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MEASURING THE ECONOMIC IMPACTS OF RAILWAY CONSTRUCTION EXPENDITURE - THE ALICE SPRINGS TO DARWIN LINE

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ABSTRACT: *The construction of a railway line involves the Government in a large investment undertaking. The injection of the investment into the economy through which the line passes could be expected to have significant impacts on economic variables such as output and employment within the region. This paper uses input-output analysis to measure the economic impacts of the construction phase of the proposed Alice Springs to Darwin railway line. The impacts are measured for both the Northern Territory economy and for Australia as a whole over a six year construction period. Various assumptions are made about the expenditure profile of the project and about the construction schedule, drawing on information supplied on the expenditure on the Tarcoola to Alice Springs track.*

For the Northern Territory, the results indicate an output boost of an order of magnitude of from 1.4 to 1.8 times the expenditure injection and a transient employment boost of from 1,000 to 2,000 jobs. For Australia as a whole, the output multipliers are somewhat higher at from 1.6 to 2.0 but the employment effects are less significant at 1,500 jobs at most.

INTRODUCTION

The construction of a major railway line involves a large investment undertaking (usually by Governments). The preliminary budget for the Alice Springs to Darwin line is $400m, in prices of 1979-80, to be spent over approximately six years. Such construction investment would be expected to generate considerable economic impacts per se, notwithstanding the effects of the railway's actual operation. The aim of this paper is to model the economic impacts of the construction phase of the Alice Springs-Darwin railway line, both on the economy of the Northern Territory and also on the rest of Australia.

There are a number of ways such impacts could be modelled. Assuming for the moment that the structure of the expenditure budget is known, the immediate impacts could be assessed by looking at which industries are recipients of the expenditure, where they are, and at how much each receives. A more comprehensive approach might encompass measuring the reactions of impacted industries and the effects such reactions have on other industries, on the labour market etc.. A more complete approach still would be to use a comprehensive econometric model which encompassed all of the interactions between industries, between industries and households, and vice versa.

This study adopts the latter approach and opts for use of the input-output model. The input-output model is chosen for two reasons. Firstly, a practical consideration, there being a readily available input-output model for the Northern Territory (West, Wilkinson and Jensen 1980 revised by Mules and Morison 1981) and for Australia (Australian Bureau of Statistics 1980). Both models are comparable in terms of valuation conventions, sector classification and year of estimation. Secondly, the input-output model, when closed with respect to households, provides information on output and household income (in the form of wages and salaries) which reflects not only reactions of industries but reactions of households as suppliers of labour.

If the assumption is further made that employment in an industry is proportional to output, then the effects on employment may also be estimated using the model. Furthermore, the model allows the disaggregation of effects into the different sectors or industries that are affected, thus providing useful information to policy makers.

It should be noted that time and space limitations prohibit this paper from explaining the nature of the input-output model to the uninitiated. Interested persons are referred to O'Connor and Henry (1975) for an introductory treatment and to Chapter 2 of Jensen, Mandeville and Karunaratne (1977) for a good summary.

The point should also be made here that the economic impacts of railway construction expenditure do not represent a measure of the net economic benefit of the railway line. They may be regarded as a short term transitory benefit of the construction of the line, and as such may form part of a larger cost-benefit study. This paper does not attempt such a study and is not concerned with a listing of all the costs and benefits. Its far more restricted aim is to provide a measure of the impacts of the construction phase only, no attention being paid to the actual operating of the line once it is constructed.

The next section of this paper discusses the nature of the data used in this study and the way in which it was used. The third section presents the results in terms of output, income (wages and salaries), both in dollar values, and employment generated in both the Northern Territory economy and in the rest of Australia. The paper closes with some reflections on the limitations of the method and qualifications to the results.

DATA AND METHODOLOGY

In order to measure the economic impacts of railway construction expenditure, the input-output model requires a detailed breakdown of the expenditure according to which goods and services are used and which industries or sectors produce them. In a spatial context, it also requires a knowledge of what inputs into the construction will be supplied by firms in the Northern Territory and what will be supplied by the rest of Australia. At the time of writing, no detailed expenditure budget for the Alice Springs-Darwin line had been prepared.

