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OCEAN MINING POLICY: A DYNAMIC APPROACH*

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To be honest with you my knowledge of mining either on the land or in the ocean is meager. The mining operation with which I am more familiar is not that of discovering an existing gold mine, but, rather, the creation of a new one; for example, the "gold mine" the aircraft industry created in California.

In order to have a better appreciation of the policy issues involved in ocean mining it is necessary to understand the payoff of such activity from the standpoint of society as a whole. First, granting that there are potato-sized objects on the ocean floor containing manganese, iron, nickel, cobalt, and so forth, I am unclear about the benefits of ocean mining for mankind. Is the world now facing a shortage of these materials; that is, is their real price rapidly rising? Or, if their price is not rapidly rising now, will it be in the future? Or, is there no economic shortage of these materials? Is the main uncertainty about future supplies a political uncertainty rather than an economic uncertainty? Second, what economic gains will be achieved in mining the ocean floor? What will the metals taken from the ocean floor cost in comparison with current or prospective costs? I know there is a great deal of uncertainty attached to cost estimates of new activities. In fact, based on previous research,

I doubt if the costs in question can be estimated within a factor of five or ten -- with the difference between the highest and lowest costs depending, in part, upon luck and, in part, on cleverness of entrepreneurs during design and development. Assuming that such a range of uncertainty does exist, one thing important to know is this: if one or more of the groups or firms that now believe ocean mining is a paying proposition, to what extent are their expectations based on conservative design and to what extent on cleverness in minimizing cost? Or, to put the point in another way, are we looking at estimates made by comfortable monopolists who do not feel hard-pressed to save money; or estimates made by eager monopolists who because of pressures from operating within a consortium are nonetheless highly risk averse; or estimates made by highly enterprising competitors who must take risks because their survival is at stake?

Granting a wide range exists in the cost of processes for both ocean floor vacuum cleaning and separating materials from nodules, how important is it to minimize the cost of these activities? Assuming costs can vary by a factor of five or ten, how important is it to approach the bottom of that range? Obviously its importance depends upon the elasticity of demand for these metals. Perhaps, as has already been suggested, the elasticity of demand for copper is so high that only a few cents difference in price would make a great deal of difference in the quantity demanded. To provide another kind of example, if the

difference between minimum cost energy and maximum cost energy were a difference between energy costs going up three or five times, we would certainly want to know: with the incentives provided today can it be assumed that energy costs are being minimized?

Now to be more specific, let us assume that mining oceans would provide a commercial advantage for the consortiums so engaged. Profits would not only cover costs, but would also recognize the degree of risk involved. However, let us also assume just for the sake of the argument that we are talking about a case of very low demand elasticity. In other words, the firms engaged in mining operations are made better off than they otherwise would be, but as far as consumers are concerned there is a rather negligible difference. Under this assumption what should government policy be? Beyond assuring that no damage is done to the ocean environment, no strong case can be made for public action. To be sure, if my understanding is correct, some companies might still refuse to go ahead, because they cannot insure themselves against the possibility of loss of property rights. But neither can American firms operating in foreign countries obtain insurance that will protect their property rights. And it is by no means clear why in ocean mining insurance should be provided, and why in other cases it should not be.

Next, let us turn to the more interesting case in which it is important to minimize costs. Let us assume that there are

important potential benefits not only for the firms involved but for the public at large. Let us assume that it is possible to obtain significant cost reductions that would be important for the future development of the economy. Under this assumption I would be disturbed that, while there is a hidden hand at work in ocean mining, there appears to be an acute need for a hidden foot. What is the difference between a hidden hand and a hidden foot? The hidden hand argument is Adam Smith's. And it states that in making profits as large as possible the butcher, the baker, and the candlestick maker are not only serving their own interests, but the interests of the public at large. To be sure, there are often risks involved in making profits as large as possible, but bringing in the element of technological risk into the equation does not change the essential character of Adam Smith's argument. The central problem with Adam Smith's definition of self-interest is that it is not broad enough. A firm does not only have to take into account technological risks, but the risk of what rivals might do to its share of the market if it develops maximum cost alternatives. It is this second risk that is the hidden foot risk. Moreover, it should be apparent that the larger risk your rival takes, the larger risk that it will pay for you to take if you value your survival. Thus, it certainly pays to take larger risks in, say, the chemical industry than in the steel industry.

I hasten to add, however, that Adam Smith really cannot be blamed for having defined self-interest so narrowly as to

leave the hidden foot out of account. In 1776 when he wrote The Wealth of Nations, competition and ideas mainly took the form of ill-organized competition between inventors rather than well-organized competition between firms. And not until 1850 was there highly organized forms of technological competition. However, on the basis of what I know today it is my conviction that the push of the hidden foot plays a more important role in the making of significant advances than the pull of the hidden hand. To be sure, wide differences can be observed among individuals with respect to their willingness to engage in risk-taking -- from risk lovers to risk haters. But business firms seldom, if ever, take risks simply because they are headed by the hero entrepreneurs we read about in storybooks. For example, when Henry Ford developed the Model T, Ford's share of the automobile market was only ten percent -- no larger than a dozen or so firms that had already gone out of business. If he wanted to compete against rugged Buicks selling for $1,000 and inexpensive runabouts selling for $400, he had no other alternative but to take the risk in making a car that was quite as rugged as the Buick but would sell for no more than $600. In other words, it was not the hidden hand that was pulling Henry Ford; it was the hidden foot that was pushing him. Indeed, in many significant advances the push of the hidden foot has really been the primary reason why firms take risks.

