MINERALS AND METALS IN JAPANESE-AUSTRALIAN TRADE*

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DURING THE LAST FIVE years or so, the whole structure of Australia's specialization in world trade has undergone a significant transformation. Rapid strengthening of export specialization in manufactures was accompanied by the remarkable growth of export specialization in minerals and metals. In the first place, these changes reflected the growing international competitiveness of the domestic manufacturing sector. In the second place, they reflected the spectacular development of huge, and in large part, newly discovered mineral resources for international markets.

Significantly, both these changes have served to reinforce a longer-run reorientation in the geographic distribution of Australia's trade, away from Britain and Europe, towards the Pacific and Asia. Over 40 per cent of Australia's trade is now done with advanced Pacific countries—Japan, the United States, Canada, and New Zealand. Around 60 per cent of export trade and 50 per cent of import trade is with the Asian-Pacific region [8]. Between 1963 and 1968, Japan's share in Australian exports alone rose from 16 per cent to 21 per cent, whilst the United Kingdom's share fell from 19 per cent to 14 per cent. In this period, the main impetus to the 7.5 per cent annual growth rate in Australian exports to Japan came from trade in minerals and metals.

The share of minerals and metals in Australian exports to Japan was just over 15 per cent in 1963. By 1967, it had grown to almost 37 per cent. This shift in the structure of Japanese-Australian trade was largely responsible for a parallel shift in the over-all structure of Australian exports. Minerals and metals comprised only 11 per cent of total exports in 1963. Five years later, they accounted for over 19 per cent. Indeed, Japanese demands have played a major role in

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This paper is a preliminary report from data collected for a larger study of minerals and metals in Australia's economic relations with Japan. Over the past year, I have received a great deal of assistance from a large number of people in the Japanese metal industry, metal and mining industry associations, chambers of commerce and industry, and the Japanese Ministry of International Trade and Industry. It is impossible to name all those who have helped me here. But I would be completely remiss if I did not record the generosity of their assistance, and the friendly and detailed attention which they gave to even the most difficult and obscure of my questions. Their help and kindness was very much appreciated. So too was that accorded to me by the Australian Trade Commissioner's Office in Tokyo. I am also very much indebted to Mr. Iwao Nakatani for his assistance in compiling some of the statistical material presented in the paper.

the recent development of Australia's strong advantage in the export of mineral products. By the middle seventies, they will have effected a complete transformation in Australia's specialization in the world economy and far-reaching changes in the whole fabric of Australia's political economy when minerals and associated metal manufactures replace wool as Australia's chief export earner.

Several important questions arise. How can Australia's industrialization and the international competitiveness of her manufacturing sector be more closely integrated with the exploitation of her vast mineral resources? In particular, what part can Japan play in the future development of Australia's mineral and metal industries? And how should Australia's international economic policy be cast in the light of these fundamental changes in her economic relations with the rest of the world?

Answers to these questions first require consideration of the factors which have caused large-scale transformation in the size and structure of Japanese-Australian trade in minerals and metals over the last half decade or so. Here the principal focus is on Australian exports of minerals and metals to Japan. Explicit discussion of the role of metal manufactures in Japanese exports to Australia is reserved for another occasion. More importantly, so too is the effect of Japanese-Australian mineral trade on the trade aspirations of nearby developing countries.

I. THE SIZE AND STRUCTURE OF JAPANESE-AUSTRALIAN TRADE IN MINERALS AND METALS

Between 1963 and 1967, Japan's share in Australia's exports of minerals and metals rose from 24 per cent to 40 per cent. The increased Japanese share in this trade resulted from three broad sets of factors: the relatively rapid growth of Japan's share in world trade in these commodities, the underlying complementarity of Japanese imports and Australian exports of mineral and metal products, and factors relating to the geographical and political closeness of the two countries.

Firstly, the increased importance of the Japanese market to Australian exports of minerals and metals derived from Japan's very high rates of economic growth and her vastly increased share in world trade. Some measure of the effect of high rates of growth on the relative importance of the Japanese market for principal mineral and metal products, other than petroleum products, can be obtained from Tables I, II, III, and IV.[1] Between 1963 and 1967, Japan's share in total industrial country imports of ferrous ore and coal, basic iron and steel, non-ferrous ores and concentrates, and non-ferrous metals climbed from

[1] Trade data referred to in the text was compiled from United Nations, *World Trade Annual*, Walker and Co., New York, 1963, 1965, and 1967. The commodity category minerals includes Standard International Trade Classification division 27 (crude fertilizers and crude minerals), division 28 (metalliferous ores and metal scrap), and section 3 (mineral fuels, lubricants and related materials). The commodity category metals includes division 67 (basic iron and steel) and 68 (basic non-ferrous metals). Unless otherwise stated, all quantities referred to in the paper are metric tons, and all values are recorded in United States dollars.

TABLE
JAPANESE-AUSTRALIAN TRADE IN

Commodity Group	1963 Australia's Exports to Japan	Total Australian Exports	Total Japanese Imports	Total Industrial Country Imports	Australia's Exports to Japan
Ferrous ores and fuel					
281 Iron ore	657	660	355,709	1,124,091	1,702
321 Coal	26,929	30,428	181,378	1,850,658	64,232
Iron and steel manufactures					
671 Pig iron	2,965	5,933	75,782	429,896	546
672 Iron and steel ingots	—	2,290	347	505,614	—
673 Bars, rods, angles, etc.	—	5,736	1,706	1,034,691	—
674 Universals, plates, sheets	657[a]	12,490	3,262	1,319,757	826[a]
All iron and steel[b]	3,857	40,930	89,978	4,135,506	1,014

Source: Calculated from data presented in United Nations, *World Trade Annual*, 1963, 1965, and 1967, Walker and Company, New York.

8.6 per cent to 13.1 per cent, largely in consequence of her high aggregate economic growth rate.

