DEREGULATION AND ROAD VERSUS RAIL INTERMODAL SUBSTITUTION
A GENERAL EQUILIBRIUM ANALYSIS

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ABSTRACT: *The purpose of this paper is to examine the economy wide effects of deregulating goods haulage by road in Australia. The paper reviews the historical development of transport regulations in Australia and presents the partial equilibrium effects of transport deregulation as identified by the transport economics literature. The paper then adopts a general equilibrium approach in tracing transport sector specific effects in addition to the effects of deregulation on those other sectors in the economy which use transport as an input and those which supply inputs to the transport sector. In this framework the gainers and losers in a deregulated transport regime are identified, which is the very necessary first step to further understanding of why regulation takes place and why it is so difficult to remove.*

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1 INTRODUCTION

The purpose of this paper is to examine the economy wide effects of deregulating landbased freight transport in Australia This investigation is possible because detailed statistical data is available on the freight transport sectors in the form of margins matrices from the Australian Bureau of Statistics and secondly because a model making full use of this data has been developed by Dixon, Parmenter Sutton and Vincent (1982). The paper focuses on the effects of dismantling the regulatory network affecting competition between the two major land-based transport modes: road and rail.

The rest of the paper is organised as follows: Section 2 briefly reviews the historical development of transport regulations in Australia and presents the partial equilibrium effects of transport deregulation as identified by the literature survey.

Section 3 of the paper gives the details of how a general equilibrium model was used to simulate the deregulation of the Australian road haulage industry. Section 4 presents and discusses the empirical results while Section 5 concludes the paper and suggests areas for further research.

2. LANDBASED TRANSPORT REGULATION AND DEREGULATION IN AUSTRALIA

Generally the major instruments of regulation have been subsidised railway services road maintenance and tonne-kilometre taxes on road transport licences and permits for road operators Such regulations started in the 1930s when there was a regulators perceptual switch from the up-to-then traditional view of railways as a monopoly which needs to be controlled in order to protect users' interests to the view that railways must be protected from the competitive pressures imposed by road haulage

The Australian experience in regulating the competition between road and rail over the past 50 years is reviewed in this section. This is done by concentrating on the experiences of one state namely New South Wales which is the most economically advanced of the six Australian states

2 1 New South Wales

In the 1930s and earlier periods the state railways of New South Wales were regarded as a development agency and were constructed with a view of promoting settlement and developing the natural resources of the state and not as a revenue producing enterprise. Thus generally freight rates were not raised sufficiently to cover the increases in the cost of maintenance and interest charges; and on many lines the earnings did not cover working expenses Furthermore railway finances tended to bear the burden of substantial concessions made for the direct benefit of primary and secondary industries Thus railway surpluses were rare even for the period preceding the 1930's as is clear from column 2 of table 1 below At the same time New South Wales witnessed a remarkable development in motor transport: particularly in the number of commercial lorry trucks which as column 3 of table 1 shows increased by a multiplicative factor of 50 in the 14 year period from 1916 to 1930

Table 1 New South Wales Railways Deficits and Lorry/Trucks Registrations

Year	Loss/Profit(+) £	Trucks
1911	- 553 998	n.a.
1916	- 223 749	846
1921	- 577 032	3 524
1926	- 830 671	22 980
1927	- 451 618	30 517
1928	-1 609 267	37 129
1929	-1 512 434	42 564
1930	-3 556 374	43 371

Source: New South Wales Official Yearbook 1931-32, Pages 175 and 220

As was the case in other States the road operators posed a threat to the viability of government railways in that they competed for those commodities which were more profitable for railways and whose rates had been set high in order to cross-subsidise the less remunerative commodities

ROAD HAULAGE DEREGULATION

In order to counteract the competition from road haulage and its challenge to the financial viability of government railways the State Transport (co-ordination) Act was introduced in 1931 by which:

(i) owners of public and of commercial motor vehicles were required to pay a fee to obtain licences

(ii) for routes and commodities where road was competing with rail only routes of less than 32 kilometres were admissible

(iii) Trips beyond 32 kilometres which were competing with rail incurred a ton-mile charge increasing with increased rail-suitability of the goods in question until at maximum rail-suitability road transportation was prohibited. The charges were levied on the aggregate tare weight plus load capacity and was payable whether full or no load was being transported.

The other Act which had an impact on road haulage regulation was the Road Maintenance (Contribution) Act of 1958 which required owners of commercial lorries with a load capacity exceeding 4 tons to pay a charge whether loaded or not towards compensation for wear and tear caused by the vehicles to the public roads.

