	.65	- .07	-4.73	-.24
33	23.07	Textile products n.e.c.	- .27	.29	-5.10	-.35
34	24.01	Knitting mills	1.62	.59	-3.81	-.34
35	24.02	Clothing	1.59	.62	-3.93	-.49
36	24.03	Footwear	.35	- .30	-5.43	-.58
37	25.01	Sawmill products	.75	.23	-4.76	-.00
38	25.02	Plywood, veneers & boards	1.91	.48	-5.20	-.01
39	25.03	Joinery & wood products	2.62	1.09	-4.18	-.05
40	25.04	Furniture, mattresses, brooms	4.50	1.46	-6.17	.05
41	26.01	Pulp, paper and paperboard	- .92	.97	-4.93	-.08
42	26.02	Fibreboard, paper containers	.86	1.10	-3.94	-.10
43	26.03	Paper products n.e.c.	.97	1.03	-3.58	-.11
44	26.04	Newspapers & books	.89	1.07	-4.17	-.13
45	26.05	Commercial & job printing	1.44	1.25	-4.14	-.11

industries and for some of the principal import competitors. The thirteen industries experiencing the largest output reductions, i.e., reductions greater than 3 per cent, are all either export industries or suppliers to export industries. Of the twenty-four main import competing industries,[1] only nine actually have output reductions. The increase in absorption cushions many of them from the effects of the changes in relative prices. The main beneficiaries in the mining boom experiment are the producers of non-traded goods, services and construction.

The effects of the mining boom on occupational employment (see Table 1) follow from the output effects. Occupations 1 - 3, the white collar groups, which are heavily employed in the non-traded service and government sectors enjoy above average employment increases and occupation 8 (rural) suffers reduced employment opportunities.

2.2 World Prices

Our second set of simulations concerns changes in Australia's terms of trade. Under the same background assumptions as were employed for the mining boom experiment, i.e., fixed real wages, fixed capital stocks and balance of trade equilibrium, ORANI was used to simulate the effects on employment by occupation, output by industry and aggregate imports and exports of the set of exogenous changes in world prices listed in Table 3. These changes are equivalent to the average

1. That is, industries 18, 28, 29, 32, 33, 36 - 38, 41, 44, 47, 49, 52, 54, 64, 65, 68 - 70, 72 and 76 - 79, see Dixon, Parmenter, Ryland and Sutton [1977, ch. 4 p. 227].

In short run ORANI simulations, a .2 per cent increase in private output requires an approximate .33 per cent increase in private employment.[1] A 2.98 per cent increase in public output requires a 3.31 per cent increase in public employment.[2] A .33 per cent increase in private employment and a 3.31 per cent increase in public employment give an increase in aggregate employment of approximately 1.3 per cent when it is assumed that about 30 per cent of employment is in the public sector while about 70 per cent is private.

Our argument, so far, refers only to the aggregate effects of the mining boom on output and employment. Table 2 gives estimates of the impact on individual industries. In accordance with the Gregory argument, we find that ORANI implies output reductions for the export

1. The ORANI data base implies that labour represents about 60 per cent of total fixed capital and labour costs for the private sector. Thus a one per cent increase in output, generated by an increase in labour alone, requires an approximate 1.66 per cent increase in employment.

2. In the public sector, ORANI implies that labour represents about 90 per cent of total fixed capital and labour costs.

TABLE 2 : (Continued)