However, planning engineers at Australian National Railways (ANR) were able to provide comprehensive information on the capital cost of the recently completed Tarcoola-Alice Springs track. The cost information was spread over eight years and over ten different cost items such as sleepers, rails, tracklaying, etc.. The assumption was made that the cost structure for this project would be broadly similar to that for the Alice Springs-Darwin line. With the assistance of the ANR planning engineers, the eight year cost structure of the Tarcoola-Alice Springs line was converted to a six year cost structure, six years being the planned construction period for the Alice Springs-Darwin track. For each year, each item of cost was shown as a proportion of the total expenditure for that year, the annual expenditure figures having been estimated by the engineers.

The cost proportions were then multiplied by the estimated annual expenditure to obtain a six year, ten item expenditure budget for the construction. This budget is based on the presumption that the project will proceed in a linear fashion from Alice Springs north to Darwin and is shown in Table 1. An alternative which is of interest to the Northern Territory Government is a twin ended construction, beginning simultaneously at both Alice Springs and Darwin and proceeding inwards. This possibility is termed the "Quadratic Scenario" and an estimated expenditure budget for it is shown in Table 2. The main difference between the linear and quadratic scenarios is that under the latter, most of the bridgework and a large part of the earthworks occurs relatively early in the project because of the relative predominance of waterways in the Alice Springs and Darwin regions.

It should be noted that the figures in Tables 1 and 2 are all in 1979-80 prices. It will be noted that they total $390m rather than the $400m budget because of $10m being allowed for tidying up operations after completion of the tracklaying and construction.

Considering the approach to modelling the effect of this expenditure on the Northern Territory, it is clearly not appropriate to treat each year's expenditure as demand for the output of the Northern Territory's Building and Construction sector. The inputs into railway construction are quite different from the inputs into general construction. It was decided to handle this problem by inserting a completely new industry, called "Railway Construction" into the Northern Territory input-output tables. The row for this industry contained all zeroes except for final demand which showed the total expenditure on the construction for each year.

The input column for Railway Construction showed the local (N.T.) content of each of the ten items of cost used by ANR. In other words, the ten cost items were allocated across 16 input-output sectors plus a component for wages and salaries (household income). This was done as follows. Let e be a 10x1 vector of budgeted expenditure on each of the ten cost items in any given year t. Define a "distribution matrix" D of order 17x10 where the j'th column of D shows the proportions of the j'th expenditure item attributable to each of the sixteen endogenous input-output sectors in the N.T. input-output model, plus a component for household income. The product De_t shows the input column for Railway Construction in transactions form. If e_t is defined in proportions, i.e. a 10x1 vector of the proportion of each item of expenditure in the total for year t, then De_t will be the input column for Railway Construction in coefficient form.

Table 1

Estimated Expenditure Budget for Alice Springs to Darwin Railway - Linear Construction ($m)

Cost Item		Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Total
1	Survey and Engineering	3.44	1.52	1.54	1.26	1.17	0.80	9.73
2	Earthworks	3.20	9.20	9.40	10.24	10.30	7.00	49.34
3	Bridges, Culverts	0.80	8.24	10.50	17.00	19.50	8.60	64.64
4	Ballast	1.06	3.04	9.17	9.90	3.51	2.80	29.48
5	Sleepers	0.68	4.68	9.38	14.85	16.74	10.80	57.13
6	Rails, Fastenings	7.64	12.48	16.73	18.09	16.29	13.12	84.35
7	Tracklaying	2.40	3.68	6.72	9.00	12.51	12.64	46.95
8	Buildings, services	0.54	0.84	1.40	1.71	4.14	18.24	26.87
9	Communications	0.02	0.04	0.07	3.24	8.37	3.12	14.86
10	Miscellaneous	0.30	1.16	1.05	0.99	0.99	2.16	6.65
TOTAL		20.08	44.88	65.96	86.28	93.52	79.28	390.00

Table 2

Estimated Expenditure Budget for Alice Springs to Darwin Railway - Quadratic Construction ($m)