Columns 2 and 3 of table 2 show the number of convictions and the road maintenance charges collected under this Act increasing over time until 1975-76 when they were double what they were in 1964-65.

On average about 70% of these convictions related to failure to deliver returns, and 30% of the convictions related either to failure to pay Road Maintenance charges or to show details of trips needed to levy the charges

The interesting thing to note though from Table 2 is that despite the two Acts; in particular despite the ton-kilometre levy under the State Transport (Co-ordination) Act, road haulage competitive with rail routes increased, both in terms of number of trips made and tonnage hauled (see columns 4 and 5

<u>TABLE 2</u>

Road Maintenance (Contribution) Act and the State Transport (Co-Ordination) Act
Some Figures

ROAD MAINTENANCE (CONTRIBUTION) ACT				STATE TRANSPORT (CO-ORDINATION) ACT			
(1)	(2)		(3)	(4)	(5)	(6)	(7)
	CONVICTIONS		TOTAL TON MILE CHARGE COLLECTED (INTRASTATE)	COMPETITIVE JOURNEY PAID CHARGES		COMPETITIVE JOURNEYS CHARGES EXEMPT	
YEAR	INTRASTATE	INTERSTATE		TRIPS	TON	TRIPS	TONS
1964-65	3,699	4,380	$ 7,017,884	100,438	787,435	35,240	240,606
65-66	3,000	4,309	$ 7,577,108	98,813	791,325	40,041	287,779
66-67	n.a.	n.a.	n.a.	124,389	909,991	n.a.	n.a.
67-68	5,601	5,811	$ 8,499,240	127,730	992,108	31,879	249,964
68-69	6,506	6,466	$ 9,992,798	131,465	1,059,218	45,332	337,277
69-70	5,540	5,921	$10,959,766	134,613	1,318,786	58,202	419,115
70-71	6,389	5,532	$11,778,555	143,092	1,334,705	63,402	458,510
71-72	6,210	5,999	$12,224,206	155,212	1,459,154	65,386	459,708
72-73	6,116	6,696	$12,449,336	153,090	1,487,773	n.a.	n.a.
73-74	4,613	5,592	$12,964,845	All Co-ordination taxes and Embargoes lifted on 31/12/73			
74-75	6,481	6,557	$14,448,311				
75-76	7,752	7,929	$14,063,938				
76-77	5,285	5,249	$14,397,648				
77-78	7,039	6,010	$14,246,193				
78-79	5,415	5,240	$14,888,478				
79-80	Abandoned from 1st March, 1979 due to truck drivers strike.						

Source: Commissioner for Motor Transport, New South Wales Annual Reports, various years.

Furthermore it was possible to evade the tax by Border Hopping' a practice which was very difficult to restrict but which made some intra-state journeys to appear as if they are interstate journeys and therefore not subject to the Act

C THE MOVE TO DEREGULATION

From 1st January 1974 all embargoes and charges on the carriage of goods by road were waived completing the move to deregulation which started on 1st July 1972 Since that date owners of all licensed goods vehicles have been able to carry goods throughout the State without a permit and free from any restrictions under the Act

The Road Maintenance (Contribution) Act was repealed on the 7th December 1979 as a result of a national strike of road hauliers

In the next section a summary of the extent of deregulation to date in other Australian states is given

2 2 OTHER STATES

In 1963 South Australia was the first State to deregulate road freight transport and it completely eliminated its restrictive licensing of intra-state trucking by 1968

The process of deregulation in Queensland began in 1975 with reductions in road permit fees All road permit fees were abolished by 1978 although permits were still required for a range of restricted goods (See table 3 below)

In Western Australia a seven year deregulation program began in 1980 based on the recommendations of the Southern Western Australia Transport Study (1977)

In Victoria it was not until 1981 that legislative controls on the movement of general freight by road were abolished in line with the recommendations of Bland (1972) Restrictions still remain

In Tasmania legislation to protect the railway still exists. It controls road transport operators who compete with rail on hauls exceeding 100 kilometres A complex licensing and trip permit fees system prevails It must be noted though that in this State there is some degree of defacto deregulation (See May Mills and Scully (1984) p 62) because new licences are currently more readily granted than in earlier periods

Table 3 summarises the present regulatory position in Australia It gives the traffics which are reserved to rail by means of State government controls.