Secondly, increased complementarity between the mineral and metal sectors in the Japanese and Australian economies ensured that Japan's over-all trade growth stimulated proportionately large purchases from Australia. In the earlier phases of postwar Japanese growth, increased import demand was heavily concentrated in textile raw materials, and provided new outlets for exports of Australian wool. In late phases, heavy industrialization demanded large imports of minerals and metals, and provided new outlets for Australian exports of these commodities. In particular, the strength of Japanese import demand for iron ore and mineral fuels, all non-ferrous ores and concentrates except nickel, and non-ferrous metals increased relative to that of other major industrial countires. In fact, Australia's export specialization was well established in only a few of the more important among these commodities in the fifties. Export specialization in lead, zinc, and copper was strong, and exports of coking coal to Japan increased after the First Trade Agreement was signed in 1957, but the significant development of export specialization in iron ore, coking coal, bauxite, alumina, and, most recently, nickel concentrates occurred during the first half of this decade. With the exception of crude oil, Australia's capacity to supply precisely the minerals and metals for which Japanese import demand was growing most strongly expanded dramatically in the period under review.

Thirdly, geographical proximity was perhaps easily the most important among the three factors which favoured growth in Australian exports of minerals and metals to Japan. Of course, some commodities, especially manufactured goods, can be delivered to distant markets at relatively small cost, so that the location of foreign markets does not much affect the geographic distribution of their

I

FERROUS ORES, FUEL, IRON AND STEEL

(Value in US$1,000)

1965			1967			
Total Australian Exports	Total Japanese Imports	Total Industrial Country Imports	Australia's Exports to Japan	Total Australian Exports	Total Japanese Imports	Total Industrial Country Imports
1,875	523,624	1,526,996	75,767	81,762	718,082	2,037,488
69,003	272,001	1,837,068	83,059	88,522	406,566	1,823,010
2,680	131,982	630,091	4,818	6,908	325,858	806,837
576	412	515,400	4,411	26,530	4,234	596,594
8,482	1,332	1,399,197	—	17,062	7,914	1,448,695
10,958	2,246	1,740,112	57	37,609	886	1,791,811
56,870	140,700	5,904,894	9,309	104,403	369,228	6,637,405

[a] Derived from Japanese import data.
[b] Includes all SITC division 67.

export. But low value to weight bulk commodities, like fuels and mineral ores, are generally expensive to transport and nearby sources of supply offer distinct cost advantages to international buyers. Some measure of the effect of this factor upon the geographic concentration of Australia's exports of minerals and metals can be obtained by comparing Japan's share in Australia's exports of any commodity with her share in industrial country exports of the same commodity. The index so defined measures special country bias in trade, or the extent to which Australia's exports of some commodity, say iron ore, are more heavily concentrated in the Japanese market for iron ore than might be expected from Japan's share in world iron ore imports. A more detailed explanation of the meaning of these and related indexes is presented elsewhere [8, 9].

The significance of special country bias in Japanese-Australian trade in minerals and metals can be gauged from the indexes calculated in Tables II and IV. An index of 100 would indicate that Japan's share in Australia's exports of some commodity was exactly equal to her share in the imports of that commodity by major importing countries—that there were no special factors inducing more than average concentration of Australian exports in the Japanese market. In fact, indexes of special country bias for all Australia's major mineral and metal exports to Japan except unwrought lead and zinc are in excess of 100; most are considerably larger than 100. Special country bias in this trade, whilst it remained high, declined somewhat between 1963 and 1967. There were two reasons for this. In the first place, the early stages of the development of export specialization in new commodities are likely to be marked by heavy concentration of exports in nearby markets, but as export specialization becomes better established, markets are likely to become more diverse. In the second place, somewhat lower indexes of special country bias resulted simply from Japan's increased importance in

TABLE II
SPECIAL COUNTRY BIAS IN JAPANESE-AUSTRALIAN TRADE IN FERROUS ORES, FUEL, IRON AND STEEL

Commodity Group	1963			1965			1967		
	(a) Japan's Share in Australian Exports (%)	(b) Japan's Share in Industrial Country Imports (%)	(c) Special Country Bias in Trade (a÷b×100)	(a) Japan's Share in Australian Exports (%)	(b) Japan's Share in Industrial Country Imports (%)	(c) Special Country Bias in Trade (a÷b×100)	(a) Japan's Share in Australian Exports (%)	(b) Japan's Share in Industrial Country Imports (%)	(c) Special Country Bias in Trade (a÷b×100)
Ferrous ores and fuel									
281 Iron ore	99.54	31.64	315	90.77	34.29	265	92.66	35.24	263
321 Coal	88.50	9.80	903	93.08	14.80	629	93.82	22.30	421
Iron and steel manufactures									
671 Pig Iron	49.97	17.62	284	20.37	20.94	97	69.74	40.38	173
672 Iron and steel ingots	0	0.06	0	0	0.07	0	16.62	0.70	2,374
673 Bars, rods, angles, etc.	0	0.16	0	0	0.09	0	0	0.54	0
674 Universals, plates, sheets	5.26	0.24	2,192	7.53	0.12	6,275	0.15	0.04	375
All iron and steel[a]	9.42	2.17	434	1.78	2.38	75	8.91	5.56	160

Source: Calculated from data derived from United Nations, *World Trade Annual*, 1963, 1965, and 1967, Walker and Company, New York.

Notes: Column (c), special country bias in trade, equals $\left(\frac{X_{aj}^i}{X_a^i} \Big/ \frac{M_j^i}{M_w^i}\right)$ 100, where X_{aj}^i are Australian exports of commodity i to Japan; X_a^i are total Australian exports of commodity i; M_j^i are total Japanese imports commodity i; and M_w^i are total imports by the twenty-four industrial countries before trade is recorded in the source. See notes to Table I.

world trade in these commodities.

Most of the special country bias in Australia's export trade in minerals with Japan is accounted for by the influence of transport costs. When transport costs were ranked alongside indexes of special country bias for major suppliers of iron ore to Japan, the degree of correspondence was extremely high. The coefficient of rank correlation was +0.77 which is significant at the 99 per cent confidence level [9]. The same generalization applies to all Australia's export trade with Japan. Transport costs were ranked alongside indexes of special country bias for Australia's major exports to Japan in 1963. The coefficient of rank correlation of +0.65 was again significant at the 99 per cent confidence level. Special country bias in minerals and metals trade was the dominant cause behind this remarkably high degree of correspondence.