Cost Item		Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Total
1	Survey and Engineering	3.44	1.52	1.54	1.26	1.17	0.80	9.73
2	Earthworks	9.66	10.17	9.63	8.40	8.24	3.24	49.34
3	Bridges, Culverts	14.28	20.79	16.65	8.08	4.16	0.68	64.64
4	Ballast	3.04	9.17	9.90	3.51	2.80	1.06	29.48
5	Sleepers	4.68	9.38	14.85	16.74	10.80	0.68	57.13
6	Rails, Fastenings	12.48	16.73	18.09	16.29	13.12	7.64	84.35
7	Tracklaying	3.68	6.72	9.00	12.51	12.64	2.40	46.95
8	Buildings, services	4.14	18.24	1.71	1.40	0.84	0.54	26.87
9	Communications	3.24	8.37	3.12	0.07	0.04	0.02	14.86
10	Miscellaneous	1.16	1.05	0.99	0.99	0.30	2.16	6.65
TOTAL		59.80	102.14	85.48	69.25	54.11	19.22	390.00

The effect on each Northern Territory sector of the construction expenditure in year t is then found by calculating the multiplier effects of the final demand expenditure on Railway Construction for year t. Note that since these figures were initially in 1979-80 prices they had to be first deflated to 1976-77 prices, 1976-77 being the year of estimation of the N.T. input-output tables. The index used to deflate the expenditure was the implicit price deflator for Non-Dwelling Construction Expenditure as published by ABS in the Quarterly Estimates of National Income and expenditure.

Note also that this methodological approach avoids the problem of having to specifically calculate the import content of the construction expenditure. This is treated as a residual in the distribution matrix D. The elements of each column of D apportion the particular cost item to Northern Territory sectors only. Thus only the effects on Northern Territory sectors are included in the multiplier for Railway Construction.

The distribution matrix used for the above exercise is shown in Table 3 below. In the absence of any factual information on the detailed composition of each item of cost, some educated guesswork was necessary in order to derive the elements of the distribution matrix. There follows an item by item run down of the elements and how they were derived.

First, items 2 Earthworks, 3 Bridges and Culverts, 7 Tracklaying, 8 Buildings and Services, and 9 Communications were all considered to be reasonably typical of building and construction activity generally and so the input column proportions for the N.T. Building and Construction sector were used for these items. In a few cases these proportions were altered to accord with information supplied by ANR on the Tarcoola-Alice Springs line. These cases were as follows:

(i) For items 2, 3 and 7, the household income proportion (H-H) was reduced from .3210 to .3076 using information on item 7 Tracklaying for the Tarcoola-Alice Springs line. Tracklaying is an activity carried out by a work gang which lives, and is fed, on the job. Items 2 Earthworks and 3 Bridges and Culverts are carried out on a similar basis, although by private contractors rather than by ANR.

(ii) The input-output tables show the Building and Construction sector as having zero purchases from the Food Manufacturing sector. However, in a work gang situation where workers are fed on the job, there are non-zero purchases from Food Manufacturing. Information supplied on the amount of these purchases for item 7 Tracklaying for the Tarcoola-Alice Springs line enabled the proportion of 0.0059 to be calculated for this entry. The proportion was also used for the other "work gang type" items 2 and 3.

Table 3

The Distribution Matrix

I/O Sector*	Cost Item									
	1	2	3	4	5	6	7	8	9	10
1	0	0	0	0	0	0	0	0	0	0
2A	0	0	0	0	0	0	0	0	0	0
2B	0	0	0	0	0	0	0	0	0	0
3	0	0	.0036	.9	0	0	0	.0036	.0036	0
4A	0	.0059	.0059	0	0	0	.0059	0	0	0
4B	0	.0073	.0073	0	0	0	0	.0073	.0073	0
4C	.0005	.0005	.0005	0	0	0	.0005	.0005	.0005	0
4DE	.01	.1125	.1125	0	0	0	.1125	.1125	.1125	.01
4F	0	.0004	.0004	0	0	0	.0004	.0004	.0004	0
5	0	0	0	0	0	0	0	.0032	.0032	0
6	0	0	0	0	0	0	0	0	0	0
7	.01	.0576	.0576	0	0	0	.0576	.0576	.0576	.01
8	.01	.0112	.0112	.1	.1	.1	.0112	.0112	.0112	.01
9	0	.0045	.0045	0	0	0	.0045	.0045	.0045	0
10	0	0	0	0	0	0	0	0	0	0
11	0	.0001	.0001	0	0	0	.0001	.0001	.0001	0
H-H	.1	.3076	.0376	0	0	0	.3076	.3210	.3210	.1

* The I/O sector classification is shown in Appendix A.

