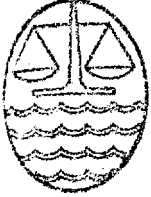




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United States: working paper on the economic effects of deep
sea-bed exploitation

I. Introduction

Numerous studies have been prepared, including the reports of the United Nations Secretary-General and the UNCTAD secretariat, concerning the potential economic effects of manganese nodule exploitation on the markets for the metals involved and on the economies of developing country producers of the metals to be extracted from nodules. The analytical work contained in these studies is open to an inevitable criticism - it is highly speculative because we are studying the impact of an industry which does not yet exist on future markets whose magnitude is impossible to predict with absolute precision. Hence, it is understandable that there are often contradictory predictions on the extent to which developing country producers will be harmed by deep sea-bed production.

The following discussion is not presented as a critique of any individual studies concerning economic implications which have previously been submitted to the Law of the Sea Conference. ^{1/} Rather, we have attempted an explanation of what will be the most probable economic effects of deep sea-bed production and why the United States is of the view that certain solutions which have previously been proposed to the Conference may result in greater economic costs to all mankind than the benefits they are designed to achieve.

Only a small number of developing countries are major producers or exporters of nickel, copper, cobalt and manganese, the metals of chief commercial interest in manganese nodules. If world production of these four metals is considered as an aggregate, it is producers in industrialized countries which account for the greater

^{1/} In certain areas, this working paper will draw upon the commentary contained in the most recent report of the Secretary-General, "Economic Implications of Sea-Bed Mineral Development in the International Area", document A/CONF.62/25, 22 May 1974. Unless otherwise noted, all figures used here are based on the Secretary-General's report.

share. The benefits to be derived from restrictions on sea-bed production will primarily flow to only six developed country producers - Australia, Canada, Japan, South Africa, the USSR and the United States - and six developing country producers - Chile, China, Peru, the Philippines, Zaire and Zambia. Restrictions on sea-bed production will result in more rapid price increases for these raw materials than would otherwise take place and will largely benefit only a few land-based producers. Inhibitions on sea-bed production may cause higher prices for a large number of developing countries with no land-based production. In relative terms, they will be considerably more harmed by higher prices than consumers in the industrialized world.

II. Assessment of Effects

A. Effects on Land-based Producers

The following discussion outlines the most probable impact of manganese nodule exploitation on land-based producers of individual metals and briefly interprets the significance of these conclusions.

Nickel

With respect to the economic effects of projected sea-bed production of nickel, the Secretary-General's report 1/ concluded the following:

For nickel, a minimum six per cent per annum long-term growth rate is assumed. In 1972, the share of developing countries in world production of nickel was only 13 per cent, although this share is expanding rapidly. Production from nodules might amount to 18 per cent of the total world demand in 1985. This volume of production would depress prices somewhat, but the impact would be lessened by the good growth prospects for nickel, and by the fact that developing producers account for a small share of the total market. Nickel production from nodules might cause some high cost laterite projects under consideration to be abandoned, but it should not have a serious effect on land-based production as a whole.

In 1972, three countries - Canada, France (New Caledonia) and the USSR - accounted for 74 per cent of world mine production of nickel. Developing country producers, primarily Cuba and Indonesia, accounted for only 13 per cent of total mine output. Within the next decade, even with sea-bed production, nickel production from developing countries is expected to increase to almost three times its present size, and the Secretary-General's report estimates that this increase will lead to an 18-20 per cent share of the world's nickel production in 1985.

Given the Secretary-General's assumption that sea-bed production of nickel from nodules will account for approximately 18 per cent of world demand in 1985, land-based

1/ Report of the Secretary-General, A/CONF.62/25, pp. 8-9.

sources of nickel will still have to increase by 70 per cent in order to meet world demand. Such a large increase in demand can be expected to result in increased prices. Thus, a number of high cost land deposits which were previously marginal may become economically feasible. We can anticipate that even with full-scale sea-bed production many new nickel deposits may be opened in developing countries. In fact, a rough computation, based on the Secretary-General's estimate that developing country producers' share of the market will increase from 13 per cent to 20 per cent, would imply that about 50 per cent of the increase in land capacity would come from developing countries.

A very strong growth rate (approximately 6 per cent) is projected for world nickel demand, and this projected increase in demand will mean that sea-bed nickel output may gradually augment world supply without displacing any land-based production. Given that demand is projected to increase at a 6 per cent annual rate, there will in all likelihood be a corresponding increase in prices over current levels, even with sea-bed production. Thus, with increased output and increased prices, the total revenue obtained by land-based producers will also be greater than current levels. Sea-bed nickel production may help to limit somewhat this expected price increase, but its effect will be less pronounced if we assume that demand for nickel is elastic, as is done in the Secretary-General's report. Any expansion in the total production of nickel thus would not have a large impact on prices and would result in an increase in total revenues accruing to the industry as a whole.