The actual structure of any country's trade specialization, and therefore the degree of complementarity in its trade with other countries, is significantly influenced by its commercial policies. Commercial policy, in the form of trade restraints such as the tariff or import quotas, has its principal effect on the pattern of import specialization. For example, examination of Tables II and IV reveals that the share of Japanese imports of minerals within both the minerals and metals categories is quite high relative to that held by the other large importing countries. This reflects two sets of factors. On the one hand, it reflects the non-availability of specific mineral resources in Japan and a much heavier dependence on imported supplies than is generally the case in other industrial countries, as well as the efficiency and competitiveness of Japan's base metal industries relative to that of the same industries in other countries [11] [18]. On the other hand, it reflects the impact of trade policy on the structure of Japanese import specialization.

Remote from other major suppliers of intermediate products, the Japanese metal manufacturing and fabricating industries were developed through fully integrated establishments based largely on imported raw materials, in the case of aluminium or steel, or on domestic raw materials, in the case of copper, lead, and zinc. In the past, remoteness in all its dimensions had a significant effect on the character of Japanese industrialization, perhaps particularly on the structure of key metal industries and on policies towards metal manufacturing and trade.

To some extent, the tariff structure and import policy still reflects this history. Whilst, by Australian standards, nominal tariffs on metal products are not high, effective rates of protection are frequently quite high. Effective rates of protection, which measure the protection afforded a particular stage of manufacture or processing by the structure of tariffs, take account of the incidence of tariffs on inputs, as well as on final output. Escalation in the tariff structure affords higher levels of protection to higher degrees of processing in manufacture [20].

In addition, import quotas still apply to major mineral imports, such as coal and manganese ores and concentrates. The protection afforded the Japanese coal-mining industry is basically protection for a declining industry with special adjustment problems because resources within it are regionally and structurally immobile. There are similar problems in other industries such as copper mining, but in their

TABLE
JAPANESE-AUSTRALIAN TRADE IN

Commodity Group	1963 Australia's Exports to Japan	Total Australian Exports	Total Japanese Imports	Total Industrial Country Imports	Australia's Exports to Japan
Non-ferrous ores					
283.1 Copper	4,928	5,099	94,083	137,866	8,213
283.2 Nickel	—	—	18,242	146,604	—
283.3 Bauxite	602	861	15,604	223,953	2,055
513.65 Alumina	—	—	3,704	101,816	3,663[a]
283.4 Lead	4,189	14,925	8,157	78,561	9,321
283.5 Zinc	1,444	9,512	8,213	100,684	2,415
Total non-ferrous ores[c]	18,262	58,004	229,103	1,665,105	33,457
Non-ferrous metals					
682.1 Copper, unwrought	8,129	16,552	36,667	1,452,004	3,004
682.2 Copper, wrought	89	5,551	2,311	238,735	—
683.1 Nickel, unwrought	—	—	372	278,601	—
683.2 Nickel, wrought	—	—	2,402	48,756	—
684.1 Aluminium, unwrought	—	2,430	10,997	514,166	888
684.2 Aluminium, wrought	—	408	1,491	227,920	—
685.1 Lead, unwrought	2,266	45,295	4,506	146,258	3,911
685.2 Lead, wrought	—	575	—	4,684	—
686.1 Zinc, unwrought	228	19,189	1,801	134,630	—
686.2 Zinc, wrought	—	437	—	13,965	—
Total non-ferrous metals[d]	10,712	94,279	127,060	3,701,709	7,880

Source: Calculated from data presented in United Nations, *World Trade Annual,* 1963, 1965, and 1967, Walker and Company, New York.
[a] Derived from world trade data.

case, the cost burdens of expensive mining operations can be borne within integrated mining, refining, smelting, and metal manufacturing firms.

Hence, tariff and trade policy, as well as the nature of industrial organization, reinforce the effect of basic resource deficiency in concentrating imports of minerals and metals largely in raw material form.

II. THE GROWTH OF DEMAND WITHIN KEY JAPANESE METAL INDUSTRIES

Where, more particularly, have been the principal sources of demand for mineral and metal exports to Japan? The Japanese iron and steel industry is now by far the most important consumer of Australia's mineral and metal exports. In 1967, iron ore, coal, and basic iron and steel manufactures alone comprised almost 66 per cent of the value of mineral and metal exports to Japan, and they already accounted for well over 26 per cent of all Australia's exports of minerals and metals. The remarkable growth of this single industry had a profound in-

III
NON-FERROUS ORES AND METALS

(Value in US$1,000)

1965			1967			
Total Australian Exports	Total Japanese Imports	Total Industrial Country Imports	Australia's Exports to Japan	Total Australian Exports	Total Japanese Imports	Total Industrial Country Imports
10,491	128,201	218,314	10,740	12,884	237,994	333,587
—	24,948	171,561	1,141	2,174	46,121	452,841
3,239	17,166	266,630	6,339[a]	13,042[b]	21,771	290,328
3,663[b]	3,965	112,126	7,072[a]	24,345[b]	7,634	192,989
24,679	14,632	126,118	5,351	25,910	20,175	125,635
16,045	38,427	210,621	7,112	22,475	48,590	222,714
105,527	346,490	2,815,564	47,195	154,902	578,293	2,842,145
24,608	86,685	2,155,181	13,522	21,248	294,008	2,916,811
17,964	11,722	528,305	—	11,880	5,351	492,896
—	4,804	361,694	—	—	38,576	462,316
—	1,551	58,531	—	—	6,044	89,862
10,926	19,276	694,510	763	5,517	81,929	794,182
1,608	1,931	308,690	—	4,952	5,342	422,397
73,689	13,310	375,315	503	63,686	4,398	230,085
571	—	8,101	—	153	—	6,991
27,086	2,142	236,020	299	26,470	4,837	216,171
635	—	20,003	—	254	—	20,965
161,380	247,515	5,787,371	20,226	145,292	589,665	6,986,970

[b] Derived from Japanese import data.
[c] Includes all items listed and all SITC division 28 except 281 and 282.
[d] Includes items listed and all SITC division 68.

fluence on the entire structure of Australian trade.

Japan is the world's third largest producer of iron and steel after the United States and the Soviet Union [14]. In 1968, production of pig iron grew to 46.4 million tons from 11.9 million tons in 1960, whilst crude steel production, which had been 22.1 million tons in 1960, reached 66.9 million tons, or 12.7 per cent of world steel production. Significantly, this huge industry is heavily dependent on imported supplies of the basic raw materials, iron ore and coking coal [17]. In recent years, over 90 per cent of the iron ore, and almost 70 per cent of the coking coal used for iron and steel production in Japan had to be obtained from sources overseas. Moreover, import dependence has risen steadily since 1955 as domestic iron ore is scarce and coking coal expensive to mine. Hence, despite the adoption of material-saving technology, raw material imports have grown even more rapidly than the output of basic iron and steel.

