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Transport Distance and Australian Coal Marketing

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INTRODUCTION

The landed cost of coal to the international customer is a major parameter which determines market competitiveness. Rail, port and shipping charges represent 30 to 50 per cent of landed costs for Australian mines selling to Asia. This proportion is higher for sales to Europe, yet it is in Europe where Australian producers are aiming for increased market share and where they are most vulnerable (Clifford, 1988).

The objective of this study is to examine Australian export coal competitiveness in terms of transport distance. A study in commodity competitiveness can be highly complex; the approach used examines world coking coal and steam coal production and the transport distances between major exporting regions and importing countries. Reference is made to the importance of land transport costs. Models developed are examined in terms of Australia's exports and an overall conclusion is reached that a reduction in rail freight costs would be an effective measure for improving the competitiveness of Australia's coal industry.

It is understood that transport distance is not the sole determinant in what makes a coal type competitively priced. Factors such as labour, fuel, and direct mining costs vary from region to region and change progressively over time. Some aspects of transport costs such as shipping demurrage and cost reductions achieved with economies of scale will also vary. However actual shipping distance from supplier to market will not vary and so this cost factor has been taken as the fundamental parameter upon which to base this competitiveness study. Coal quality will vary from supplier to supplier, and is viewed as an independent competitiveness parameter not in the scope of this paper.

METHODOLOGY

Given the present world coal marketing position, the price that a supplier can expect to receive is based on prices set at annual negotiations between major suppliers and major market consumers around the world. The bottom line is an agreed delivered price for a particular quality of coal, no matter where that coal may originate from in the world. In this way, the actual distance to the market from a supplier will have little significance on the price as the world coal market is truly global. Of course, in the negotiations, a supplier will have an idea of profit tolerance due to shipping costs related to distance, and this is where that distance becomes a significant factor in the competitiveness of a supplier's coal. The relative location of other competitors becomes highly significant, if they can offer a coal type of similar quality, and quantity.

It is not the purpose of this study to integrate other factors of competitiveness into a complete picture, but rather to look at the factor of shipping distance alone; a factor highly relevant to Australia's geographic position. Export advantage is based on the assumption that the shorter trade route has trading preference and the prefered supplier on this basis sells all its coal ahead of the next preferred supplier. Other factors may then negate or enhance the advantages/disadvantages which come to light. A complete picture cannot be fully understood unless the separate components themselves are initially understood.

As an extension to this topic, the issue of rail freight transport charges can be examined given the following. The first assumption made is that actual rail operating charges for a particular unit distance are comparable from country to country, where coal transporting is concerned. This is born out in a study by Koerner (1990) who makes a comparison between Queensland and the United States internal railing rates, and states that there is a potential 70 per cent tax component in Queensland's coal rail charges. Figure 1 illustrates the effect of this tax. If the tax component was taken out, the figures for NSW and Queensland would be more in line with the other countries represented. Though there is no figure given for Eastern Block, or Third World countries, which have a lower cost increment, South Africa acts as a representative example of a country with lower average labour costs and freight charges in line with other countries. The second assumption is that the impact of reducing the tax component on the rail freight of coal can be seen by equating a reduction in rail freight to a corresponding increase in the internal rail distances of competitors. For example, a 50 per cent decrease in Australian rail freight, gives a similar competitive advantage to Australia as a hypothetical doubling of the internal rail distance of all its competitors.

By the use of shipping distances, it is possible to rank exporters by their distance to respective markets. This ordering will then show which suppliers are most competitive in a particular market or region. The rail plus sea distance in kilometres then becomes one approach to establishing an index of competitiveness; the lower the index, the more competitive the supplier. Doubling the internal rail transport distances of Australia's competitors will have the effect of adjusting the competitive ranking of Australia in its favour, and so can indicate if there is sufficient cause for highlighting the effects of a reduction in this form of taxation.

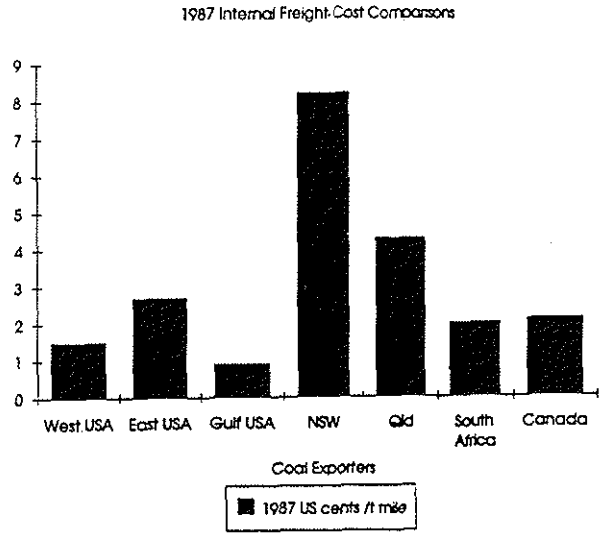

FIG 1

1. Postgraduate student in mining engineering - The University of Queensland.
2. Postgraduate student in mining engineering - The University of Queensland.
3. Senior Lecturer in mining engineering - The University of Queensland.

TABLE 1

Major seaborne coal consumer markets.