Copper

The Secretary-General's report 1/ concluded the following with respect to the impact of sea-bed copper production on world markets:

The world market for copper is huge compared to that for nickel, being about 14 times the size of the nickel market in 1972. Copper prices rose dramatically from 1970-1974, reaching a record level of \$US 1.10/lb in early 1974. Of the metals contained in nodules, copper production is the least concentrated among producers. It is expected that the demand for copper will show an annual percentage growth rate of 4-5 per cent to the end of the century. Production from nodules might supply about 1.3 per cent of world consumption in 1985 and would displace only 5.5 per cent of the net import requirements of developed countries by that time. Copper production from nodules is expected to have a minimum impact on a relatively large, growing and somewhat diffuse market.

1/ A/CONF.62/25, p. 9.

In 1972, developing country producers accounted for around 42 per cent of world mine production of copper. While there are over fifty countries which produce significant volumes of copper, three developed countries - the United States, USSR and Canada - contributed 46 per cent to the 1972 world production total.

The Secretary-General's report estimates that sea-bed production of copper in 1985 would account for only 1.3 per cent of total world demand. In contrast, land-based production of copper will virtually have to double by 1985, given the UNCTAD assumption that demand will increase at a rate of 4-5 per cent per year. Assuming that developing country producers will continue to provide the same proportion of total world copper output as they have in the past, the reasonable presumption is that their current revenues and export earnings from copper production will also double by that year.

It is difficult to predict what the precise effect ten years from now will be of an added supply of less than 2 per cent for an industry that may grow by 100 per cent. However, the implications of sea-bed production for world copper markets will be clearly insignificant.

Manganese

The Secretary-General's report 1/ draws the following conclusions with respect to the effect of sea-bed production on world markets of manganese:

Manganese might be recovered from nodules in two forms, either as pure metal or as ore-equivalent. More than 90 per cent of the manganese produced is used in the form of ferromanganese in the manufacture of steel; thus the rate of growth in its consumption will tend to parallel that of steel production. On the other hand, the market for manganese metal is relatively small. Metal production from one operation of one million tons/year in 1985 might amount to twice the volume of projected demand. Therefore, manganese metal supply from nodules would depress prices. Depending on the form and volume of manganese recovery from nodules, the export earnings of developing country producers might drop significantly. However, with just one exception, developing countries are not dependent upon manganese exports to a great degree.

There is some dispute concerning whether there will be significant manganese recovery from sea-bed nodules. 2/ Evaluation of the conclusions reached in the Secretary-General's report requires some analysis of the uses of manganese and of the manganese market. More than 90 per cent of world manganese is used as a "scavenger",

1/ A/CONF.62/25, p. 9.

2/ In this connexion, it should be noted that an "Intensive Consultation" on manganese ore was held in Geneva early in 1974. This Consultation, which was held under the auspices of UNCTAD, was attended by representatives of all countries interested in the production, consumption and marketing of manganese ore. Delegations may be interested in studying the outcome of this meeting, of which one decision was that no recommendation about manganese should be sent to the Law of the Sea Conference in Caracas.

or remover of impurities, in the production of steel from iron ore. Manganese is added to the molten ore in the form of either manganese ore or ferromanganese, which is produced from manganese ore. The manganese combines with the impurities and is drawn off with the slag and discarded.

In contrast with manganese ore from land-based mines, manganese nodules contain metals other than manganese. Therefore, manganese from nodules cannot be used in steelmaking unless it is refined, since otherwise it would add impurities to the steel rather than removing them. Since the percentage content of manganese in nodules is lower than the percentage in land-based ores, there is also a higher proportion of waste rock which would have to be melted in the steelmaking furnace, thus adding substantially to fuel costs and processing time. The small likelihood that manganese from nodules can compete with manganese ore from land sources has been recognized by the companies which are preparing to mine the nodules. Only one United States company has indicated that it may produce any manganese from nodules, and this manganese would be in the form of a highly pure metal which would serve only a very small segment of the manganese market.

It therefore appears highly unlikely that the assumption by the Secretary-General of significant impact on land-based manganese producers from manganese nodule production will be realized. Even if new uses develop for pure manganese metal, it is by no means certain that the nodules would be a more economic source of such metal than the higher grade, purer manganese available from traditional sources.