Dependence on imported resource supplies has by no means worked entirely to the disadvantage of Japanese iron and steel producers, since it has allowed them more flexibility in the use of the higher quality and most suitable ores and

TABLE IV

SPECIAL COUNTRY BIAS IN AUSTRALIA'S EXPORTS OF NON-FERROUS ORES AND METALS TO JAPAN

Commodity Group	1963			1965			1967		
	(a) Japan's Share in Australian Exports (%)	(b) Japan's Share in Industrial Country Imports (%)	(c) Special Country Bias in Trade (a÷b×100)	(a) Japan's Share in Australian Exports (%)	(b) Japan's Share in Industrial Country Imports (%)	(c) Special Country Bias in Trade (a÷b×100)	(a) Japan's Share in Australian Exports (%)	(b) Japan's Share in Industrial Country Imports (%)	(c) Special Country Bias in Trade (a÷b×100)
Non-ferrous ores and concentrates									
283.1 Copper	96.64	68.24	142	78.28	58.72	133	83.35	71.34	117
283.2 Nickel	—	12.44	0	—	14.54	0	52.48	10.18	516
283.3 Bauxite	69.91	6.96	1,004	63.44	6.43	987	48.60	7.49	649
513.65 Alumina	—	3.63	0	100.00	3.53	2,833	29.04	3.95	736
283.4 Lead	67.00	10.38	645	43.47	11.60	375	20.65	16.05	129
283.5 Zinc	15.18	8.15	186	15.05	18.24	83	31.64	21.81	145
All non-ferrous ores and concentrates	31.48	13.75	229	31.70	12.30	258	30.46	20.34	150
Non-ferrous metals									
682.1 Copper, unwrought	49.11	2.52	1,950	12.20	4.02	303	63.63	10.07	632
682.2 Copper, wrought	1.60	0.96	167	—	2.21	0	—	1.08	0
683.1 Nickel, unwrought	—	0.13	0	—	1.32	0	—	8.34	0
683.2 Nickel, wrought	—	4.92	0	—	2.64	0	—	6.72	0
684.1 Aluminium, unwrought	—	2.13	0	8.12	2.77	293	13.82	10.31	134
684.2 Aluminium, wrought	—	0.65	0	—	0.62	0	—	1.26	0
685.1 Lead, unwrought	5.00	3.08	162	5.30	4.83	110	0.78	1.91	41
685.2 Lead, wrought	—	—	—	—	—	—	—	—	—
686.1 Zinc, unwrought	1.18	1.33	89	—	0.90	0	1.12	2.23	50
686.2 Zinc, wrought	—	—	—	—	—	—	—	—	—
All non-ferrous metals	11.36	3.43	331	4.88	4.27	114	13.92	8.43	165

Source: Calculated from data derived from United Nations, *World Trade Annual*, 1963, 1965, and 1967, Walker and Company, New York.
Note: See notes to Tables II and III.

fuel and encouraged efficient re-location of capacity by the sea, but the transport cost component of raw material inputs is a prime object for economy. Thus, the proximity of her newly developed deposits of iron ore and coal favoured much more rapid growth from Australia than from other raw material sources.

In the middle fifties, more than 50 per cent of imported iron ore came from very short-haul sources such as Malaysia, and the Philippines. But supply from these sources could not keep pace with the rapid growth in Japanese demand, and by the middle sixties, they were responsible for only 26 per cent of imported ore requirements. Long-haul sources such as South America and Africa, which had supplied only 1 per cent in the earlier period, now supplied 40 per cent of imported ore requirements. Meanwhile, medium to short-haul sources of supply such as Australia and India had become important.

Economies in distance-haulage of ore and coal have, to some degree, eroded the advantage of closeness to the ore consumption point in Japan. For example, although the average distance over which Japan had to haul ore doubled to almost 6,000 nautical miles over the last ten years, freight costs were reduced by around 40 per cent with the introduction of large specialized bulk ore carriers. The average size of Japanese ore carriers increased from 20,500 tons deadweight in 1960 to 48,000 tons deadweight in 1968, port facilities at supply sources and plants in Japan were improved, and economies were effected through the introduction of ore-coal, ore-oil combination bulk carriers [19].

But the advantages of closeness are still extremely large. Given that port and loading facilities are available on a comparable and adequate scale, the freight cost on ore imported from Australia in carriers of 80,000–100,000 tons deadweight remains about 40–45 per cent of that on ores imported from Latin American sources. Hence, the availability of high-quality and accessible Australian ore for export from the middle sixties led to a major re-direction in Japanese import purchasing. Within five years, Australia became Japan's largest supplier of imported ore, shipping some 13.8 million tons, or 20.3 per cent of total Japanese ore imports in 1968. Given the competitiveness of extraction costs and delivery schedules, location, and the influence of special country bias on trade, has been the determining factor in Australia's especially rapid gains in the Japanese market for iron ore.

Transport costs also had a major influence on the steel industry's pattern of coal import purchase, though, as with ore, factors affecting the competitiveness and availability of alternative supplies also played their part. Newly opened reserves in Australia are more accessible and less expensive to mine than reserves in the United States, where prices of higher grade coking coal have been rising sharply and stand above Australian and Canadian prices [5]. Furthermore, Australia's geographical advantage remains strong. Despite trends in the bulk carriage of coal parallel to those in the bulk carriage of ore—the average size of coal and combination-coal carriers has risen to 40,200 tons deadweight—transport charges on Australian coal imports to Japan still amount to only around 50–55 per cent of those on imports from the United States. In 1968, Japan imported approximately 10.8 million tons, or about 38 per cent, of her imported coal requirements from Australian mines.

The fourfold increase in Japanese pig iron production over the last eight years, reflects accelerated growth in the main steel-consuming heavy industries. The construction, shipbuilding, and automobile industries along provided high-growth outlets for over two-fifths of steel production throughout this period. There was also substantial growth in export sales, which reached 13.2 million tons last year, 55 per cent of which went to North America. The strong international competitiveness of the Japanese steel industry derives from five main factors: the efficient use of high quality raw materials; the favourable port-side location of new capacity; the rapid diffusion of best technological practice in an overwhelming proportion of new capacity; economies of scale in the production of basic iron and steel as well as milled products; relatively low wage costs; and automatized production control. The Japanese industry has achieved lower coking ratios, a higher ratio of L-D converter steel production, and higher output per mill worker than all its major overseas competitors.