Region	Country	Representative Port	DWT Limit (tonnes)	Stockpile Capacity (tonnes)	Import Capacity (Mt/a)	Coking Imports 1989 (Mt)	Steam Imports 1989 (Mt)	Coking Imports 1995 (Mt)	Steam Imports 1995 (Mt)
Asian	Hong Kong	Hong Kong	120 000	1 000 000	12.6	-	9.9	-	15.8
	Japan	Fukuyama	300 000	1 000 000	283.9	73.4	31.6	69.5	39.6
	Philippines	Batangas	65 000	2 000 000	4.5	-	1.0	-	3.0
	South Korea	Kwangyang	250 000	1 000 000	63.6	11.7	13.4	15.6	20.9
	Taiwan	Hsinta	130 000	1 000 000	45.6	5.0	12.0	7.1	19.4
	Thailand	Bangkok	100 000	2 000 000	5.6	-	0.4	-	1.2
Indian	India	Tuticorin	30 000	-	7.0	4.3	0.1	8.7	0.3
	Pakistan	Qasim	60 000	450 000	2.8	1.1	-	2.3	-
North & West European	Belgium	Antwerp	150 000	5 000 000	55.5	6.4	6.3	6.0	8.8
	Denmark	Stignaes	180 000	2 000 000	23.3	-	10.7	-	13.2
	Finland	Helsinki	120 000	3 600 000	13.1	0.1	4.5	0.1	5.6
	France	Le Havre	260 000	2 000 000	46.8	7.8	6.3	7.1	7.7
	Germany	Hamburg	150 000	3 000 000	33.9	0.7	5.7	-	8.8
	Nederlands	Rotterdam	360 000	4 000 000	73.5	4.5	9.4	4.2	13.2
	Norway	Brevik	100 000	300 000	2.0	0.1	0.5	0.1	0.6
	Portugal	Sines	75 000	80 000	8.0	0.7	2.9	1.1	3.3
	Sweden	Lulea	200 000	1 000 000	16.9	2.7	1.0	2.3	1.2
	UK	Southampton	350 000	750 000	44.1	7.7	4.4	7.2	9.9
Mediterranean	Egypt	Alexandria	40 000	120 000	1.4	1.1	-	1.1	-
	Greece	Milaki	170 000	70 000	4.9	-	1.2	-	2.4
	Israel	Hadera	65 000	1 100 000	8.6	-	3.7	-	7.4
	Italy	Taranto	300 000	600 000	41.1	7.3	13.1	10.0	19.8
	Spain	Algeciras	200 000	1 000 000	41.6	3.8	6.8	2.7	7.7
	Turkey	Iskenderun	60 000	450 000	21.9	2.6	1.1	2.5	2.2
	Yugoslavia	Rijeka	150 000	300 000	10.8	4.3	-	4.2	-
South America	Brazil	Santos	170 000	1 000 000	25.5	9.9	0.2	15.6	1.1

A third assumption made in this study is that the closer suppliers can have selling preference over those further away purely by their distance advantage, as they are in a better position to be 'price setters' rather than 'price takers'. This is also significant on the market side where a marketer would like to be in a preferential position in times of low supply. This is relevant to Japan in particular, which has a very high demand for seaborne coal imports.

INTERNATIONAL COAL TRADE

The initial step was to identify the major seaborne coal importing and exporting markets. This information was sourced from World Coal Ports (Mannini, 1989), the ACR Coal Marketing Manual 1990 (Anon, 1990b), and Coal Information 1990 (Anon, 1990c). This information appears in Table 1, Table 2 and Table 3.

The Commonwealth of Independant States (CIS) has a port capacity lower than the tonnage exported. The difference is made up by the tonnage moved by overland transport to Western Europe. Table 2 includes average internal freight distances, indicating distance by rail to reach the port. From the source base data already mentioned for this table, weighted averages were made of the various potential rail routes of a particular supplier, in relation to the coal tonnages transported on those routes. Representative coal ports were chosen on the basis of centrality of location, and whether there was shipping distance data for that port, or one in close proximity to it. Coal exported from Venezuela has been combined with Colombia because of the comparatively much lower volume of Venezuelan coal exports, and their proximity to the main Colombian coal fields.

Tables 1 and 3 include projections of imports and exports for 1995, sourced from Coal Information 1990 (Anon, 1990c), Reform of International Coal Protection (Jolly *et al*, 1990), and Platt, (Queensland Coal Board, per comm).

An important step in the study was to determine the shipping distances between the various suppliers and consumers. There is, at times, a choice of routes a supplier could take to reach certain markets, such as via the Cape of Good Hope (Capetown), the Suez Canal, or the Panama Canal. The feasibility of each possible route was examined and an optimum route chosen in each case, on the basis of minimum shipping distance.

It is not the scope of this study to make any comparison between transport costs by different ship sizes, which could then close off certain routes, such as ships greater than 150 000 DWT through Suez, and ships greater than 60 000 DWT through Panama (Lee, 1978). The number of ports which could see major variations in supplier competitive indices by varying ship sizes is limited by the ship size limits of the port. Only 11 of the 27 importers covered in this study can actually handle ships over 150 000 DWT.

TABLE 2
Major world coal suppliers.