Cobalt

The Secretary-General's report ^{1/} reached the following conclusions on the effect of sea-bed production on the prices of cobalt:

Cobalt is a relatively expensive metal with a small market, and its value in world commodity trade is rather small. By 1985, production from nodules could account for about half the volume of world output while effecting a drop in price to about two thirds of current levels.

Projected production of cobalt from the sea-bed would account for such a large share of world demand by 1985 that some downward pressure on cobalt prices would be inevitable. Since cobalt can serve as a substitute for nickel in many of its uses, however, the price of nickel in the long-term can be expected to provide a lower limit on this potential decline.

Several developing countries - Zaire, Morocco, Cuba and Zambia - produce cobalt, but of these, only Zaire earns more than 1 per cent of its foreign exchange from this metal. Even at a significantly reduced price, present cobalt producers probably could continue to operate profitably, for cobalt is produced as a by-product, usually from copper or nickel recovery. Assuming, then, that land-based production of nickel and copper will increase dramatically in the next decade, the total revenues of individual cobalt producers accruing from the combined recovery of cobalt and copper or cobalt and nickel will probably continue to increase.

^{1/} A/CONF.62/25, p. 9.

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It is also possible that new uses for cobalt, particularly as a partial substitute for nickel, will create additional demand if the price of cobalt declines. Although it is difficult to predict the precise magnitude of this phenomenon, the result would be an increase in total revenues from cobalt production accruing to the entire industry.

Summary

Table 1 below demonstrates that developed, as well as developing countries are major producers of the metals contained in manganese nodules and contains some order-of-magnitude estimates for the value of production, based on 1971 prices. This table demonstrates that by value, cobalt, manganese and nickel production are small in comparison with copper.

Many producers of one of the metals contained in nodules are also major producers of other metals. This is particularly true with respect to cobalt, which is produced as a by-product, usually of copper or nickel. Thus, if we can expect major expansions in productive capacity over the next decade for copper and nickel, the effect which decreased cobalt prices might have on Zaire, Zambia, Morocco and Cuba would be more than compensated by projected increased revenues from copper and nickel production.

Table 2 summarizes our estimates with respect to present (1971) production, future sea-bed production, future land-based production and future production for all sources. An implied assumption of the table is that the division of output between developing and developed countries will remain about the same as current levels.

The projected income of individual land-based producers of nickel, copper, manganese and cobalt from their combined production of these metals will increase significantly between the present and 1985, even with sea-bed production.

B. Positive Economic Implications

As explained in the preceding section, only a small number of developing countries are major producers of nickel, copper, cobalt and manganese (Chile, Zambia, Zaire, Peru, the Philippines and China), while a large share of total production for these minerals comes from developed countries (the United States, Canada, USSR, South Africa, Australia and Japan). Even fewer developing countries depend on production from one or more of these metals as a significant source of foreign exchange earnings. In contrast, all developing countries are consumers in varying degrees of the products made from these raw materials and in most cases they use valuable foreign exchange earnings to pay for importation of these goods.

An increase in the prices of raw materials will inevitably result in increased prices for the goods made from them, and the goods made from nickel, copper, cobalt and manganese are largely capital goods - the industrial equipment and machinery which is used in the manufacturing sector, such as wire, electrical equipment, stainless steel, steel with better shock resistance, heat resistant steel and permanent magnets. A country which is attempting to develop quickly must increase its stock of these and other capital goods at a much higher rate than is now found in industrialized countries. For nations with scarce resources, this means a lower rate of consumption than might

otherwise prevail, and even a slight increase in the prices of goods necessary for development will mean a further intensification of the sacrifices to be made by consumers in developing countries or a reduction in economic growth. In relative terms, then, consumers in developing countries as a whole are more affected by increased prices for these goods than those in the industrialized world.

Consuming countries, including the developing countries, clearly stand to gain positive economic benefits from the exploitation of deep sea-bed resources, for the existence of a large alternative source of supply will serve to prevent the prices of these four metals from rising as quickly as they might otherwise. Cheaper prices for such commodities as wire, electrical equipment, stainless steel and permanent magnets will mean that some of the essential elements for economic growth are more readily available.

In addition to the benefits which the world's consumers will derive from sea-bed production, developing countries will gain positive financial benefits from the generation of revenues from sea-bed exploitation. Another positive economic effect may be the development of technology, especially with regard to mineral recovery, which could contribute markedly to the development or improvement of mineral extraction elsewhere.

III. Analysis of Economic Effects of Certain Proposals

Although the benefits to be derived from greater availabilities and lower prices resulting from sea-bed production will accrue to developing as well as developed country consumers, the major share of these benefits in absolute terms will of course be gained initially by the industrialized world. Moreover, the economic effects of sea-bed production for developing country producers of these four metals cannot be considered solely from the perspective of whether the level of their present earnings is jeopardized, for there is also the question of whether developing country producers will earn less than they would have earned in the absence of sea-bed production.