Table 3: Traffics presently reserved to rail

Reserved Traffics	Instrument used
New South Wales	
Coal (most)	Environmental Planning and Assessment Act 1979
Grain for export	Grain loaders have no road receival facilities
Victoria	
Grain, briquettes, limestone aviation turbine fuel cement superphosphate, undressed sawn hardwood and sawmill products, petroleum products	Transport Act 1983
Queensland	
Road permit fees are required for coal and coke all grains limestone, minerals and ores bulk petroleum products LPG raw sugar log timber salt new motor vehicles and pavement materials extracted from quarries	Transport Act 1960-81 and regulations made thereunder
Western Australia	
Grains fertilizer, wool bulk petroleum bulk ores and minerals and some timber	Truck licensing (Transport Act 1966-82); licences not granted for these traffics
Tasmania	
Bagged cement, limestone fertilizer timber logs coal and sulphuric acid	Regulations under Traffic Act 1925 set prohibitive permit fees for road haulage where rail service is available
South Australia	(No restrictions)

2 3 The Partial Equilibrum Effects of Deregulation

This section gives a brief survey of the literature on Australian transport deregulation Joy (1964) argued that the Australian experience following deregulation of interstate road transport in 1954 showed that freedom of entry and operation need not necessarily lead to chaotic conditions in the road haulage industry, neither do they lead to the demise of the railway. Hirst (1963) and Kolsen (1968) argue that tonne-kilometre taxes and permit charges cause resource mis-allocation in favour of rail, implying that deregulation would lead to improved resource allocation. On the other hand, the Report of the Royal Commission on State Transport Services (1968) recommended for South Australia, a scheme to regulate road transport services again after a period of deregulation (i e. 1963 to 1968). The recommendation was never implemented The consensus though (see Bland (1972) Wheeler and Gilmour (1974), Nelson (1976) is that just as interstate regulation was beneficial so would intra-state deregulation The typical partial equilibrium effects of deregulation are summarised in Table 4

TABLE 4 - THE EFFECTS OF DEREGULATION

AUTHOR	REPORTED EFFECTS	BASIS OF CONCLUSIONS
Joy (1964)	1. Short run road freight rate instability but stabilise in the long-run. 2. Reduced safety effects . overloading . excessive hours of driving 3. Road rates set at or just below the competing rail rates 4. Loss of rail freight to road due to lower rates lower transit time and lower rail reliability 5 the cost of railway operations decrease; increased efficiency.	Informed opinions on interstate transport deregulation
Wheeler and Gilmour (1974)	6 Railway rates fall 7 The predicted fall in rail freights are not realised 8. Road's market share unlikely to rise because the regulated traffic is a small percentage of the whole.	Some figures from the Commonwealth Bureau of Census Statistics.
Nelson (1976)	9. Market structure remains one of a many firm industry 10. Increased integration of road-rail transport. 11 Has no effect on government railway deficits. 12. Shipper groups like farmers and graziers benefit from cheaper rates. 13. Prices of goods fall benefiting consumers. 14. Excessive capacity in both the rail and road haulage industry.	Literature survey and Discussion with Australian Transport Economists.
Lubulwa (1986b)	15 Railway's average cost per tonne kilometre rise in short run and fall in long run 16. Railway's average revenue per tonne kilometre behave as in 15 above.	Regressions using data from Australian Bureau of Statistics

3. SIMULATING DEREGULATION

3 1 The Environment For the Simulations

The results of any general equilibrium simulation are conditional on the details of the exogenous/endogenous variables split which defines the economic environment of the simulation. In this section the salient features of the environment are indicated

The results are computed using the recommended closure of the longrun version of Orani. The macro features of this environment, which are common to all of the simulations reported in this paper, include the following assumptions:

(i) Capital is assumed to be in elastic supply to each industry at fixed rates of return.

(ii) Labour is in fixed aggregate supply, but is mobile between industries. The average wage is endogenous but relativities are fixed.

(iii) The nominal values of national saving and household consumption move in proportion to one another.

(iv) Government demands move in line with real household consumption

(v) In each industry, investment grows at the same rate as the capital stock.

(vi) Saving and aggregate investment are not necessarily equal implying that foreign funds may be required to fund part of investment. We recognize this by specifying that only part of the national capital stock belongs to Australians. Australian equity is determined by the level of national saving. Only revenue from Australian-owned capital accrues to Australians. Hence we distinguish between income accruing to Australians (GNP) and income generated in Australia (GDP).

(vii) National Income (GNP) is divided between household consumption, government demands and national saving.