Despite the efficiency of the iron and steel industry, and the rapid growth of basic iron and steel manufacturing capacity, pig iron production regularly fell short of domestic demand and substantial quantities were imported. During 1967 and 1968, capacity increased sharply with the kindling of six new giant blast furnaces. In consequence, pig iron imports fell from 6.5 million tons in the former year to 4.5 million tons in the latter. There remains, nevertheless, a substantial market for competitively priced pig iron, as well as some crude steel products, in Japan for which the Soviet Union, South Africa, and South America have become the principal suppliers. Whilst in some years imports of pig iron from Australia have been large, they have been quite variable. The effective rate of protection[2] for Japanese pig iron production is 22 per cent, and it varies between 15 and 27 per cent on basic steel products. My calculations are somewhat lower than those reported by Yamazawa, using earlier tariff data [20].

The Japanese aluminium industry is now the second most important consumer of Australian mineral and metal products, though this can be deduced only indirectly since Australian export statistics are not published separately. Since 1963, primary aluminium production in Japan has grown at 18–20 per cent per annum, and total production reached 481,905 tons last year. The construction, transport equipment, and communications industries account for over half the Japanese demand for aluminium products [12]. There are no domestic bauxite reserves and the three aluminium refineries import ore from Indonesia and

2 The concept of *effective protection* used in the paper is defined as follows:

$$g_j = \frac{t_j - \sum_{i=1}^{m} a_{ij} t_i}{1 - \sum_{i=1}^{m} a_{ij}}$$

where g_j is the effective rate of protection for industry j, t_j is the nominal tariff on final output from industry j, a_{ij} is the proportion of each traded input i in the final output of industry j, t_i is the nominal tariff on each traded input i, and $1 - \sum_{i=1}^{m} a_{ij}$ is the proportion of value added in the final output of industry j.

Malaysia, as well as Australia. At present there are four large smelters, Nippon Light Metals, Shōwa Denkō, Sumitomo Chemicals, and Mitsubishi Chemical—another, Mitsui Aluminium, is to begin production late in 1970—and one of these relies largely on imported alumina. In addition, imports of metal constitute 25 per cent of domestic supplies and independent fabricators' reliance on imported metal has grown considerably.

Japanese alumina production suffers the disadvantage of relatively high cost raw material input and diseconomies of small-scale production, so that effective production for the refining process is currently 25 per cent. Japanese aluminium smelting suffers the disadvantage of high cost raw material input and high cost electricity input, but large-scale production and the application of best-practice technology have reduced costs towards international levels. The effective rate of protection for the smelting operation is about 11 per cent, though this is not necessarily a true reflection of protection required by the industry since alumina refining and smelting are undertaken within integrated firms, and costs can be spread. Fabrication, the bulk of which is undertaken by fifteen large firms, appears efficient, with the achievement of economies of scale in rolling, extrusion, and casting, although rates of effective protection vary between 38 and 70 per cent on sheets, extrusions, tubes and pipes, and bars and rods, and are commonly around 45 per cent [12]. These levels of protection will be reduced somewhat under the Kennedy Round within the next three years.

The reduced availability of Malaysian bauxite and relatively small Indonesian reserves in relation to Japanese requirements led to a shift to Australian supplies when Comalco's deposits were opened up at Weipa. Almost 32 per cent of Japan's bauxite now derives from Australia, compared with the 9 per cent that came from that source in 1963. Given similar extraction costs, transport charges, which constitute 40–45 per cent of the landed value of Japan's imports of bauxite, are again the determining factor in the competitiveness of nearby supplies of this mineral product. Freight costs on African and Indian bauxite inhibit imports from those sources [12].

Australia is also far and away the most important supplier of imported alumina, accounting for 98 per cent of the tonnage imported in 1967. Alcoa will soon achieve an annual output approaching 1 million tons, much lower than Queensland Alumina's Gladstone plant, yet three to five times the scale achieved by the three Japanese refiners. The cost of Australian raw material inputs is also much lower so that exports are competitively priced around US$59–60 landed in Japan.

Finally, Australian imports of aluminium metal to Japan, which have been relatively insignificant in the past, will rise steeply from 1970 in consequence of the installation of new and relatively competitive capacity in Australia and the negotiation, more specifically, of a long-term contract between Furukawa Aluminium, a major Japanese rolled products manufacturer, and Alcoa of Australia for the import of 20,000 tons of metal rising to 30,000 tons annually. Among the most significant developments in the aluminium industry within the western Pacific region, was the conclusion of agreements between Sumitomo Chemicals, Shōwa Denkō, (two of the four large Japanese smelters) and Comalco for the establishment of a large-scale smelter at Bluff in New Zealand which will combine low cost alumina from Gladstone with low cost power from the New Zealand government's Manapouri project, and produce ingot for sale by Comalco and for export to Japanese fabricators [10] [15].

The Japanese copper, lead, and zinc industries have long been important users of Australian raw materials. Though their growth, and its impact on the structure of trade was not so spectacular as that of the steel and aluminium industries, it was still responsible for over 15 per cent of the increase in mineral and metal exports to Japan in the period under review. The Japanese nickel industry will soon rank alongside these old-established customers as its consumption of nickel concentrates from the newly developed mines in Western Australia grows.

There are domestic reserves of copper, lead, and zinc in Japan but the rate of growth of metal consumption and production necessitated increased dependence on imports. Imported ores and concentrates accounted for 38 per cent of the metal content of raw materials used in the copper refining industry in 1960, but almost 53 per cent last year. Imported ores and concentrates of lead accounted for only 30 per cent of the metal content of raw materials used in lead refining in 1960, but over 52 per cent last year. And the share of imported ores and concentrates of zinc in raw materials used in zinc refining rose from 23 per cent to 53 per cent over the same period. The complex and diverse raw material supply networks of firms within each of these three old-established industries makes generalization about the economics of raw material trade difficult. Whereas the Japanese iron and steel industry, for example, represents a fairly homogeneous consumption point within the world market for its raw materials, the copper, lead, and zinc industries each rather represents a collection of more or less heterogeneous consumption points. In particular, it is difficult to assess the impact of relative transportation costs on the economics of production for these industries as a whole. However, in the case of crude ores and concentrates, the accessibility and quality of resources, and next their relative closeness to the consumption point in Japan are once more among the principal determinants of the origin of imports. Yet, for these commodities, the former factors are much more important than the latter simply because of the higher value of their crude metallic content. So the geographic concentration of imports is less pronounced. Nickel presents a different case and will be given separate attention in the next section.