(iii) For item 7 Tracklaying, there were three items of input into the Building and Construction sector which seemed to be inappropriate. They are .0036 for purchases from sector 3 Mining, .0073 for purchases from 4B Wood and Paper Products, and .0032 for purchases from 5 Electricity, Water and Gas.

The Building and Construction purchases from sector 3 Mining are presumed to be mainly quarry materials and since, for Railway Construction, this is covered by item 4 Ballast, it was decided to set this input at zero, for Tracklaying at least. Since none of the sleepers are likely to be made of wood, and in any case, sleepers are a separate item (item 5), it was decided that it was most unlikely that Tracklaying would require any inputs from the Wood and Paper Products Manufacturing sector of the Northern Territory. On the other hand, Earthworks, Bridges and Culverts are likely to require wooden products for shoring up, boxing etc.

For Electricity, Gas and Water, it was considered that the work gangs are likely to generate their own electricity, to use water from bores sunk for the purpose, and to be self-sufficient in terms of any gas inputs. Therefore all work gang expenditure (items 2, 3 and 8) on sector 5 Electricity, Gas and Water were set at zero.

Note that it may be considered unusual to treat items 8 Buildings and Services, and 9 Communications as items of Building and Construction activity. However, these items refer to the construction and installation of such things as station buildings, signalling equipment, communication systems etc. and not the use of such things.

Referring to Table 3 again, the elements in columns 1, 4, 5, 6 and 10 were all arrived at somewhat arbitrarily. For column 1 Survey and Engineering, it was learned from the officers of ANR that the most likely Northern Territory input into this item would be sinking of bores by local contractors. Most of this payment would become household income to the contractor (usually a local farmer or similar), with some inputs possibly coming from 4C Machinery and Appliances, 4DE Metals, Metal Products, 7 Trade and 8 Transport. The proportions allocated to these items in Table 3 are arbitrary.

Item 4 Ballast is expected to come mainly from local quarries which will be established for the purpose along the route. Accordingly, it is mainly a demand on sector 3 Mining. Some local transport from the quarry face to the rail head will be necessary and this is represented as a demand from the local sector 8 Transport. Again the proportions are arbitrary. For item 5 Sleepers, it was learned that sleepers would be mainly concrete, and for the Tarcoola-Alice Springs line, these were made in South Australia at a town approximately 320 km north of Adelaide. On the assumption that these concrete plants in South Australia will supply sleepers for the line to Darwin, no allocation is shown in Table 3 for a demand for sleepers from sector 4DE in the Northern Territory.

However, a possibility to be considered is that sleeper manufacturing plants would be established at Alice Springs and Darwin. This raised the possibility of modelling a low versus a high involvement of N.T. industry in supplying inputs to the project. The same consideration applies to item 6 Rails and Fastenings, part of which includes trackwelding and which for Alice Springs-Tarcoola was done at Port Augusta in South Australia. Thus it was decided that for each of the linear and quadratic construction scenario, there would be a low and a high N.T. content scenario, making four scenarios in all.

The low N.T. content scenario assumed that all sleeper manufacturing and trackwelding would be done outside of the N.T. and the distribution matrix accordingly shows only a small arbitrary allocation for local transportation under items 5 and 6. The high N.T. content scenario assumes that all sleepers are manufactured in N.T., resulting in the balance of this cost item (after transport) being allocated to sector 4DE. It also assumes that trackwelding will be done in N.T. and based on information from Tarcoola-Alice Springs, the proportion of item 6 allocated for this purpose was 0.4.

Finally, there was no available information on the components of item 10 Miscellaneous and so a wholly arbitrary allocation was made to each of Metals etc., Trade, and Transport.