Major Coal Exporters	Representative Coal Port	Average Internal Freight Distance (km)	Maximum Ship Size (DWT)	Maximum Regional Export Capacity (Mt)	Total Production Mt, 1989	Total Coal Exports Mt, 1989	Percent Production Exported Mt, 1989
Queensland	Gladstone	220	230 000	81.5	190.1	58.3	52
NSW	Newcastle	100	170 000	60.5	In Above	40.4	-
Canada	Roberts Bank	1100	260 000	36.5	59.7	32.6	55
China	Chinwangtao	1300	120 000	32.5	958.8	15.2	2
Colombia	Cartagena	150	170 000	30.0	18.9	14.0	74
Indonesia	Balikpapan	100	60 000	5.0	8.7	2.6	30
Poland	Gdansk	600	170 000	17.0	178.0	28.9	16
South Africa	Richards Bay	500	170 000	48.0	178.2	46.7	26
East USA	Hampton Road	560	160 000	150.2	803.3	60.9	11
Gulf USA	New Orleans	1340	150 000	74.4	In Above	28.5	-
West USA	Long Beach	1370	100 000	13.5	In Above	2.0	-
East CIS	Vostochny	3500	110 000	12.2	576.5	9.9	7
SW CIS	Ilichevsk (Black Sea)	3800	70 000	6.9	In Above	29.9	-
NW CIS	Tallinn (Baltic Sea)	4000	20 000	6.0	In Above	-	-

TABLE 3
International suppliers of coking and steam coal.

Major Cokecoal Exporters	Total Exported Mt, 1989	Total Exports Mt, 1995	Major Steamcoal Exporters	Total Exported Mt, 1989	Total Exports Mt, 1995
NSW	17.1	21.67	NSW	23.3	36.2
Qld	38.6	48.4	Qld	19.7	30.9
Canada	28.5	28.2	Canada	4.1	4.0
China	3.5	3.0	China	11.7	20.0
Colombia	0.5	0.5	Colombia	13.5	40.0
Poland	9.8	5.3	Indonesia	2.6	25.0
Sth Africa	3.5	3.5	Poland	19.1	16.0
East USA	39.4	33.3	Sth Africa	43.2	70.0
Gulf USA	18.7	14.2	East USA	21.5	20.0
West USA	1.0	3.0	Gulf USA	9.6	11.0
East CIS	11.5	7.5	West USA	1.0	10.0
West CIS	7.1	0.7	East CIS	4.3	12.5
			West CIS	16.9	16.0

A base assumption is that any exporter capable of transport cost savings to a particular market by using a larger ship, is faced with its competitors enjoying the same advantages. This is presently not the situation for Indonesia for example, but this will change in time as it upgrades infrastructure. Secondly, with blending requirements and stockpile limitations at the receiving port, coal parcel sizes greater than 60 000 tonnes are uncommon particularly with steaming coals.

Table 4 shows the distance from each exporter to major world markets. Exporters are ranked in terms of average distance to market in Table 5. Average export distance weighted by market demand tonnage over routes to the various markets are listed in Table 6. For example, Indonesia has a rank of six in Table 5 and a rank of one in Table 6 as it is closer to the Asian markets which are generally larger than the more numerous European markets. The figures in Table 6 were derived by multiplying each distance to a market by its respective coal import figure, and dividing the sum of those multiplied figures by the total market coal import level. As an example, Indonesia was calculated in the following manner:

$$(2740 \text{ km} \times 9.9 \text{ Mt} + \ldots + 18\,100 \text{ km} \times 1.4) / 302.8 \text{ Mt} = 10\,402 \text{ km}$$

The figure 2740 comes from Table 4 and represents the shipping distance between Indonesia and Hong Kong in

TABLE 4

Distance of exporting region to markets (km by sea).