The consumption of copper in Japan has been growing at almost 14 per cent annually, compared with growth rates around 3 per cent in Europe and North America, and the production of refined copper reached 470,000 tons in 1967. Wire and cable manufacturers, brass producers, and the electrical equipment industry have been the main consumers [11]. Imports of blister and refined copper have tended to grow even more rapidly than domestic production. Australia, which was the second largest supplier of imported concentrates in the early sixties only ranked ninth last year. Imports from Canada, the Philippines, Chile, and Peru have grown much more rapidly. On the other hand, imports of blister from Australia have held up, and with the completion of expansion programmes there, are assured a growing market. The most significant development in this industry within the region, has been the opening up of reserves on Bougainville. Seven Japanese smelters will import 80,000 tons of concentrates annually for the ten year period beginning 1972, and 30,000 tons annually for the five years thereafter. This project, together with similar projects planned in Indonesia and Canada, will dramatically change the network of material supplies for the Japanese industry [5].

The rate of growth of Japanese lead consumption over the last ten years was lower, at 6.5 per cent, than that of other metals. But this was the highest growth rate in lead consumption among all industrial countries [11]. The substitution of plastics for cable sheathing was the chief depressant on growth, whilst the rapid growth of the automobile industry stimulated an annual growth in excess of 15 per cent per annum for lead used in storage batteries. Australia's proximate and rich reserves have always been a dominant source of Japanese imports of ores and refined lead, although Canada has recently emerged as the largest supplier of both products. Since Japanese refinery capacity has grown more rapidly than domestic demand, import demand for refined lead has dropped sharply.

Zinc consumption grew more rapidly at 14 per cent per annum—a much higher growth rate than that recorded in any other industrial country. Consumption in galvanizing, die casting, and brass were the principal stimulants to this high rate of growth [11]. Japan has diversified her imports of ore, with larger imports from Peru, Canada, and South Korea, but Australia remains the second largest supplier. As with lead, Japan's capacity for zinc refining has increased more rapidly than consumption, and while imports have been variable, the trend is toward self-sufficiency. In the last four years, Japanese producers have exported considerable volumes of zinc slab to North America.

Exports of manganese, tungsten, tin, mineral sands, opals, petroleum products, and salt have also been significant in Japanese-Australian trade in minerals and metals, but even a cursory survey of their place in the Japanese economy is not possible here.

III. THE SCOPE FOR CLOSER REGIONAL INTEGRATION IN MINERAL AND METAL TRADE

The brief survey of Japanese-Australian trade and key Japanese metal industries presented in the previous sections serves two purposes. First, it highlights the importance of minerals and metals in Australia's commercial relations with Japan and in the whole structure of her trade specialization. Second, it points to some of the possibilities for initiating closer and more efficient integration between the Japanese and Australian industry, and achieving larger gains from trade for both countries [8].

Scope for benefit from closer sectoral integration within the region exists because national policies or national business practices and institutions can frustrate the optimal regional location of industry from the viewpoints of minimization of transport costs, economies of scale, and the intensive use of high quality resources specific to one part of the region. Tariffs and import restrictions are the most important national policies which have this effect. Autarkic business integration and purchase agreements are the most important business institutions that work in exactly the same direction. The latter are important in every country, but they are, perhaps, of special importance in this part of the world. Finally, imperfect knowledge within business or government about the opportunities that exist for profitable investment can frustrate the efficient location of productive capacity.

The three types of benefit which would derive from closer regional integration within the mineral and metal industries are clear in principle. First, protection of basic treatment processes that require large inputs of low value to weight raw materials prevents treatment closer to resource deposits, and high transport costs are needlessly added to the cost of the product. Pig iron production, alumina refining, or nickel refining are all examples of industries which thrive on location close to the source of raw materials. Second, in industries with access to significant economies of scale, high protective barriers made secure by government support, can lead to the duplication of plants of sub-optimal scale. All stages of aluminium production can give rise to this inefficiency. Finally, protective barriers can lead to the establishment of industries outside countries with important advantages in the quality and cost of inputs. The aluminium smelting industry, which requires large volumes of electricity is one such case. All these sources of inefficiency can also be examined in relation to the nickel industry.

Raw materials are an important element in the costs in all the basic metal industries. Raw materials account for around 60 per cent of the value of Japanese produced pig iron. Of these costs, between one-third and one-half, or 20 to 30 per cent of the total cost of pig iron, represents the cost of freight. The cheapest and most convenient raw materials used by the Japanese industry are imported from Australia. It would therefore appear that, provided auxiliary resources were available at comparable prices, large benefits would derive from re-locating in Australia more pig iron or crude steel capacity to serve the Japanese steel industry. A new trade in metal agglomerates is desirable for essentially the same reason.

In fact, comparison of Japanese and Australian pig iron prices suggests that auxiliary resources are available as cheaply in Australia as Japan. In 1967, the published price of Australian pig iron at US$55.05 per ton was 27 per cent lower than that for Japanese pig iron, at US$75.20 per ton. The Australian export price at about US$42 per ton, is 40 per cent below the Japanese domestic price. The present cost of freight for large lots from Australia to Japan is US$8.40 per ton or around 20 per cent of the Australian export price. Freight costs on pig iron would probably be lowered if the volume of trade in pig iron grew.

Since the 8–10 per cent Japanese tariff on pig iron does not raise the price of pig iron imported from Australia above the domestic price level, business institutions in both countries can be presumed to prevent effective competition in the Japanese market. The degree of autarkic business integration in the Japanese iron and steel industry is still large. Moreover, the institutional structure of the Australian industry has not, in the past, been conducive to pushing large-scale export production, so that the opportunities for more efficient regional specialization have not been realized.

Although published data suggest that the Japanese iron and steel industry might have been slightly more efficient in the production of basic steel products than the Australian industry, there is probably considerable scope for rationalization in the production and trade of certain steel products too. This would tend to favour crude steel exports from Australia, and specialized steel exports from Japan.