Many of the cost items in Table 3 above involve substantial payments to household income which in turn results in induced consumption changes in proportion to the consumption propensities shown in the Households column of the Northern Territory input-output matrix. However, it is unreasonable to suppose that the workers on work gangs doing tracklaying etc. will have the same consumption propensities as the Northern Territory average. Many workers could be expected to be imported from elsewhere and are not likely to purchase consumer durables, housing etc. in the Northern Territory. On the other hand, those workers who are "local" could be expected to have the same average consumption propensities as the Northern Territory average.

It was decided to tackle this problem by arbitrarily assuming that 50% of the household income generated in work gangs went to local labour and 50% went to imported labour. The 50% going to local labour would be retained as the wage and salary input in the Railway Construction column and would result in induced consumption expenditure in line with the Northern Territory average propensities. It was decided to further assume that the 50% going to imported labour would be spent within N.T. on recurrent items as follows:

4A	Food Manufacturing	0.0094
7	Trade	0.1489
8	Transport	0.0122
11	Community Services, Entertainment	0.0715
	Total	0.2420

where the proportions were obtained from the Household column of the input-output matrix. It is assumed that the remainder of the income going to imported labour (0.758) would be spent outside of the Northern Territory. The local consumption expenditure by imported labour on the above four items can be thought of as extra final demand for those items and will have multiplier effects accordingly. These effects were added on to the multiplier effects of the railway construction itself.

To summarise the above discussion, the methodology for measuring the impact of the railway construction expenditure on the Northern Territory economy amounted to inserting a new industry "Railway Construction" into the revised N.T. 16 sector input-output table (Mules and Morison 1981). The input column for Railway Construction was obtained from an estimated expenditure budget for the project. This procedure was carried out for each of the six years of the project, for both the linear and quadratic construction scenarios, and for both low and high involvement of N.T. industry. The effects on the Northern Territory economy were calculated using the multipliers for the inserted Railway Construction sector under each of the above scenarios.

To measure the impacts on the rest of Australia, the Australian national input-output table of 1974-75 was used (ABS 1980). This table is available at a 19 sector level of aggregation which corresponds closely with the N.T. table's 16-sector classification system. The national sector classification is shown in Appendix B. The following national sectors were readily identified as being recipients of expenditure from the railway construction project:

4D Metals, Metal Products

4E Non-Metallic Mineral Products, and

9 Finance.

Sector 4D Metals, Metal Products is where rails and rail fastenings are manufactured; 4E Non-Metallic Mineral Products contains the manufacture of concrete sleepers and 9 Finance contains technical services involved in aerial and other route surveying (expenditure item 1). The last item was not affected by high or low N.T. content considerations but for the first two sectors a different allocation to national industries was made under each of these scenarios. The expenditure allocations to each of these sectors was deflated to

1974-75 prices using the same implicit price deflator as was used for deflating the N.T. allocated expenditure and was then treated as new final demand for each of these sectors' output. The impacts of the expenditure on the rest of Australia were then measured in the normal way using the national input-output table.

In addition to the effects of the above allocated expenditure, account was also taken of the consumption expenditure by imported work gang labour. As noted above, some 75.8 per cent of the estimate of such income was deemed to have been spent outside of the Northern Territory. It was assumed that this income was allocated over consumption items in accordance with the consumption vector in the Australian input-output matrix. The effects of this consumption expenditure were added on to the effects of the expenditure on rails and sleepers etc. to get estimates of the total effects on the Australian economy under each of the four scenarios.

The proportion of total expenditure allocated to either N.T. or Australian input-output sectors is 72.1 per cent. The details of this allocation under the two different content scenarios is shown in Table 4 below. The remaining 27.9 per cent was thought to be expenditure on non-Northern Territory production, the detailed nature of which was too uncertain to permit even an arbitrary allocation to Australian input-output sectors. Thus it is felt that the results estimated for the rest of Australia are a considerable underestimate.

Table 4

Proportion of Total Railway Construction

	Low N.T. Content	High N.T. Content
	%	%
Allocated to N.T.	31.9	53.7
Allocated to Rest of Australia	40.2	18.4
Total	72.1	72.1

THE RESULTS

The input-output model provides estimates for each year and for each scenario of the output generated in each sector of the economy as a result of the construction expenditure allocated to that economy. By assuming that wage and salary income, and employment in each sector is strictly proportional to output in that sector, estimates can also be made of the income and employment generated by the construction expenditure.