MARKET	NSW	QLD	CANADA	CHINA	COLOMBIA	INDONESIA	POLAND
Hong Kong	8300	6950	10 700	2520	17 640	2740	19 980
Japan	8120	7690	8410	1780	15 350	5210	22 130
Philippines	7320	5470	11 070	3080	17 920	2290	19 650
South Korea	8470	7700	8570	1200	16 000	4860	21 830
Taiwan	7930	6550	10 220	2100	17 180	3030	20 200
Thailand	6510	5150	14 660	5160	20 470	3390	19 110
India	7810	5960	16 040	8010	18 070	4890	15 370
Pakistan	12 000	11 740	18 440	10 420	16 510	7290	13 190
Belgium	21 430	21 550	16 530	20 470	8500	17 310	2020
Denmark	23 040	22 440	15 920	22 010	9880	18 840	500
Finland	23 830	23 880	18 720	22 800	10 840	19 630	780
France	21 070	21 190	16 170	20 100	8130	16 940	2340
Germany	21 990	19 340	17 010	20 960	8980	17 790	1550
Nederlands	21 420	21 790	16 530	20 480	8490	17 310	1870
Norway	22 440	22 380	16 930	21 420	9100	18 240	980
Portugal	19 530	19 480	15 430	18 410	7380	15 230	3860
Sweden	24 290	24 330	19 180	23 260	11 300	20 090	1270
UK	21 000	21 130	16 110	20 060	8070	16 890	1810
Egypt	15 700	15 950	18 930	14 680	10 960	11 510	7710
Greece	16 510	16 760	18 370	15 480	10 420	12 370	7170
Israel	15 730	15 980	19 310	14 700	11 380	11 530	8140
Italy	17 160	17 420	17 830	16 160	9920	13 000	6463
Spain	19 110	19 370	15 690	17 990	7640	14 810	4280
Turkey	16 120	16 370	19 290	15 090	11 490	11 930	8250
Yugoslavia	17 740	17 990	18 630	16 740	10 680	13 570	7430
Brazil	18 290	19 940	16 020	21 430	7710	17 510	11 870
Chile	11 660	12 470	10 460	19 450	4920	18 100	15 080
MARKET	Sth Africa	East USA	Gulf USA	West USA	SW CIS	NW CIS	E CIS
Hong Kong	11 550	20 410	19 700	11 820	14 240	20 380	3040
Japan	13 830	18 130	17 410	9610	16 640	22 530	1490
Philippines	11 130	20 700	19 980	12 100	13 980	20 050	3540
South Korea	13 500	18 770	18 050	9690	16 180	22 230	1260
Taiwan	11 860	19 960	19 240	11 320	14 550	20 600	2260
Thailand	10 630	21 030	22 520	14 730	13 090	19 510	5680
India	6940	17 310	19 530	17 510	9710	16 170	8520
Pakistan	7220	15 120	17 330	19 920	7510	13 990	10 910
Belgium	13 090	6370	9050	14 370	5860	2420	21 110
Denmark	14 430	8050	10 470	15 630	6750	900	22 510
Finland	15 210	9050	11 470	16 630	8190	100	23 290
France	12 730	6000	8690	14 000	5500	2740	20 750
Germany	13 570	6850	9530	14 850	6350	1950	21 590
Nederlands	13 080	6360	9040	14 360	5870	2270	21 110
Norway	13 830	7260	9670	14 840	6690	1380	21 900
Portugal	11 080	5680	8190	13 340	3790	4260	18 890
Sweden	15 680	9520	11 940	17 100	8640	900	23 750
UK	12 670	5940	8630	13 940	5440	2210	20 500
Egypt	8750	9460	11 880	16 840	2100	8110	15 290
Greece	9560	8900	11 340	16 290	1250	7570	16 110
Israel	8700	9860	12 300	17 220	2350	8540	15 290
Italy	10 200	8400	10 840	15 740	2100	6860	16 790
Spain	11 170	6120	8560	13 520	3370	4680	18 560
Turkey	9160	9970	12 410	17 210	1900	8650	15 720
Yugoslavia	10 810	8240	11 600	16 550	2700	7830	17 330
Brazil	7690	9100	9820	13 940	11 540	12 270	21 990
Chile	18 010	7720	6980	8410	15 840	15 480	17 800

TABLE 5

Ranking of average export distances to coal markets.

Rank	Supplier	Average Distance
1	Poland	9697
2	South West CIS	11 657
3	East USA	11 681
4	Colombia	11 814
5	Sth Africa	12 209
6	Indonesia	12 856
7	North West CIS	13 428
8	Gulf USA	14 161
9	West USA	15 869
10	China	15 965
11	NSW	16 193
12	Qld	16 235
13	Canada	16 699
14	East CIS	18 573

TABLE 6

Ranking of weighted average export distances to coal markets (by Market Demand Tonnage).

Rank	Supplier	Weighted Average Distance
1	Indonesia	10 402
2	China	11 277
3	Colombia	12 872
4	Sth Africa	13 123
5	Qld	13 625
6	East CIS	13 675
7	NSW	13 694
8	West USA	13 720
9	Canada	13 724
10	East USA	13 982
12	Poland	14 130
12	South West CIS	14 893
13	Gulf USA	15 537
14	North West CIS	17 903

TABLE 7

Ranking of 1989 weighted average export distances to coal markets (by Market Demand and Exporter Supply).

Rank	Supplier	Weighted Average Distance/Supply
1	East USA	230
2	Qld	234
3	Sth Africa	281
4	NSW	339
5	Canada	421
6	Gulf USA	545
7	West CIS	498
8	China	742
9	Colombia	919
10	Poland	995
11	East CIS	1381
12	Indonesia	4001
13	West USA	6860

TABLE 8

Ranked rail transport distance within supply countries.

Rank	Supplier	Weighted Average Distance/Supply
1	Qld	172
2	Sth Africa	179
3	NSW	237
4	East USA	262
5	Colombia	318
6	Indonesia	416
7	Canada	426
8	China	490
9	Gulf USA	617
10	East CIS	684
11	West CIS	897
12	West USA	1055
13	Poland	1442

TABLE 9

Ranked rail transport distance within supply countries.

Rank	Country	Distance (km)
1	NSW	100
2	Indonesia *	100
3	Colombia	150
4	Qld	220
5	Sth Africa	500
6	East USA	560
7	Poland	600
8	Canada	1100
9	China	1300
10	Gulf USA	1340
11	West USA	1370
12	East CIS	3500
13	South West CIS	3800
14	North West CIS	4000

* Indonesia is given 2nd rank to NSW as its internal freight infrastructure is not as advanced as that of NSW.

TABLE 10

Coal consumer's diversity constraints.

Region	Steaming (%)	Coking (%)
Germany FR	30	45
France	30	45
Spain/Portugal	45	45
Italy	40	45
United Kingdom	30	45
Belgium/Holland	30	40
Denmark	30	45
Other Europe	45	40
Japan	50	55
Taiwan/Hong Kong	35	60
South Korea	50	55
Other Asia	50	50
East Mediterranean	60	50
South America	60	40

TABLE 11

Supply/demand ranking under various conditions.