What kind of arrangements for the Japanese and Australian iron and steel industries might be beneficial? More important than tariff concessions extended on a most-favoured-nation basis would be the initiation of moves to break down protective business institutions. In particular, investment in iron and steel capacity should be planned and encouraged from a regional rather than national point of view. This would be facilitated by joint business ventures and tie-ups, the freer flow of investment within the industry, and direct government intervention. There are ten major integrated iron and steel producers in Japan. Any one of them could profitably establish capacity in Australia, preferably in conjunction with a domestically based firm, to serve Japanese consumption outlets. Equally, opportunities exist for the profitable arrangement of long-term contracts for the supply of pig iron from the Australian industry to independent operators in Japan. Or, indeed, the establishment of an Australian joint venture in Japan based on Australian crude iron and steel supplies deserves serious consideration. The gains from such initiatives would be large, both for Japan and for Australia.

Economies of scale are important at all stages of aluminium production. The region's bauxite mining industry, an increasingly important supplier to world markets, is already operating at efficient levels of output. However, of the three alumina producers in Japan, only one had achieved an output approaching 300,000 tons by 1967 and economies can be obtained as units are duplicated beyond this efficient level through the more effective use of maintenance, materials handling, and storage facilities [12]. The two large Australian producers will achieve outputs over 900,000 tons and 1,800,000 tons annually by the end of this year. In aluminium smelting, where economies of scale are obtained up to production levels of about 100,000 tons per annum, and beyond if lumpy investments in electric power generation are required, there are plants operating in both countries at sub-optimal capacity. But there are more essential elements in the costs of these segments of the aluminium industry, once outputs of the size already attained in both Japan and Australia have been achieved. Scale economies are of more fundamental importance in the fabrication end of the industry. In the case of alumina production, raw materials account for around 40–50 per cent of the value of Japanese output [12]. Thus, 16–20 per cent of the total cost of alumina represents the cost of freight on raw materials. Given that economies of scale have been achieved in Australia, and that auxiliary resources and inputs are available at comparable prices, large benefits would derive from supplying more of the Japanese industry's alumina requirements from Australia. Almost all of these criteria appear to be satisfied. The one noteworthy exception is the remaining protection afforded caustic soda producers in Australia. Caustic soda is only available at international prices for input into exported production. That constraint on the competitiveness of the Australian alumina industry is hardly justifiable in view of the natural advantages which domestic caustic soda production could exploit more effectively [7].

The aluminium industry also evidences the third type of potential gain through closer regional integration: through the more intensive use of high quality resources specific to one location within the region. In this case, the potential for generating electricity cheaply is the specific resource. Electric power is a major input in aluminium production—estimates place requirements at over 17,000 kilowatt hours per ton of metal in efficient North American plants [3]. In Japan, the economization of expensive electricity input has been a prime objective of technical endeavour within the industry. By 1967, average electricity input per ton of metal was about 16,800–17,000 kilowatt hours [12]. Presently, electricity input in the newest and largest plants is as low as 15,300 kilowatt hours per ton of metal, one unit having achieved an input as low as 14,200 kilowatt hours per ton of metal. Still, the price of electricity is extremely important in determining the cost of smelting. Australian electricity can be generated at probably less than two-thirds the cost of generation in Japan. New Zealand, New Guinea, and perhaps other parts of South East Asia, have potential for generating hydroelectricity more cheaply than electricity can be produced in Australia, and much more cheaply than it can be produced in Japan. Thus, the power costs of aluminium produced at the smelter planned for Bluff in New Zealand, will probably be in the vicinity of US$38 per ton, and possibly considerably less, compared with typical costs two and half times as high in Australia and three and a half to four times as high in Japan [10]. With a world aluminium price of US$560, electricity input is a significant proportion of total cost. Production in Japan is sustained only behind high effective rates of protection, and through high cost segments of the industry being carried by efficient segments within integrated firms.

What measures can be taken to stimulate highly desirable rationalization of the region's aluminium capacity? Our conclusions are similar to those for the steel industry: the efficiency of Australian bauxite mining and refining, New Zealand's electricity generation, and Japan's fabricating industry are, in themselves, powerful inducement to regional enterprise. Most-favoured-nation tariff reductions by all parties on aluminium and aluminium products would assist the promotion of more efficient regional specialization. Again, the breakdown of autarkic business integration and the extension of business horizons should be an important objective. A prototype of the kind of development that is possible within the western Pacific region is provided by the Comalco-Shōwa Denkō K.K.-Sumitomo Chemicals venture in New Zealand. This tripartite operation, and Furukawa's agreement to purchase increased volumes of aluminium ingot from Alcoa's Australian capacity, give ground for optimism about the prospect for closer integration within the region's aluminium industry.

Lastly, raw materials are also a large element in the costs of producing nickel metal and ferro-nickel. Raw materials account for around 30 per cent of the cost of producing nickel metal in Japan and 60 per cent of the cost of producing nickel matte [16]. Even in the former, the transport cost component in total costs is 12 per cent or thereabouts, whilst it comprises over 20 per cent of total costs in the latter. Again, provided that auxiliary resources are available at comparable prices in Australia, it would appear that the re-location of capacity based on newly opened nickel ore reserves at Kambalda would enhance regional efficiency within the industry. In fact, auxiliary resources are available more cheaply in Australia. Significantly, both coke cost, an important element in the cost of producing matte, and power costs, in producing electrolytic nickel, are lower in Australia than Japan.

What kind of arrangements might be beneficial to the Japanese and Australian nickel industries? First, the import of Australian concentrates with a 15 per cent metallic content offer considerable scope for the economization of the transport cost input in matte and metal production. Already, Sumitomo Metal Mining have negotiated long-term contracts with Western Mining for the supply of concentrates aimed at realizing these economies. Second, imports of matte and refined metal from Australia should be increased as capacity becomes operational. Protection for Japanese producers, in the form of a tariff quota arrangement, is currently very high. The domestic price of nickel has commonly been 30–40 per cent higher than the landed price of imports in Japan in recent years. The effective rate of protection on matte refining is about 35 per cent and the implicit effective rate of protection on the production of electrolytic nickel is about 55 per cent. Trade barriers should gradually be reduced. More usefully, the Japanese and Australian industries should enter into much closer co-operation through joint venture operations in Japan and Australia [16]. Whether this results from ties between existing firms, whether it results from regional rather than national investment and marketing decisions by existing firms, or whether it is achieved by new producers straddling both markets, it would yield considerable gains to both economies.