The total effects for each of the six years, on output, income and employment are shown in Tables 5, 6 and 7 respectively. The effects shown in these tables are the "flow-on" effects on N.T. industries and do not include the construction expenditure itself. The output and income figures have been reflated to 1980-81 prices using various price indices published by ABS. The time patterns of effects reflect partly the timing of the construction expenditure and partly its composition. For example, the peak output year for the linear-low combination is year 4 but for the linear-high scenario the peak is year 5. The high content peak coincides with the peak in total expenditure under the linear scenario and is strongly influenced by the peak in expenditure on sleepers in year 5. On the other hand, under the low content scenario, the role of ballast expenditure dominates and its peak is year 4.

It is possible to calculate an implicit multiplier for the output effects by relating the total output generated to the construction expenditure. Both figures must be in prices of the same year and, to be comparable with other output multipliers the construction expenditure (the initial impact) should be included with the total effects. The average over the six years of such multipliers was 1.4 for the low scenario and 1.8 for the high scenario. The latter figure is towards the upper end of the range of N.T. input-output multipliers whereas the former average is about in the middle of the range.

Considering the income and employment effects in Tables 6 and 7, it is worth noting that although the effects may not be considered large absolutely, relative to the size of the N.T. economy they represent a considerable injection of economic activity. For example an employment boost of between 1,000 and 2,000 jobs is a considerable change to a work force of around 50,000. It should be noted that these employment effects relate only to flow-on effects on N.T. industries and do not include the direct employment in work gangs involved in the various facets of the construction project itself.

The industrial composition of the income and employment effects is also of some interest. In every year and for every scenario, sector 7 Trade is the sector which shows the greatest income and employment effects. The Trade sector provides the wholesaling and retailing service on the various inputs used in the construction. In addition, the extra household consumption expenditure that is induced by increased household income results in a further boost in demand for wholesaling and retailing services. Reinforcing those effects is the fact that the Trade sector is relatively labour intensive and significantly expands its employment, and therefore its wage payments, in response to increases in its output.

Table 5

Total Effects on N.T. Output of Railway Construction $'000

Year	Linear Scenario		Quadratic Scenario	
	Low N.T. Content	High N.T. Content	Low N.T. Content	High N.T. Content
1	7 554	14 577	23 844	46 563
2	20 352	37 971	59 005	88 083
3	34 646	63 628	44 123	83 806
4	44 622	84 399	28 325	69 858
5	43 522	85 203	22 956	51 755
6	39 636	68 317	7 368	14 416

Table 6

Total Effects on N.T. Income of Railway Construction $'000

Year	Linear Scenario		Quadratic Scenario	
	Low N.T. Content	High N.T. Content	Low N.T. Content	High N.T. Content
1	2 254	3 242	8 485	11 015
2	5 786	8 263	16 594	20 873
3	8 615	12 800	11 503	17 229
4	11 630	17 414	8 246	14 430
5	13 226	19 270	6 671	10 870
6	12 117	16 497	2 201	3 218

Table 7

Total Effects on N.T. Employment of Railway Construction
Number of Jobs

Year	Linear Scenario		Quadratic Scenario	
	Low N.T. Content	High N.T. Content	Low N.T. Content	High N.T. Content
1	248	321	700	846
2	466	612	1 404	1 736
3	671	887	886	1 236
4	897	1 249	708	1 046
5	1 091	1 549	557	823
6	1 051	1 352	166	245

Other sectors to experience major effects in all scenarios are 3 Mining (due to ballast), 4DE Metals and Non-Metal Mineral Products, 8 Transport, 9 Finance and 11 Community Services. The effects on 3, 4DE and 8 are all mainly direct effects of supplying inputs to the construction project. The effects on 9 and 11, on the other hand, come about indirectly as a result of induced consumption expenditure and, in the case of sector 9 Finance, in order to service the increased demand for wholesaling and retailing. Naturally enough, the effects on sector 4DE are far greater under the high content scenario when sleeper manufacturing and track welding is carried out in this sector in the Northern Territory.