Condition	Steam Coal Sea & Rail 1989 Supply/Demand		Steam Coal Sea & 2 Rail 1989 Supply/Demand		Coking Coal Sea & Rail 1989 Supply/Demand		Coking Coal Sea & 2 Rail 1989 Supply/Demand		Steam Coal Sea & Rail 1989 Diversified Supply/Demand		Steam Coal Sea & 2 Rail 1989 Diversified Supply/Demand	
RANK												
1	Poland	Philippines	Poland	Philippines	Poland	Finland	Poland	Finland	Poland	Philippines	Poland	Philippines
2	China	Finland	Indonesia	Chile	China	Norway	China	Norway	China	Thailand	Indonesia	Thailand
3	Indonesia	S Korea	China	Thailand	E CIS	Sweden	Colombia	Sweden	Indonesia	India	China	India
4	E CIS	Sweden	Qld	India	W CIS	Germany	Qld	Germany	E CIS	Norway	Qld	Portugal
5	W CIS	Denmark	E USA	Taiwan	Colombia	S Korea	NSW	India	W CIS	Brazil	E CIS	Brazil
6	E USA	Greece	NSW	Portugal	Qld	Chile	E CIS	Taiwan	Qld	Japan	NSW	Chile
7	Qld	Chile	E CIS	UK	RSA	Turkey	S Africa	Portugal	NSW	Portugal	Colombia	Norway
8	NSW	Thailand	W CIS	France	NSW	Egypt	W CIS	UK	E USA	Chile	E USA	Germany
9	Colombia	Norway	Colombia	Spain	E USA	India	E USA	France	Colombia	Germany	W CIS	Israel
10	Canada	Turkey	Canada	Brazil		Portugal		Spain	Canada	Israel	Canada	Turkey
11	W USA	India	W USA	Finland		UK		Nederlands		Turkey		Greece
12		Portugal	C USA	S Korea		France		Belgium		S Korea		Japan
13		UK		Nederlands		Spain		Pakistan		Spain		S Korea
14		France		Israel		Taiwan		S Korea		Greece		Italy
15		Spain		Turkey		Nederlands		Chile		Italy		Spain
16		Taiwan		Greece		Belgium		Yugoslavia		Denmark		UK
17		Brazil		Italy		Pakistan		Italy		Hong Kong		Taiwan
18		Nederlands		Belgium		Yugoslavia		Japan		Taiwan		Denmark
19		Israel		Germany		Italy		Brazil		Finland		France
20		Belgium		Norway		Japan		Egypt		UK		Belgium
21		Italy		Hong Kong		Brazil		Turkey		France		Finland
22		Germany		Japan						Sweden		Sweden
23		Hong Kong		Denmark						Nederlands		
24		Japan		Sweden						Belgium		

Condition	Steam Coal Sea & Rail 1995 Supply/Demand		Steam Coal Sea & 2 Rail 1995 Supply/Demand		Steam Coal Sea & Rail 1995 Diversified Supply/Demand		Coking Coal Sea & Rail 1995 Supply/Demand		Coking Coal Sea & 2 Rail 1995 Supply/Demand		Coking Coal Sea & 2 Rail 1995 Diversified Supply/Demand	
RANK												
1	Poland	Philippines	Poland	Philippines	Poland	S Korea	Poland	Finland	Poland	Finland	Poland	India
2	China	Hong Kong	China	Hong Kong	China	Thailand	China	Norway	China	Norway	China	Taiwan
3	Indonesia	Finland	India	Chile	E CIS	Philippines	E CIS	Sweden	Colombia	Sweden	Colombia	Chile
4	E CIS	S Korea	E USA	Thailand	Indonesia	India	Colombia	India	Qld	India	Qld	Finland
5	W CIS	Sweden	Qld	India	W CIS	Norway	W CIS	Portugal	NSW	Taiwan	NSW	Japan
6	E USA	Denmark	W CIS	Taiwan	Qld	Taiwan	Qld	UK	E CIS	Portugal	E CIS	S Korea
7	Qld	Greece	Colombia	Portugal	E USA	Brazil	S Africa	France	S Africa	UK	S Africa	Portugal
8	Colombia	Chile	C USA	UK	C USA	Japan	NSW	Spain	W CIS	France	W CIS	UK
9		Thailand		Spain		Portugal	E USA	Taiwan	E USA	Spain	C USA	Norway
10		Norway		Brazil		Chile	C USA	Nederlands	C USA	Nederlands	W USA	Pakistan
11		India		Finland		Hong Kong	W USA	Belgium	W USA	Belgium	Canada	Spain
12		Portugal		Japan		Turkey	Canada	Pakistan	Canada	Pakistan		Brazil
13		UK		S Korea		Spain		Chile		Chile		France
14		Taiwan		France		Greece		Yugoslavia		Yugoslavia		Nederlands
15		Spain		Nederlands		Italy		Japan		Japan		Belgium
16		Brazil		Belgium		Finland		S Korea		S Korea		
17		Japan		Israel		Sweden		Brazil		Brazil		
18		France		Turkey		Israel		Italy		Italy		
19		Nederlands		Greece		France		Egypt		Egypt		
20		Belgium		Italy		Nederlands						
21		Israel		Germany		Denmark						
22		Turkey		Norway		UK						
23		Italy		Denmark		Belgium						
24		Germany		Sweden		Germany						

kilometres. The figure 9.9 comes from Table 1 and represents the total import volume of both steam (and coking coal) by Hong Kong in millions of tonnes. This is done for all the coal consumers with their corresponding shipping distances from Indonesia, and total coal import levels, ending with Chile (18 100 km from Indonesia; 1.4 Mt import level). The sum of these figures is then divided by 302.8, which is the total import level of the whole world market in millions of tonnes. This calculation was done for every coal exporter to give the weighted average export distances to coal markets of Table 6.