Industry			Simulations of Effects of:			
ORANI No.	ABS IO Code	Description	Mining Boom	World Prices	Average Wage Increase	Relative Wage Change
			(percentage change)			
46	27.01	Chemical fertilizers	-3.00	1.60	-3.31	-.05
47	27.02	Industrial chemicals n.e.c.	-1.96	.41	-4.54	-.12
48	27.03	Paints, varnishes, lacquers	1.57	.48	-4.00	-.05
49	27.04	Pharmaceutical & chemicals	- .07	.93	-3.95	-.36
50	27.05	Soap and other detergents	1.89	1.21	-3.84	-.15
51	27.06	Cosmetic, toilet preparations	1.45	1.23	-3.15	-.21
52	27.07	Chemical products n.e.c.	- .33	1.29	-4.68	-.14
53	27.08	Petroleum & coal products	1.64	1.64	-4.09	-.00
54	28.01	Glass & glass products	.58	1.14	-4.16	-.06
55	28.02	Clay products	1.60	1.44	-4.19	-.04
56	28.03	Cement	2.10	1.44	-3.66	-.01
57	28.04	Ready mixed concrete	3.16	1.41	-3.56	-.03
58	28.05	Concrete products	2.88	1.55	-3.65	-.02
59	28.06	Non-metallic mineral products	1.79	1.38	-3.93	-.03
60	29.01	Basic iron & steel	-5.46	1.38	-6.00	.17
61	29.02	Other basic metal products	-5.82	2.06	-4.56	.02
62	31.01	Structural metal products	2.58	1.92	-4.48	-.03
63	31.02	Sheet metal products	2.86	1.28	-4.37	-.01
64	31.03	Metal products n.e.c.	.77	1.24	-4.92	-.07
65	32.01	Motor vehicles & parts	- .48	-3.72	-6.35	-.01
66	32.02	Ship & boat building	.95	.93	-2.88	-.13
67	32.03	Locomotives, rolling stock	- .23	2.08	-2.50	-.12
68	32.04	Aircraft building	- .55	-1.50	-4.21	-.01
69	33.01	Scientific equipment etc.	1.64	.23	-4.78	-.19
70	33.02	Electronic equipment	1.51	-1.97	-7.24	-.42
71	33.03	Household appliances n.e.c.	4.31	.81	-6.10	-.00
72	33.04	Electrical machinery n.e.c.	1.58	- .62	-5.11	-.13
73	33.05	Agricultural machinery	-3.50	1.10	-3.88	-.21
74	33.06	Construction etc. equipment	.57	1.37	-4.64	-.11
75	33.07	Other machinery, equipment	.65	.68	-4.68	-.09
76	34.01	Leather products	.29	.59	-4.42	-.36
77	34.02	Rubber products	1.25	.74	-5.39	-.05
78	34.03	Plastic & related products	.80	.25	-4.79	-.18
79	34.04	Signs, writing equipment etc.	1.26	1.65	-5.02	-.13
80	34.05	Other manufacturing	1.33	.64	-3.92	-.12
81	36.01	Electricity	1.11	.92	-3.85	.03
82	36.02	Gas	2.72	.88	-5.21	.09
83	37.01	Water, sewerage & drainage	.85	.65	-2.19	-.06
84	41.01	Residential buildings	2.98	1.48	-3.92	-.08
85	41.02	Building n.e.c., construction	3.32	1.27	-3.42	-.01
86	46.01	Wholesale trade	1.31	1.55	-4.05	-.06
87	48.01	Retail trade	3.28	1.68	-4.10	-.04
88	48.02	Motor vehicle repairs	3.60	2.23	-6.69	.22
89	48.03	Other repairs	2.83	2.01	-5.94	.03
90	51.01	Road transport	- .50	1.87	-3.26	-.01

TABLE 2 : (Continued)

Industry			Simulations of Effects of:			
ORANI No.	ABS IO Code	Description	Mining Boom	World Prices	Average Wage Increase	Relative Wage Change
			(percentage change)			
91	52.01	Railway & other transport	-1.55	2.77	-3.36	.02
92	53.01	Water transport	- .43	.65	-2.19	.00
93	54.01	Air transport	- .88	- .12	-2.58	-.07
94	55.01	Communication	1.77	1.40	-4.66	-.08
95	61.01	Banking	1.91	1.30	-4.46	-.12
96	61.02	Finance & life insurance	2.73	1.36	-5.08	-.18
97	61.03	Other insurance	2.58	1.44	-5.44	-.23
98	61.04	Investment, real estate etc.	1.84	1.09	-4.26	-.12
99	61.05	Other business services	1.90	1.22	-4.53	-.14
100	61.06	Ownership of dwellings	0	0	0	0
101	71.01	Public administration	3.01	1.49	-4.10	-.08
102	72.01	Defence	2.89	1.43	-3.79	-.08
103	81.01	Health	3.78	1.67	-6.55	-.79
104	82.01	Education, libraries, etc.	3.27	1.57	-4.82	-.23
105	83.01	Welfare services	3.23	1.60	-5.56	-.13
106	91.01	Entertainment	3.55	1.77	-6.48	-.21
107	92.01	Restaurants, hotels, clubs	3.44	1.85	-5.80	-.33
108	93.01	Personal services	3.57	1.60	-6.43	-.65
109	99.01	Business expenses	1.70	1.27	-4.21	-.11

z is the percentage change in the volume of government services (defence, education, health, public administration, etc.). We assume that about 80 per cent of output can be classified as "private" while 20 per cent is public. Thus the percentage change in national output (excluding the new exports) is (.8y + .2z). The + 2.25 on the right side of (2.1.1) represents the percentage increase in absorption allowed by the new export revenue. This revenue is assumed to be 15 per cent of exports and exports are assumed to be 15 per cent of GNP (15% of 15% = 2.25%).

Next, we note that

$$z = a \quad . \tag{2.1.2}$$

(2.1.2) reflects an assumption built into the present ORANI simulations that public services, private consumption and private investment all expand at the same rate.

On bringing (2.1.1) and (2.1.2) together we obtain

$$z = a \simeq 2.8 + y \quad .$$

Then from Table 1, we observe that $a = 2.98$ (see the mining boom result for real private investment and consumption) and thus $y \simeq .2$.[1]

1. Imagine a one commodity model in which producers choose X and L to maximize short run profits,

$$PX - WL \quad ,$$

$$\text{subject to} \quad f(K, L) = X \quad ,$$

where P is the price of output, W is the wage rate, X is the level of output and L and K are inputs of labour and capital. K is fixed and thus it follows that

$$X = \psi(W/P) \quad .$$

Hence, if real wages are fixed, i.e., W/P is fixed, then X will be constant. Of course, in ORANI, there are many products and our mining boom experiment produces changes in relative prices. The outputs of different industries move in different directions. However, in aggregate, the change in output will be small.