The main difference between the simulations is as follows: the first reported and more extensively discussed simulation assumed that the general wage shift variable f1 was endogenous which meant that the price of labour $p^{(1)}_{(g+1,1,m)j}$ was endogenous and determined by the model. In the equation defining $p^{(1)}_{(g+1,1,m)j}$ the general wage shift variable would reveal the overall change in real wages which would be necessary to achieve an exogeneously given aggregate employment level. Thus in the first simulation the aggregate employment level was set exogeneously and the real wage was left to change (as a result of the deregulation policy) to such an extent as is required to achieve the set level of aggregate employment.

This assumption was modified in simulation 2 by setting f1 exogeneously and letting the employment levels adjust to ensure that labour markets clear at the exogenously set wage rate.

3.2 The model

In order to examine the economy-wide implications of the road haulage deregulation use is made of a general equilibrium model of the Australian economy. The equations of this model are derived from orthodox microeconomic assumptions about the price-taking economic agents. Producers are assumed to minimise costs while consumers maximise utility subject to budget constraints.

Details of the derivation of these equations is documented in Dixon, Parmenter, Sutton and Vincent (1982).

In Dixon et al (1982) for each industry j, j = 1 ... h it is assumed that the production function is of the following form:

$$\underset{i=1 \,\ldots\, g+2}{\text{Minimum}} \left(\frac{X^{(1)}_{1j}}{A^{(1)}_{1j}} \quad \ldots \quad \frac{X^{(1)}_{g+2j}}{A^{(1)}_{g+2_{1j}}} \right) = A^{(1)}_{j} \; Z_j \qquad (3a)$$

where

the superscript (1) denotes current production

Z_j is the jth industry's activity level

$A^{(1)}_{ij}$ and $A^{(1)}_{j}$ are technological coefficients

$X^{(1)}_{ij}$ is the effective input of good or factor i into the current production of industry j

There are g+2 inputs altogether The first g of these are interpreted as produced intermediate inputs for example steel, petroleum etc. The subscript g+1 denotes primary factors Finally the subscript g+2 denotes 'other cost tickets' which includes production taxes, costs of holding inventories and other miscellaneous production costs.

We assume that regulations which impose license fees tonne-kilometre charges and distance constraints plus other restrictions on the road haulage industry as detailed in Section 2, do increase the cost of those other tickets for the road haulage industry. Similary a regulated environment which say imposes common carrier obligations on the railway systems imposes on these systems additional 'other cost tickets'. Generally in order to achieve a unit level of activity, Z_j, industry j must buy $A^{(1)}_{g+2,j}$ 'other cost tickets'. The economy wide effects of deregulation can then be simulated by introducing the appropriate change in the price of 'other cost tickets'. In order to do this use is made of the following equation (See Dixon et al (1982 p 128)

$$p^{(1)}_{g+2,j} = h^{(1)}_{g+2,j} \xi^{(3)} + f^{(1)}_{g+2,j} \qquad (3b)$$

where

$p^{(1)}_{g+2,j}$ stands for percentage change in the price of 'other cost tickets' used in current production by industry j.

$\xi^{(3)}$ stands for the consumer price index

$h^{(1)}_{g+2,j}$ is a parameter. Usually this is set at one which means that prices of other cost tickets move together with the consumer price index

$f^{(1)}_{g+2,j}$ is an exogenous shift variable.

In this paper $h^{(1)}_{g+2,j}$ is set to zero and $f^{(1)}_{g+2,j}$ is exogenously set and is used to simulate the impact of road haulage deregulation.

The impact of road haulage deregulation on the transport/freight charges vary according to the commodity in question, from corridor to corridor and from time to time.

Nelson (1976 p 61) states that:

> the available evidence indicates that . freight rates have fallen in many traffic areas in South-Australia with the greater road-rail competition'

Among the available evidence he refers to Australian Wool Board (1971) where wool rates were reported to have fallen by up to 50% and grain rates to have been reduced. Wheeler and Gilmour (1974) do not indicate by how much railways are likely to cut their rates as a result of deregulation. Lubulwa (1986b) provides some empirical evidence that road haulage deregulation is likely to lead in the long run to a downward shift in both the average cost and average revenue curves for government railways. Both of these effects would suggest that freight rates would drop.

We assume that deregulation will lead to a ten percent reduction in the road and rail freight rates. This is a conservative figure compared to the figures in Nelson (1976). The question then is what would be the impact on the rest of the economy if deregulation led to a ten percent reduction in the costs of moving goods by road and rail?