Tables 7 and 8 show the figures from Table 6 divided by the tonnage supplied overseas by each exporter for years 1989 and 1995 respectively. For example, Indonesia in Table 7:

10 402 km / 2.6 Mt = 4001 km/Mt

The figure 10 402 represents the weighted average export distance already derived for Table 6. The figure 2.6 is the total coal exported by Indonesia in 1989, taken from Table 2. This division gives the figure of 4001 km/Mt, as given in Table 7 (this calculation is done for all the coal exporters to make up Tables 7 and 8, for the years 1989 and 1995 respectively). For Indonesia the first place ranking in Table 6 drops to 12th place in Table 7 as Indonesian export tonnage is comparatively very low.

Table 9 details average rail freight distance within coal exporting countries. Table 10 examines coal importers diversity constraints based on historical marketing data (Jolly *et al*, 1990). No country for strategic or commercial reasons likes to import all coal from one source; the diversity constraint sets down the maximum percentage of each type of coal that importing countries would prefer to source from the largest supplier country.

Table 11 is an example of a spreadsheet model which lists in rank order exporters and importers selling or buying advantages. Exporter advantage is ranked by who sells all their available coal first, on the assumption that the shorter trade route has trading preference. This order of trade route distance varies with adjustments in the internal freight distance, and the ranking can be modified again by changes in the diversity constraint, and the supply and demand figures for different years. Market advantage is ranked in the same way, according to which market has its demand satisfied first. The table thus examines 1989 and projected 1995 conditions for competitiveness based on actual distance (sea plus rail distance) and the land biased consideration (sea plus rail distance doubled). Models have been projected for steam coal marketing, coking coal marketing and conditions with a diversification constraint in place. In some cases not all the supplier or consumer countries are listed. This indicates either that some supplier was unable to export all its available coal, or that some market was unable to have its demand satisfied.

DATA ANALYSIS

Examination of Table 9 shows that Australia, Indonesia and Colombia share the shortest rail haulage routes of exporting countries. As Figure 1 indicates, Australia has the highest internal freight charges per unit distance carried. Further, a number of Australia's competitors have a significant portion of the distance to markets overland, and where the distance by sea may be short, as in East CIS shipping to Hong Kong, the journey by rail can be as much as that by sea.

There is no comparison when looking at economies of scale between sea and rail transport. For example, Kembla Coal and Coke has paid A$16 per tonne of coal railed less than 100 km, from Tahmoor Colliery to the port of Port Kembla, and then paid A$12 to ship that same tonne by sea to Wales, more than 200 times the distance.

Even if there was as much as a 70 per cent taxation component in the rail cost, the comparison is still quite clear. The point being made here is that a proportionally short rail segment of the total transport distance should add up to a definite competitive advantage. Australia at the present time is not claiming this.

Table 11 indicates that Australia's competitors in the Asian Pacific Rim with a natural distance advantage are Indonesia, China, and the CIS. Compared to these three, Australia enjoys a significantly lower proportion of rail freight in the overall transport distance, and this proportional advantage is highlighted even more by reducing the cost of rail haulage by 50 per cent, as illustrated by doubling the rail distance of all competitors. This 'doubling' exercise also serves to close the competitive margin that these countries have over Australia. The distance between China and Hong Kong, for example, is increased by over 30 per cent, and the competitive margin between Queensland and China is reduced by nearly 40 per cent. Though China maintains its competitive edge, in this example, it still serves to demonstrate the advantage that can be lent to the industry by rail freight reductions. The fact that China maintains her competitive position should give more reason for Australian rail authorities to adopt a favourable stance towards the coal industry.

To take another example, there is a significant overland portion between East CIS and South Korea (ROK), which is more than half of the distance between NSW and the same market. Given the economy of scale in sea transport between NSW and South Korea, as compared to more costly rail freight from East CIS to South Korea, if there was such a link, the competitive edge should belong to NSW, but not if government intervention is excessive. Doubling the rail portion of the CIS on this route in the model does put NSW in a more competitive position than the CIS in this market.

Those competitors with the greatest internal freight distances to cover have their competitive rank position lowered in Table 11, under a condition of sea plus rail distance doubled. The United States, with its large export volume, falls into this category. Importantly for this exporter, the magnitude of coal tonnage for sale can be as much of a competitive factor as other items more specifically related to cost. The USA has the ability to bring relatively large amounts of coal into the market at short notice because of high domestic capacity and low proportion of coal produced which is sold overseas.

The data compiled in this study also serves to highlight regions where a supplier can influence market conditions, or in industry terms, be a 'price setter', rather than a 'price taker'.

Extension of the data model to triple a competitors internal freight distance as a way of illustrating the impact of reducing rail freight taxes by two thirds, could place Australia in first place on a competitive basis into some markets.

Table 4 shows that Australia's closest markets, and hence areas where it can hold the most market influence, are in Asia. It is thus in Asia that Australia should be looking to be a price setter, or has any hope of achieving that end. This end will only be achieved through honing every competitive advantage available, and internal freight advantages should be taken advantage of where possible. Those countries best suited to be price setters are China, Indonesia and Poland. Being a low volume supplier has not helped Indonesia in the past to be a price setter, as volume of supply can be as important as proximity, in determining regions of influence. Poor quality is also a characteristic of Indonesian coal.