The scope for gains from closer regional integration in minerals and metals in huge. Perhaps more important to their realization than the negotiation of trade concessions or narrow commercial policies is the capacity of business to establish wider horizons within which to take investment and marketing decisions, and the capacity of governments to co-operate in planning smooth economic adjustments regionally in the pursuit of economic efficiency and higher income levels. There is a great deal of evidence that the Japanese and Australian firms involved in these key industries are developing an appreciation of the character and desirability of the initiatives that have yet to be taken, as well as the network of contacts that will enable them to be taken more easily. Much can also be done through government encouragement and planning. If these private and government initiatives are carried through effectively, Australia will be assured more efficient and competitive industrial development based on the exploitation of her vast mineral resources, and Japan the gains to be derived from that.

IV. THE FUTURE OF JAPANESE-AUSTRALIAN TRADE IN MINERALS AND METALS

If the gains from what has already been achieved are merely held, it is possible to forecast a much more significant role for Japanese-Australian trade in minerals and metals within the next five years. Take forecasts for the five major importing industries in Japan alone. If Japanese import growth for the iron and steel, aluminium, copper, lead, and zinc industries achieves the levels predicted by industry or by the Ministry of International Trade and Industry, and Australia achieves predicted import shares or maintains past import shares, total Australian exports of these minerals and metals to Japan will reach US$1,240 million in 1973. This may be compared with the most recent estimate for total Australian exports of minerals and metals, of US$1,369 million by 1972–73 [13]. In particular, estimated exports of US$504 million for iron ore and US$292 million for coal to Japan greatly exceed the Australian estimates which are based solely on contracted sales.

But the purpose here is not to predict the future of Japanese-Australian trade in minerals and metals by crudely projecting past growth and structural relationships five years or so hence. Rather it is to suggest briefly the way in which the future of the trade might be shaped in accordance with the potential described in the previous section. The most important task is to try to outline the positive acts of commercial and economic policy that are necessary to realization of the promise that has been defined.

The directions that this preliminary examination of trade in minerals and metals recommend for Australian commercial and international economic policy are quite clear. They are three in number: Australia should adopt a more liberal stance in trade and commercial policy; her policy towards foreign participation and investment should remain open and liberal; and she should seek a greater degree of joint government action at the official level in investigating the opportunities for more effective regional specialization and encouraging their achievement.

First, there is the role of commercial policy. Here the focus of attention has been deliberately on the flow of export trade from Australia to Japan. Trade and economic policy cannot be formulated in such limited dimensions. Trade is fundamentally a reciprocal exchange, and it is also multi-sectoral and multinational. So too is the negotiation of trade concessions in present-day circumstances. In other words, the removal of tariff and trade barriers which restrain the achievement of more effective regional specialization within the mineral and metal industries will demand from Australia a broader and more liberal approach to trade policy all round. Several alternatives suggest themselves in the pursuit of this objective [8]. Perhaps the best option is for Australia to push for the negotiation of most-favoured-nation trade concessions with her largest trading partners. For example, there is ample scope for regional negotiations on trade barriers in the Pacific. If the United States were reluctant to come to the party—and Australia has a profound direct and, through Japan, indirect interest in United States participation—Japan, Australia, and New Zealand could probably take the initiative in such moves. Inward-looking policies are entirely inappropriate. Empty pleas for "increased processing" in Australia are no substitute for carefully formulated trade and development policies executed in co-operation with the private business sector in an international environment. Indeed, such pleas encourage entirely the wrong sentiment towards resource development and entirely the wrong guidelines in policy decision-making. The economic case for exporting a large range and volume of mineral products, in unprocessed form will remain strong throughout the foreseeable future. So too, incidentally, will the political case in terms of the contribution of resource-trade flows to the objectives of regional prosperity and stability. At the same time, we have seen that the potential for efficient industrial development based on the achievement of closer sectoral integration within the western Pacific region is also great, so long as outward-looking trade and development policies are able to be implemented.

Second, there is the role of private investment flows. There are solid grounds for considerable optimism on this score. The large scale involvement of internationally-oriented firms in Australia's mineral development, provides a sound basis for the establishment of internationally-oriented manufacturing capacity. Moreover, Japanese government and business attitudes towards investment flows within this sector are entirely favourable. The precise relationship between the efficiency of adjustment in trade and economic structure, and the role of various forms of direct overseas investment deserves closer study, but business connections across national frontiers will generally enhance international economic efficiency and improve the mechanism of international adjustment greatly. Certainly, there could be no less appropriate time in the history of Australia's economic development to adopt excessively restrictive attitudes and policies towards overseas participation in the Australian mineral and metal industries. Liberal policies towards trade and foreign participation should be coupled with closer intergovernment co-operation in these matters. Ultimately, the need for a greater degree of harmonization in economic policies, especially with respect to overseas investment, company taxation, and public utility pricing, will arise.

Finally, there is the need for joint government endeavour. Not even the preconditions to such harmonization of economic policies can be achieved without the establishment of new inter-governmental institutions to facilitate the flow of information between governments within the region, and explore the opportunities for the more efficient regional location of industrial capacity. International economic relations of the scale and character of those that should develop between Japan and Australia cannot be managed remotely and independently. Thus, an important immediate concern of policy ought to be the establishment of an intergovernmental organization for Pacific Trade Aid and Development [8]. Sensibly, this would include New Zealand participation. In the context of trade in minerals and metals, OPTAD could relay economic information, undertake research, and advise independently on questions of trade policy affecting industries in member countries. It would help to identify sectors within the mineral and metal industries in which intra-regional capital flows and business associations would bring gain, and thereby smooth the institutional channels for international capital movements.

And ultimately, it would facilitate harmonization in regional economic policy.

Undoubtedly, Japanese-Australian trade in minerals and metals will continue to prosper without these initiatives or without formal regional arrangements. But if some of the initiatives were taken and if formal regional arrangements were entered, the potential for regional growth and more rapid and efficient Australian industrialization would be greatly enhanced. At this turning point in her commercial history, Australia would do well by directing her economic policy towards achieving much closer integration in mineral and metal production, and other such industrial sectors, within the western Pacific region.

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