Initially the model by Dixon et al (1982) is treated with a shock of 100% in the prices of 'other cost tickets' of road and rail transport leading to the 2 x 2 elasticity matrix in (3C) below.

$$\begin{bmatrix} -5\ 6231 & 0\ 1568 \\ 0\ 3687 & -2\ 2670 \end{bmatrix} \begin{bmatrix} f^{(1)}_{g+2,\text{road}} \\ f^{(1)}_{g+2\ \text{rail}} \end{bmatrix} = \begin{bmatrix} p_{1\ \text{road}} \\ p_{1\ \text{rail}} \end{bmatrix} \qquad (3c)$$

where $p_{1\ \text{road}}$, $p_{1\ \text{rail}}$ are the percentage changes in the road and rail freight charges.

$(p_{1,\text{road}}, p_{1\ \text{rail}}) = (-10,-10)$ by assumption

$f^{(1)}_{g+2\ \text{road}}$ $f^{(1)}_{g+2\ \text{rail}}$ are the appropriate percentage decreases in the purchases prices of the 'other cost tickets' for road and rail respectively which are required to be introduced simultaneously in order to obtain a balanced 10 percent decrease in road and rail freight charges.

By matrix inversion (3c) can be solved to get:

$$\begin{bmatrix} f^{(1)}_{g+2.\text{road}} \\ f^{(1)}_{g+2,\text{rail}} \end{bmatrix} = \begin{bmatrix} -\ 191\ 0045 \\ -\ 472.1792 \end{bmatrix} \qquad (3d)$$

The difference in the required shocks for road and rail are a result of the differences in the share of 'other cost tickets' in the total cost of the two modes The mode where 'other cost tickets' account for a larger share in total costs need a relatively smaller decrease in the price of 'other cost tickets' in order to achieve a 10 percent drop in that modes' freight rates

Most studies stop at the point where the impact of deregulation on road or rail freight rates is determined. There is often no examination of the implication of these freight rates changes on the rest of the economy This paper examines these second round effects of road haulage deregulation by introducing the computed price changes in (3d) into a general equilibrium model of the Australia economy. The results of this policy simulation are presented and discussed in section 4 below.

4 RESULTS : THE EFFECTS OF ROAD HAULAGE DEREGULATION

It must be noted first of all that the simulation strategy adopted in section 3 cannot reveal anything about the road versus rail substitution possibilities Secondly the adopted strategy does not suffer from the objections raised in Lubulwa (1985 1986a) relating to the use of a Leontief fixed proportion function in Dixon et al (1982) to describe intermodal substitution in the transport sector This is because the simulation strategy explicitly avoids changes in the road versus rail relative prices.

This section presents results on the impact of deregulation on the various sectors in the economy It is worth examining the process which is responsible for generating these results. Having introduced the shock discussed in Section 3 the first major equation which would be affected is equation 18 2 in Dixon et al (1982) which states that in the absence of technological change, then for each industry j

> 'a weighted average (the weights being revenue shares) of the percentage changes in the basic prices of outputs equals a weighted average (the weights being cost shares) of the percentage changes in the relevant purchasers prices of inputs'.

This is a percentage form restatement of the zero profit condition which states that for industry j the basic price of output is equal to the total payment for inputs. Thus the shock introduced in Section 3 above leads to a decrease in the basic prices of the road and rail transport sectors which are margin industries in the general equilibrium model used here

The next set of equations to be affected are equation 18 18 and 18 19 of Dixon et al (1982) which relate changes in the prices paid by domestic users for all goods to changes in their basic prices, to changes in the relevant taxes and to changes in the costs of margin services. The simulation in Section 3 has the effect of lowering user prices for all industries which use road or rail transport or both.

The results in Tables 5 and the changes in the output in each of 112 industries in table 6 are used to depict the potential impact of road haulage deregulation on the Australian Economy. The final results depend on a number of factors which include the type of industry one is dealing with, the elasticities of demand, the cost shares of the particular industry to mention a few. Most of the outputs of the road and rail transport industries represent mark-ups associated with distributing goods between producers and users, and so the share of the road and rail transport margins in the total industry costs play a major role in generating the results reported below. These shares are given in column 4 of table 6 for convenience.

In Tables 5 and 6 industries are classified as exporting (E) if exports constitute significant proportions of the aggregate outputs of these industries. An industry is export related (ER) if it produces output which though not exported directly is sold to exporting industries. Import competing (IC) industries are those which sell in markets where the level of import penetration is significant. Non-trading (NT) industries are those whose output is predominantly consumed within the Australian economy.