Australia's volume of supply is at present a key advantage in its favour, but such an advantage can diminish relatively over time. Australia cannot hope to always maintain this advantage with the emergence of increased exports from Indonesia, China, and Colombia/Venezuela. A comparison of Tables 5 and 7 indicates this condition for Indonesia and Colombia in particular.South Africa is a supplier centrally located to all major markets. With all other competitive factors aside, South Africa is well placed to supply both Europe, and Asia, with a slight advantage to its traditional marketplace in Europe. West USA could be seen as being in a similar position to South Africa, but low levels of supply prohibit that section of the country from being of major influence in a regional sense.

Tables 5 - 8, rank average export and weighted average export distances and demonstrate the combination of proximity, demand, and supply needed to be of influence in a region. The ranking of average distances to markets demonstrates which supplier has the advantage purely on a proximity basis. In this case, Poland is in first place, and NSW and Queensland in 11th and 12th positions respectively. Poland, however, is close to a lot of relatively small markets in Europe. The actual size, and therefore importance, of the market, should play a role as well.

The weighted average distance value for each exporting country gives a ranking taking into account the importance of the respective markets. In this case, Poland shifts down to 11th position, with the lead taken by Indonesia, reflecting the strength of being close to the high demand Asian markets. The positions of Queensland and NSW improve to the fifth and seventh positions respectively. Indonesia, however, only had a small contribution to make to the world coal market of 0.7 per cent in 1989, and so could not really be in a position to be an important influence on the market.

The competitive advantage of an exporter's supply is indicated in Tables 7 and 8. As already mentioned the picture changes dramatically from the trends shown in Table 6, with Indonesia dropping back to 12th position, and a new lead being taken by the East USA. Australia's position changes for the better again, with NSW in fourth, and Queensland in second position.

Though this presents a very positive picture for Australia, it must be pointed out that such a model only has relevance in a climate of high demand for coal. The weighted average distance ranking presents a better representation of competitiveness in times of low demand, where proximity and demand become the key factors.

Australia is not the closest source of supply to any major market. It can be construed from this that it is not only its competitive position that helps Australia to sell its coal, but rather factors like stability of quality, reliability, low cost of extraction, and magnitude of production to meet a certain demand. Australia therefore has to be ready to meet a situation where it is confronted by competitors who can equal these aspects.

China, Indonesia, and the East CIS hold consistent advantage over Australia into its Asian markets, by their location. In 1989, this presented little problem to Australia, as the demand was adequate to sell all coal produced in spite of 'geographic' competitors, who all had a very low volume to supply to the market.

Size of vessel has worked to Australia's advantage in the past. While Australia has an advantage over Indonesia by its greater capacity to export by capesize vessels with resulting economies of scale, this advantage will be lost in the future as Indonesia upgrades its infrastructure.

Projections of supply for 1995 in Table 3 indicate China and Indonesia both achieving big increases in their export levels. Clifford (1988) predicted that an effect of high government charges would be to encourage companies to invest in coal offshore. Clifford (1990) two years later, illustrated this point by showing the advantages that CRA and BHP were looking forward to enjoying in their new Indonesian coal mine interests, due to ownership of deepwater ports, and conveyor belt links direct to those ports. This expansion overseas by Australian interests can only be to the detriment of the domestic export coal industry.

Table 11 under the 1995 Sea + Rail Steam Coal scenario shows how Queensland and NSW are affected by the greater export volumes of China and Indonesia into our key Asian markets. NSW actually doesn't rank as it is unable to sell all its coal. If China and Indonesia were to export the same volumes as Australia, Australia would be in danger of being forced significantly out of the Asian markets.

Heavy Japanese reliance on Australia for much of its coal supplies has forced Japan to take steps to reduce this reliance by investing heavily, and encouraging development in coalfields in China, West USA, and East CIS. Japan currently imports 70 per cent of steaming coal requirements from Australian mines.

While Australia has the challenge of holding onto its markets, new competitors face the challenge of developing markets. One approach for them is to undercut the market for a number of years, even if it means operating at a loss, until their coal types have an established reputation in relation to other coal types, and then the basic market forces will adjust the price of these new coals so that a profit can finally be made and previous losses made up.

While the CIS, in its present state of social upheaval, is not expected to be a major threat to Australia's lead in the coal export trade, there are other countries in a strong position to do so. Traditionally China with its huge production levels, has never been seen as a threat to Australia's dominant position in export markets in Asia due to its very poor rail transport infrastructure, and high domestic demand fuelled by the desire to develop industrially at a rapid pace. With large cash injections of Japanese money to upgrade rail and port facilities, plus a need for foreign exchange, China is expected to emerge as a key supplier of steaming coal into the Asian market as the 1990s progress (Anon, 1990a). This, plus a slow world economy could severely affect Australia's place in those Asian markets which China is close to.

Indonesia, with three billion mt of proven economically mineable coal reserves, has the second largest coal reserves after India of the southern Asian region (Anon, 1990d). This country is without doubt a force to be reckoned within Australia's 'safe' markets in Asia, chiefly because moves are being made to develop these resources by foreign companies, some of which are Australian. Indonesian coal is very wet though, which is to Australia's advantage.

The incentive for these companies to develop rapidly comes from the fact that they only have a limited time to profit from the mines before the Indonesia government assumes full control. Development is simplified by cheap labour supplied with the support of a sympathetic government. In this way, BHP has been able to fully develop one of its operations there, including constructing a port, within two years, and to the same production level of a typical Bowen Basin mine of four to six million mt per annum. The Indonesian government supports input from foreign companies for their large multinational network and marketing skill. Current Indonesian market strategy, as with other new players on the coal export scene, is to undercut the market to establish market credibility. Table 12 shows this current cost advantage per giga joule. Once market credibility has been established, Indonesia will be in a strong competitive position.