Turning now to the effects on the rest of Australia, Tables 8, 9 and 10 show the effects on national output, income and employment respectively. The output and income figures are in 1980-81 prices. The effects on the rest of Australia would seem to be as great as, if not greater than, the effects on the Northern Territory. This is notwithstanding the fact that under the high N.T. content scenario only 18.4 per cent of construction expenditure is allocated to the rest of Australia. The main reason for the national effects being relatively large is that the implicit national output multipliers for construction expenditure are larger than the N.T. implicit multipliers. The six year average national multiplier is 2.0 for the low N.T. content case and 1.6 for the high N.T. content case. National multipliers would be expected to be larger than N.T. multipliers because the greater manufacturing base of the national economy leads to more interdependency between sectors than is the case in the N.T. economy.[1]

The time-spread of national effects is very similar to that of the N.T. effects. The linear peaks tend to occur in years 4 or 5 while the quadratic peaks occur in year 3. In neither situation does the employment peak rise significantly above 1,500 jobs which suggests that the construction activity will not have a significant effect on national employment.

Under the low N.T. content scenario, the national sector 4D Metals, Metal Products receives a large boost, mainly due to the demands made on it for rails and fastenings.[2] Related to this is the expansion in the mining sector 3B which incorporates the iron ore requirements for rail manufacturing. Other sectors to experience gains in the low content scenario are 4E Non-Metallic Mineral Products (sleepers), 9 Finance

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1. The N.T. economy is based mainly on the export of primary products such as beef, fish, minerals, and on tourism and Government activities such as defence.

2. The details of sectoral effects are not shown in this paper in the interests of brevity. They are, however, available on request from the author.

Table 8

Total Output Effects on the Rest of Australia of N.T. Railway Construction $'000

Year	Linear Scenario		Quadratic Scenario	
	Low N.T. Content	High N.T. Content	Low N.T. Content	High N.T. Content
1	22 685	13 904	47 743	26 831
2	44 217	23 156	67 746	33 925
3	64 135	30 131	80 144	34 822
4	80 265	34 687	77 433	30 351
5	81 752	34 376	58 035	25 107
6	58 825	25 702	20 731	11 998

Table 9

Total Income Effects on the Rest of Australia of N.T. Railway Construction $'000

Year	Linear Scenario		Quadratic Scenario	
	Low N.T. Content	High N.T. Content	Low N.T. Content	High N.T. Content
1	5 669	3 509	12 456	6 992
2	11 465	5 999	17 867	8 855
3	16 796	7 785	21 321	9 025
4	21 365	9 068	20 733	7 833
5	22 014	9 114	15 436	6 501
6	15 679	6 745	5 164	3 004

Table 10

Total Employment Effects on the Rest of Australia of N.T. Railway Construction Number of Jobs

Year	Linear Scenario		Quadratic Scenario	
	Low N.T. Content	High N.T. Content	Low N.T. Content	High N.T. Content
1	393	250	890	520
2	808	438	1 273	658
3	1 181	566	1 509	664
4	1 514	669	1 463	573
5	1 573	684	1 092	478
6	1 114	500	354	211

(survey services), 7 Trade and 8 Transport. Much of the expansion of the last three of these sectors comes about indirectly as a demand for the services which must be provided along with the "hard" inputs into railway construction. Some is also due to induced household consumption expenditure.

National sector 4D Metals, Metal Products also receives the greatest boost under the high N.T. content scenario, although its expansion is less pronounced due to the shifting of trackwelding onto the N.T. economy under this scenario. In terms of output, sector 9 Finance is the next most important sector in this scenario, but in terms of income and employment, sector 7 Trade is the next most important. This apparent anomaly is due to the relatively higher labour intensity of the latter sector.

The prevalence of relatively large impacts on sector 7 Trade is worthy of some attention. This sector received significant impacts in all scenarios that were modelled, in both the Northern Territory and the rest of Australia. It is not a direct supplier of inputs into railway construction but its function in providing the wholesaling/retailing service is obviously quite pervasive. Not only does it supply this service on the tangible direct inputs, but it also supplies the service on inputs into linked industries and on induced household consumption. If a less comprehensive model than the input-output model had been used for this study, the importance of the Trade sector might not have been detected.