An industry is a 'gainer' if road haulage deregulation leads to an increase in its output while a 'loser' is one whose output drops as a result of deregulation. The distribution of gainers and users by industry classification is given below in Table 5

TABLE 5

DEREGULATION WITH AN ENDOGENOUS REAL WAGE : DISTRIBUTION OF GAINERS AND LOSERS IN SIMULATION 1

Industry Type	No. of Gainers	No of Losers	Total
Exporting	4 (3.7%)	8 (7.4%)	12 (10.7%)
Export Related	6 (5.4%)	6 (5.4%)	12 (10.7%)
Import Competing	32 (28.6%)	18 (16.1%)	50 (44.6%)
Non-Trading	33 (29.6%)	5 (4.1%)	38 (34%)
Total	75 (67.0%)	37 (33.0%)	112 (100%)

SOURCE: The numbers of industries are computed from Table 6. The percentages are percentages of the total number of industries recognised in Dixon et al (1982).

It is clear that while not every industry would benefit from road haulage deregulation with an endogenous real wage, the majority of industries (67%) would benefit. The majority, (almost half) of the number of gaining industries, is from the non-trading sector, followed by the import competing industries. The majority of exporting and export-related industries are adversely affected by road-haulage deregulation with an endogenous real wage. Out of a total of 24 of these industries, 14 industries (more than half) experience a decline in their output

The major cause of this adverse effect is that the results in tables 5 and 6 (simulation 1) were generated under the assumption of an endogenous real wage. Thus while deregulation was beneficial to all industries in terms of reduced transport costs these benefits were translated into an increase of 1.74 percent in the real wage which increased the production costs of industries and for most of those industries which are labor intensive the reduction in output due to higher labour costs was such that it led to the decline in total industry output. When the general equilibrium model was shocked as in section 3 but under the assumption that real wages are exogenous (i.e. with zero percentage changes) and so do not change when road haulage deregulation precipitates a fall in basic prices, as one would expect all industries registered gains from road haulage deregulation. (See Simulation 2 in Table 6).

TABLE 6: EFFECTS OF ROAD-HAULAGE DEREGULATION ON INDUSTRY OUTPUT

ORANI number	Simulation 1 $l = 0$	Simulation 2 $f_1 = 0$	Share of rail & road costs in total cost
Export industries* (E)			
1 Pastoral zone	-1.7	2.7	1.1
2. Wheat-sheep zone	0.2	6.5	1.5
3. High rainfall zone	-1.3	5.6	1.5
11. Fishing	-0.2	6.0	0.6
12. Iron	6.2	26.6	2.2
13. Other metallic minerals	-1.4	18.6	0.8
14. Coal	8.9	56.7	1.5
18. Meat products	-1.0	10.2	5.7
25. Food products, n.e.c	-1.1	15.6	5.7
30. Prepared fibres	-1.1	10.3	3.8
63. Basic iron and steel	0.9	18.7	2.7
64. Other basic metals	-1.1	20.4	4.0
Export related industries (ER)			
4. Northern beef	-1.2	19.4	1.5
5 Milk cattle	-0.3	4.6	1.9
6. Other farming export	-0.7	13.1	1.3
8. Poultry	-0.6	5.8	2.1
9. Services to agriculture	-0.3	12.5	0.2
49. Chemical fertilizers	-0.2	10.5	4.9
69. Ship and boat building	0.7	13.9	11.9
70. Locomotives	2.3	20.3	0.8
76. Agricultural machinery	0.9	10.9	3.7
93. Road transport	0.7	17.0	0.3
94. Railway transport	1.6	20.5	1.44
95. Water transport	0.3	9.6	0.7
Import competing industries (IC)			
16 Non-metallic minerals n.e.c	1.1	21.5	1.6
21 Margarine oils & fats	-0.03	10.5	2.9
24 Confectionery	-0.02	8.7	2.8
28 Alcoholic drinks n.e.c	-0.01	27.4	3.5
29 Tobacco	0.2	11.2	3.8
31 Man-made fibres, yarns	-1.6	16.8	2.5
32 Cotton silk flax	-1.7	11.6	0.7
33 wool and worsted yarns	-0.3	13.9	0.8
34. Textile furnishing	-0.1	11.7	0.4
35 Textile floor coverings	0.3	28.6	1.4
36. Textile products, n.e.c	0.2	19.6	0.9
37 Knitting mills	-0.4	8.0	0.4
38. Clothing	-0.3	7.2	0.2