Several proposals have been submitted to the United Nations Sea-Bed Committee and the Conference which attempt to reconcile the interests of all peoples in minimizing prices to the consumer with the interests of developing country producers whose revenues may not increase as rapidly as a result of sea-bed production. Several of these proposals envision production or price controls on sea-bed exploitation. The policy issue of whether it is necessary to balance the interests of the international community in efficiency with its interests in protecting developing country producers will not be addressed by this economic working paper. However, the implications in economic terms of the various proposals for resolving this problem may not be as clear as they have been portrayed. The following discussion analyses some of the economic effects associated with the implementation of these proposals.

Restrictions on Sea-Bed Production

There are essentially two types of restrictions which can be imposed upon sea-bed production to limit production. The first includes controls which can be imposed on sea-bed miners who have already come into commercial production, such as controls in the rate of sea-bed production, high financial or other regulatory burdens, or

requirements that miners limit their production of individual metal components from nodules. It is unlikely that producers would begin operations under a régime that erratically inhibited recovery operations, for such actions are tantamount to depriving producers of a return on their investment and could drive them to other sources outside the international régime. As has been generally agreed, the international régime must provide security of investment for potential miners to be effective and successful.

The second category of production restrictions relates to the potential for limiting the entry of new operations in sea-bed mining through burdensome financial and regulatory provisions or by limiting the amount of sea-bed area available for exploitation. The purpose of these measures would be to decrease supply from the sea-bed and increase market prices. However, there are several reasons why production restrictions on sea-bed output do not provide an effective mechanism for increasing the revenues of land-based producers.

First, restrictions of this nature would not offer a very precise tool for the purposes of controlling the effect of sea-bed production on land-based producers of one particular metal, since the impact of these controls would be experienced in all of the markets of the metallic components of nodules. Even selected controls on the rate of production of one metal would alter the internal cost structures of firms and possibly decrease sea-bed production of all other metals.

Moreover, restrictions of this nature cannot affect the short-term revenues of land-based producers, since these controls would have to be applied anywhere from three to ten years in advance of the problem. In other words, limiting new entries into sea-bed mining would not affect the output levels of existing sea-bed producers or the projected level of output for those miners who had received rights but not yet achieved full-scale recovery.

Second, there is reason to believe that demand for these raw materials is elastic, that is, a 1 per cent change in price produces a change in consumption of more than 1 per cent. Although restrictions on production resulting in decreased output from the sea-bed will cause market prices to rise and the quantity demanded to decrease, the decrease in quantity demanded will be larger in percentage terms than the increase in price. Putting it another way, it is necessary to restrict sea-bed output to a much larger extent to achieve a desired increase in land-based earnings when demand is elastic. A glance at Table 2 where the magnitude of potential sea-bed production is shown, indicates that in most instances, sea-bed production would not be so large a percentage of the total that its complete elimination could cause much of an increase in earnings for land-based producers.

Third, production controls are not selective in their effects. Whatever wealth is transferred from consumers to land-based producers will go to land-based producers in both developing and developed countries. Inspecting the value of output for all four metals from land-based production in Table 1 demonstrates that industrially developed countries produce the larger share of the present world supply of the four metals in question. If the present division of production continues, the major share of the increased earnings will go to producers in industrially developed countries.

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Finally, limitations on sea-bed production will not resolve the most critical problem for existing producers of these four metals - competition from the opening of new deposits on land.

Commodity Agreements

Another mechanism which has been suggested for regulating sea-bed production in order to control the world market prices of the metals produced from nodules is the establishment of international commodity agreements. Such agreements would no doubt be characterized by provisions such as floor prices, production quotas, etc. To be effective, they would require the participation of virtually all producers both land-based and sea-based, and their agreement on matters such as price ranges and market shares.

Based on past experience, it can be anticipated that the negotiation of commodity agreements for the four metals involved would be difficult. Assuming, however, that they could be negotiated, they would be difficult to operate, and would not necessarily be effective, because of the obvious conflicts of interest which would exist among producers, on the one hand, and between producers and consumers, on the other.

It is assumed, of course, that membership in any such agreements would include most of the countries with a major interest in the production, trade and consumption of the various metals. However, even under these circumstances, not only the decision-making process, but also the development and implementation of means of enforcing decisions would be problems of major proportions. Moreover, the joint product nature of sea-bed production makes it difficult to selectively manage, through commodity agreements as well as through production restrictions, the amount of recovery from the sea-bed of individual metallic components of nodules.