Colombia and Venezuela, with Exxon as the principle participant, are receiving the same attention from foreign companies as Indonesia. Government incentives are similar, with Exxon only having 15 years before relinquishing full control to the respective governments. The role of these two countries will chiefly be in selling to the European markets, forcing Australia to be more dependent on its Asian sphere of influence.

A further competitor in the Asian scene is the western USA, which, as with China, is receiving significant Japanese encouragement to develop. The purpose once again is to diversify coal supply sources. American firms are traditionally viewed by the Japanese buyers as being unreliable, but then Australia, with a poor industrial record, has had its reliability reputation tarnished. Only time will tell to what extent the USA will encroach on Australia's Asian markets. Even if the US coal

TABLE 12

Selected export prices of steaming coal (1991 US $/tonne) destination japan.

Sources (Surface Mines)	FOB Price	CIF Price	Heat Contents (GJ/mt)	Cost ($/GJ)
QLD	26.2	34.2	28.4	1.204
NSW	34.8	43.3	28.2	1.535
Indonesia (Kalimantan)	17.0	29.0	26.4	1.098

exporting sector is incapable of landing coal in Japan at a competitive price Australian producers, for reasons of diversification alone, the USA still represents another reason why Australia's competitive edge in the Asian region may be eroded (Banks and Smith, 1991).

A current development in the USA is the impact of the Clean Air Act. The basic consequence of this legislation is that about ten per cent of the US domestic production will be faced with closure. There is some concern that this will place the USA in a position to dump cheap steaming coal onto the world market. This coal would otherwise have been used in domestic plant. Historically though, with such a high domestic consumption rate, US companies do not have pressure to sell overseas. The trend has been to leave whatever could not be sold at home in the ground, unless there was sufficient market force in the form of high prices to encourage production for export. Private industry factors keep production costs relatively high in the USA, and with the expected trend of no dramatic price increases for export coal for at least the next five years, high sulphur US coal looks set to remain in the ground.

South Africa, with recent and expected further political changes, may become a more significant exporter. Sanctions had the effect of demeriting South African coal by $US 3 per tonne. At that time, their range of costs was lower than the Australian cost structure, basically due to the abundance of cheap labour. As a result, they were able to produce high unit productivity figures from continuous miner usage. The abolition of apartheid will see basic cost structure rise. This change is presently being met by reducing manning levels. Wages will increase, but the high production levels should remain. As a consequence, the expected rise in unit costs per tonne of mined coal will not be dramatic, and most likely offset by the removal of the sanctions 'demerit'. The removal of sanctions will also allow South Africa to buy cheaper oil. Coal which otherwise would have been converted to oil, will be available for export. Upgrading of Richards Bay is also on the agenda. With feasible and expected increases in production, a figure of 70 mt for export is quite a possibility. The erosion of protection for the European coal industry could absorb much of this anticipated increase in South African output, making South Africa significant as a factor to limit Australia taking full advantage of freer market conditions in Europe. Colombia and Venezuela will have a similar influence.

Table 11 illustrates that there is a positive future for Australia's coal industry if there is sufficient demand in 1995. The impact of reducing freight rates to halve the costs of Australian coal rail freight rates is demonstrated by comparing spreadsheets where the only variable is between Sea + Rail, and Sea + 2 Rail shipping distance parameters. Table 11 shows that for steam coal at 1989 supply/demand levels, reducing rail rates does have an impact in increasing Australia's competitive advantage, as demonstrated by the positions of NSW and Queensland moving from eighth and seventh positions to sixth and fourth positions, gaining advantage over both East and West CIS, and to a lesser extent, the East USA. This same advantage is shown, for 1995 conditions, though in both cases NSW still fails to sell all its coal and so is not listed in the table. For coking coal the advantages are much the same. It is also interesting to note the improvement in market position for Japan.

1995 figures forecast a worsening supply/demand position for steam coal with fewer steam coal suppliers able to sell all their coal, while a better situation is shown developing for coking coal exporters. Contrary to the predictions of the model, coking coal demand is expected to remain flat due to the increased use of PCI (Pulverised Coal Injection) steel making technology, which gives better economics, and extends the life of coke ovens (Tanaka, 1990). As a result, it should not be surprising to see a decline in levels of coking coal supply for a period, as there is not the incentive for suppliers to necessarily maintain levels when the major trend of the industry is turning towards steam coal.

The effect of market diversification in Table 11 is more pronounced on the consumer side than the supply side. There are some minor shifts in supplier ranking but what is most evident is that diversification is shown by the model to improve the position of the larger Asian coal markets like Japan, Taiwan, and South Korea. The models successfully demonstrate the supply demand forces, even if only in a simple fashion, which are encouraging Japan to develop other markets to be in competition with Australia.

CONCLUSIONS

The models put forward in this thesis demonstrate on a relative basis that there is strong competitive advantage to be gained by reducing rail freight rates. An analysis of competitiveness based on shipping distances clearly points out that Australia is really only well off in times of high demand in the world coal market. Market diversification, and emerging competitors who are situated closer to the main markets threaten to erode its once uncontested position as a leader in world coal trade.

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