ORANI number	Simulation 1 l = 0	Simulation 2 $f_1 = 0$	Share of rail & road costs in total cost
39. Footwear	-1 3	12.0	5 8
40 Sawmill products	0 6	27 8	0 9
41 Plywood veneers	0 7	27 2	14 3
42. Joinery and wood products	0.9	28 7	1 3
43 Furniture, matresses	0 5	29 9	2.2
44. Pulp paper	-0.1	17 5	4.3
45. Fibreboard	0 2	15 8	3 5
46. Paper products n.e.c.	0 1	16.1	7.4
47. Newspapers and books	0 1	18 3	0 6
48 Commercial printing	0 2	18.4	1.3
50 Industrial chemicals	-0 02	19.0	1 0
52. Pharmaceuticals	-0 2	23.5	1 0
53 Soap and detergents	0 1	12.8	2.6
54. Costmetics toiletry	-0 03	11.3	3 0
55 Chemical products, n e c	0.6	20.5	1 1
56. Oil and coal products	0.5	18 5	0.4
57 Glass	0.2	19.9	7.3
58. Clay products	0 7	32 6	1 8
62. Non-metallic mineral products	1 2	30.1	7 2
65 Structural metal	1 7	22.4	2.9
66. Sheet metal products	0.8	20.3	1.6
67. Metal products, n.e.c	0.7	22.8	1 1
68 Motor vehicles, parts	-0.2	22.3	0.6
71. Aircraft building	0.2	21.3	0.6
72 Scientific equipment	0.2	1.78	0.2
73 Electronic equipment	0 3	26.2	0 5
74. Household appliances	0 4	29.0	1.0
75 Electrical machinery	1 2	23.1	1.0
77 Construction equipment	2 7	22.1	1 2
78. Other machinery	1 8	19.5	0 5
79 Leather products	-0.7	10 6	6.4
80. Rubber products	0.5	21 3	0.8
81 Plastic products	0.1	18.9	0.7
82 Signs, writing equipment	0.1	18.9	17 6
83. Other manufacturing	-0 2	17.3	0 6
96 Air transport	-0 1	25 8	0 7
Selected industries supplying investment goods			
76 Agricultural machinery		10.9	3.7
60 Ready-mixed concrete	1 7	27 0	4.9
61. Concrete products	1 7	27.0	24.1
88. Buildings, n.e.c.	2.2	21.0	1.9

ORANI number	Simulation 1 $l = 0$	Simulation 2 $f_1 = 0$	Share of rail & road costs in total cost
Non-trading industries			
7. Other farming non-traded	-0.2	12.3	1.6
10 Forestry	1.9	25.7	2.7
15. Crude oil	0.5	18.0	0.7
17 Services to mining	1.1	24.1	0.3
19 Milk product	-0.0	2.0	3.1
20. Fruit and vegetable products	0.1	9.5	3.6
22 Flour and cereal products	-0.1	4.6	3.8
23. Bread, cakes	0.1	4.1	1.8
26. Soft drinks, cordials	0.2	11.8	2.2
27 Beer and malt	0.01	15.5	1.6
51. Paints, varnishes	0.7	26.9	1.0
59. Cement	1.6	27.0	5.5
60. Ready-mixed concrete	1.7	27.0	4.9
61 Concrete products	1.7	27.0	24.1
84. Electricity	0.5	22.2	1.2
85 Gas	0.3	22.1	9.9
86 Water, sewerage	0.5	28.3	0.3
87. Residential building	0.8	37.9	0.3
88. Buildings n.e.c	2.2	21.0	1.9
89. Wholesale trade	0.4	17.6	2.7
90. Retail trade	0.2	16.1	0.3
91 Motor vehicle repairs	0.2	21.9	1.3
92. Other repairs	0.4	23.4	1.5
97 Communication	0.2	23.7	0.5
98 Banking	0.3	27.0	0.1
99. Finance and life insurance	0.5	27.3	0.2
100 Other insurance	0.3	22.2	0.9
101 Investment real estate	0.4	26.6	0.04
102 Other business services	0.5	21.9	0.04
103 Ownership of dwellings	0.8	37.9	0.01
104 Public administration	0.2	22.8	0.4
105 Defence	0.2	22.5	0.6
106 Health	-0.1	26.8	0.2
107 Education, libraries	0.2	23.4	0.4
108 Welfare services	0.04	24.6	0.8
109 Entertainment	0.2	26.2	0.4
110 Restaurants, hotels	0.0	24.9	0.7
111 Personal services	-0.0	29.5	1.1
112. Business expenses	0.2	22.8	0.0

5. CONCLUSIONS

In this paper a general equilibrium model has been used to assess the implications of road haulage deregulation for the Australian economy. The following conclusions are drawn.

Firstly the gains and losses precipitated by deregulation are not evenly distributed amongst users of road and rail transport services. Table 5 gives this distribution of benefits and losses.