Finally, commodity agreements are incapable of being designed to aid just the land-based producers that are developing countries. Their very nature requires them to be based upon existing capacity and this would mean favouring the industrially advanced producers.

Compensation

The function of compensation is often to pay a supplement to a high cost producer in order to permit that producer to stay in operation when the market price is too low to enable him to operate profitably without the supplement. Since the higher cost producers are being subsidized in their operation, they have little incentive to reduce costs or improve the quality of their product. If the sea-bed segment of the industry, in this case, were required to provide a subsidy to land-based producers, additional costs would be imposed on sea-bed mining and consumers of sea-bed products and the effect would be similar to that of production restrictions. Thus, a compensation scheme for land-based production could lead to upward pressure on prices.

Compensation does have the advantage, however, that it can be selectively applied so that only developing country producers are eligible. In addition, compensation can be provided only to the extent that resources freed from mineral production are not

employable in other productive activities. If such a system were adopted, it would be desirable to use it in a way that encourages internal adjustment in the countries affected.

IV. Conclusions

The following conclusions concerning the effects of production restrictions, commodity agreements and compensation can be drawn from the preceding analysis:

- (1) All three schemes invariably cause prices to be higher than they would otherwise be;
- (2) Restricting sea-bed production cannot effectively stabilize land-based producer revenues, much less increase them, due to the small segment of the market served by sea-bed production;
- (3) Commodity agreements are extremely difficult to establish and have built-in impediments to their success;
- (4) Except for compensation, these solutions cannot be selectively applied solely to benefit developing country producers.

In a summary of effects that are to be expected from these three types of restrictions on sea-bed production, one point is most important. To the extent there are beneficiaries of restricting sea-bed production, they will be land-based producers who are largely the industrially developed countries. Those suffering the greatest losses will be the world's consumers, including the peoples of the lesser developed economies who depend so heavily upon the capital goods made with these minerals for increasing their future standards of living.

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Approximate 1971 Value of Mineral Production

(millions of 1971 dollars)

	Cobalt	Copper	Manganese	Nickel	Total	Percent of World Output
I. TOTAL	\$115	\$6125	\$223	\$445	\$6908	100%
II. Group of 77 Countries	88	2602	98	45	2833	40
III. Other Countries	27	3523	125	400	4075	60
<u>Non-Group of 77</u>						
U.S.A.	--	1522	--	9	1531	22
Canada	11	720	--	186	917	13
U.S.S.R.	8	680	76	80	844	12
Australia	2	195	11	22	230	3
South Africa	--	174	36	9	219	3
Japan	--	133	2	--	135	2
Poland	--	99	--	--	99	1
France	--	--	--	71	71	1
Rhodesia	--	--	--	9	9	0.1
Finland	6	--	--	--	6	0.1
Greece	--	--	--	9	9	0.1
<u>Group of 77 Producers</u>						
Chile	--	790	--	--	790	11
Zambia	10	718	--	--	728	10
Zaire	65	449	4	--	518	7
Peru	--	235	--	--	235	3
Philippines	--	230	--	--	230	3
China	--	110	12	--	122	2
Mexico	--	70	2	--	72	1
Cuba	8	--	--	27	35	0.5
Brazil	--	--	29	--	29	0.4
Gabon	--	--	20	--	20	0.3
India	--	--	20	--	20	0.3
Indonesia	--	--	--	18	18	0.3
Venezuela	--	--	--	--	--	0.1
Ghana	--	--	7	--	7	0.1

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TABLE 2 *

Approximate Value of Mineral Production
 (millions of 1971 dollars)

	Cobalt	Copper	Manganese	Nickel	Total
<u>Landbased</u>					
Group of 77 Producers					
1971	88	2602	98	45	2833
1980	99	4036	110	131	4376
1985	106	5214	150	175	5645
Other Countries					
1971	27	3523	125	400	4075
1980	31	5346	200	486	6063
1985	34	6755	213	650	7654
<u>Seabeds</u>					
1971	0	0	0	0	0
1980	70	123	12	135	340
1985	120	158	33	181	492
<u>TOTAL</u>					
1971	115	6125	223	445	6908
1980	200	9505	322	752	10,779
1985	260	12,127	396	1006	13,789

* Countries are listed in rank order of the total value of the four metals in question. The countries listed produce at least 1% of the world production of one of the metals listed.

* Data is extrapolated from UNCTAD documents TD/B/449/Add 1; TD/B/484; TD/B/483; TD/113/Supp 4; UN document A/Conf.62/25; and U.S. Department of the Interior 1971 Minerals Yearbook.