REFLECTIONS, LIMITATIONS AND QUALIFICATIONS

As was stated in the introduction to this paper, this study does not attempt to measure the net economic benefit of the Alice Springs-Darwin railway line. The study measures only the economic impacts of the railway line construction and these impacts may only be regarded as a sub-set of the benefits. The fact that they are short term and transitory benefits at that highlights one of the weaknesses of the input-output model, namely an inability to provide a time frame for the impacts.

The results in the previous section have been presented as though the impacts of each year's construction expenditure were felt in the same year as the expenditure itself. This is clearly unrealistic, particularly where large amounts of expenditure occur near the end of the year. An improved state of affairs would result from a more detailed time frame of the expenditure itself, say on a quarterly basis. However, this would still not enable a time dimension to be given to the flow-on effects of the expenditure, since the conventional input-output model does not provide for any such time frame. Some work has been dome (Romanoff and Levine 1980, Mules 1981) on extending the input-output model into the time domain, but at the time of writing, this work is largely experimental and could not be incorporated into this study.

A second limitation of the input-output model in this type of study concerns the assumption of strict proportionality between output and inputs. This assumption may be quite realistic in relation to the tangible inputs into railway construction but may be more questionable when applied to the provision of services such as wholesaling and retailing. Such considerations as excess capacity and economies of scale may make it possible for service establishments to expand their output without a proportionate expansion in their inputs, in particular their labour input. To the extent that this is true, the impacts in this study, especially income and employment impacts, are over-estimated.

A third problem with the input-output approach in this study concerns the relevance of the tables used to the period of the construction project. The Australian national input-output table used was based on data for 1974-75 while the Northern Territory data referred to 1976-77. Technological change and changes in relative prices have the effect of altering input-output coefficients over time and it could well be the case that the coefficients used in this study are out of date by the start of the project, let alone by the end of construction. However, in a review of input-output analysis, the United Nations Statistical Office (1973, p. 84) concludes that "coefficient change appears to be fairly gradual" making it possible to "extend the useful life of any table". Nevertheless, the coefficients used are likely to be subject to change by the time the later years of construction come around, and it is hoped that by such time this study may be updated using revised input-output coefficients.

Fourthly, it could be argued that some double counting has occurred in this study because of the fact that Northern Territory transactions are part of the Australian national input-output table. While this is true, it was decided, for two reasons, not to take specific account of the problem here: (1) it was impractical to net out the Northern Territory transactions in order to obtain a truly "rest of Australia" input-output table; and (2) since the Northern Territory transactions are insignificant in relation to the Australian transactions, such a procedure would have made very little difference to the results for the rest of Australia.

Finally, it may be admitted that a major limitation of this study lies in the rather speculative nature of the construction expenditure data, based as it is on the expenditure for the Tarcoola-Alice Springs line. It is hoped that when more detailed and accurate expenditure budgets for the Alice Springs-Darwin line become available, they will enable a more accurate measure to be made of the economic impacts of the construction.

APPENDIX A

Northern Territory Input-Output Sector Classification

Sector Number	Sector Description
1	Animal Industries
2A	Other Agriculture, Forestry
2B	Fishing
3	Mining
4A	Food Manufacturing
4B	Wood and Paper Manufacturing
4C	Machinery, Appliances, Equipment
4DE	Metals, Metal Products, Non-metallic Mineral Products
4F	Other Manufacturing
5	Electricity, Gas and Water
6	Building and Construction
7	Trade
8	Transport and Communication
9	Finance
10	Public Administration and Defence
11	Community Service, Entertainment

APPENDIX B

Australian Input-Output Sector Classification

Sector Number	Sector Description
1	Animal Industries
2A	Other Agriculture
2B	Forestry, Fishing
3A	Coal and Crude Petroleum Mining
3B	Other Mining
4A	Food Manufacturing
4B	Wood and Paper Manufacturing
4C	Machinery, Appliances, Equipment
4D	Metals, Metal Products
4E	Non-Metallic Mineral Products
4F	Other Manufacturing
5	Electricity, Gas and Water
6	Building and Construction
7	Trade
8	Transport and Communication
9	Finance
10	Public Administration and Defence
11A	Community Services
11B	Entertainment

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