Secondly it is clear from column (4) of table 6 that the share of road and rail transport in the industry's total cost while important is not the major factor in determining which industry gains and which one loses from road haulage deregulation. For example industry 61 (Concrete products) is ranked number 6 among the gainers while road and rail transport costs form 24.09% of total cost in this industry which is the highest share of total costs over all the 112 industries in the model. Similarly industry 32 (Cotton, Silk, Yarn) which is ranked number 112 and is the worst adversely affected industry by road haulage deregulation with an endogenous real wage has 0.72% as the share of road and rail transport in total costs, while services to mining (Industry number 17) is ranked third among gainers with a share of road and rail transport in total costs of 0.29% only.

Thirdly the value of the analysis in this paper lies not so much in the detailed numerical projections as in indicating the nature of the adjustment problems associated with road haulage deregulation. In particular we hope that our indication of relative vulnerability of different industries will prove helpful in policy discussions.

Finally, it must be noted that transport deregulation is simulated in this paper in such a way as to avoid the issue of inter-modal (road versus rail) substitution in the movement of goods.

While the literature indicates the extent of inter-modal substitution at an aggregate level (see Fitzpatrick and Taplin (1982) and Bureau of Transport Economics (1979)) Dixon et al (1982) models the transport sector in such a way that for the jth industry the various transport modes are used in fixed proportions with zero possibility for inter-modal substitution.

The specification of the demand for transport margins in this model is (See Dixon et al (1982, pp 106-108)).

$$x_{(r1)}^{(is)jk} = x_{(is)j}^{(k)} + a_{(r1)}^{(is)jk} \quad (5a)$$

i = 1,2, . . g
r1 = (road, rail, water, air)
s = (domestic imported)
k = (current production, capital formation)

$$x_{(r1)}^{(i1)k^*} = x_{(is)}^{(k^*)} + a_{(r1)}^{(is)k^*} \quad (5b)$$

k^* = (households government)
r,s i as above

$$x_{(r1)}^{(is)Export} = x_{(i1)}^{(Export)} + a_{(r1)}^{(i1)Export} \quad (5c)$$

where $x_{(r1)}^{(is)jk}$ in equation (5a) is the percentage change in the demand for transport margin (r1) required to move good i from source s to industry j for purpose k $x_{(is)j}^{(k)}$ is the percentage change in the ith intermediate input from source s to industry j for purpose k.

Equation (5b) describes the demand for transport margin flows associated with the delivery of commodities to households and governments, while (5c) describes the transport margin flows associated with the delivery of commodities from Australian producers to Australian ports prior to export.

Equations (5a) - (5c) do not allow for substitution between various modes of transport. The different modes of transport are used by each of the different users in fixed proportions, a Leontiev type assumption. In order to discuss road versus rail substitution possibilities and their implication in a general equilibrium framework the above equations have to be modified so that non-Leontiev intermodal substitution possibilities can be incorporated into the model. This generalisation of the model is essential before a meaningful general equilibrium analyses of road-transport deregulation can be done.

The strategy to be adopted in this generalisation is very similar to that used by Truong (1986). That is replace (5a) - (5c) by the following equations:

$$x^{(is)jk)}_{(r1)} = x^{(k)}_{(is)j} + \sum_{m} \eta^{(j)}_{(r1)(m1)} \, p^{(o)}_{(mi)} \qquad \text{(5d)}$$

$$k = 1,2$$

$$x^{(is)k^{*}}_{(r1)} = x^{(k^{*})}_{is} + \sum_{m} \eta^{(j)}_{(r1)(m1)} p^{(o)}_{(m1)} \qquad \ldots \text{(5e)}$$

$$k^{*} = 3,5$$

$$x^{(i1)4}_{(r1)} = x^{(4)}_{i1} + \sum_{m} \eta^{(j)}_{(r1)(m1)} p^{(o)}_{(m1)} \qquad \ldots \text{(5f)}$$

where

$\eta^{(j)}_{(r1)(m1)}$ is the demand price elasticity of transport mode r1 with respect to changes in the price of services of transport mode m1 in industry j

$p^{o}_{(m1)}$ is the basic price of transport services of mode (m1) where m1 = (road, rail, air, sea).

Essentially (5d) - (5f) would generalise the demand for margins equations in Dixon et al (1982) so that demand for the services of transport mode m_1 depends on the prices (and price elasticities) of the various modes of transport

To arrive at a computable version of Dixon et.al (1982) with the generalisation in (5d) - (5f) would be an interesting and non-trivial research task which would greatly enrich our discussion of the general equilibrium implications of policy initiatives which change the relative attractives of various transport modes

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