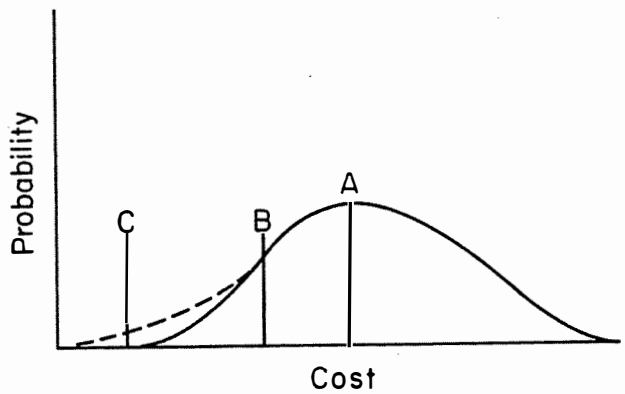
Now that we have introduced rivalry into our model, let us be more clear about the role of rivalry in reducing costs.

Let us assume that we are talking about a subjective probability distribution with respect to the cost of an operation (see Figure I). While the firm may have a fair idea of the distribution, beforehand it does not know just where on the curve particular hypothesis will lie. So what does it do? Suppose the firm is content with a hypothesis that falls in the middle of the distribution (A on Figure I). If it sets A as its limit cost it merely has to search until it finds a satisfactory alternative. This is the likely search strategy of a firm which is not pushed to operate within a tight cost constraint. Next, suppose the cost limit is set at B. The firm will be provided with an incentive not only to search more widely, but to ask more and more pointed questions. Quite obviously, the more pointed questions entrepreneurs can ask, the more they can reduce search costs. Finally, assume the limit is set at C. This provides entrepreneurs with an incentive to extend the probability distribution.

The key point is this: the greater the change in market shares likely to result from significant discoveries (i.e., the more effective the hidden foot), the greater the likelihood of extending the probability distribution.

Of course, the entrepreneur cannot know beforehand the probability of extending the distribution. Indeed, it is very important not to try to attach probability estimates before making guesses about new hypotheses, because by attaching probability estimates to your hypothesis, many relevant hints will not be taken into account. This new probability distribution is really

FIGURE I
Operation X: Probability Distributions of Hypotheses with Respect to Cost



an ex post probability distribution. To return for a minute to the Model T, when it was first introduced it cost $950 and its sales were disappointing. Consequently a $600 target price was set. After that an employee of the Ford Motor Company informed Henry Ford that he had visited a meat packing plant and had seen the disassembling of carcasses with overhead production lines and questioned why it would not be possible to reverse that process for assembling cars. That was just a hint, and no one could calculate the probability of its leading to a significant reduction in costs. What Ford did was try out the idea where its application would be most obvious. Not until this was accomplished was the probability distribution extended.

In order to generate new probability distributions, an organization like a criminal law firm is required. But the kind of organizations that you have in these more mature technologies more resemble probate law firms -- if you ever asked a probate law firm to try a criminal law case it could not do it. And no more than a probate law firm can try a criminal law case, can you take a highly structured organization that is set up for specialized tasks and get it to develop a new kind of technology. The essential difference between an organization which acts on the basis of given probability distributions and one that generates new distributions is that the latter must be more interactive -- so interactive that the authorship of particular inventions is always in doubt. A highly interactive organization is one which encourages many lucky discoveries. On the other hand, a highly structured organization is one in which outcomes depend to a larger

extent on luck and luck alone.

To be sure, when existing firms go into the business of ocean mining separate divisions will probably be set up for that purpose. But, in all of the cases about which I am familiar, the parent organization seldom gives the new division a great deal of autonomy. For example, when a highly productive firm is acquired by merger, the parent organization invariably provides so many constraints that the acquired organization can no longer remain innovative. Moreover, in the case of ocean mining we must consider not only the constraints imposed by the parent company, but also those imposed by other firms belonging to the corsortium; and those imposed by various regulatory agencies.

Moreover, to return to my main argument, it is impossible to imagine a firm remaining dynamically efficient if it does not face genuine competitive threats. People who have worked at Bell Telephone Laboratories will tell you that the much greater degree of dynamism that BTL demonstrated after World War II, as compared with its performance in earlier periods, was the result of its facing real threats to its monopoly position: private microwave stations, underseas telephone cables owned by other companies, and communications satellites owned by others. And, if a real hidden foot was required in the case of Bell Laboratories, how can we expect dynamic efficiency without a hidden foot in the case of ocean mining?

If new ocean mining firms would have the same advantage in this industry as new firms have had in other industries -- an

advantage in dynamic efficiency -- why have not independent new firms entered this field? One possible explanation has been already alluded to -- the payoff for being clever might not be nearly as great as it is in industries such as semiconductors. A second reason newly formed firms have not entered the ocean mining business is simply the difficulty of obtaining risk capital. Finding something like a billion dollars for this kind of venture certainly would not be easy. As compared with other industries, the cost of entry is no doubt very high.

What, then, should the government do to encourage competition? If I were really convinced that minimizing the costs of these mining operations was important, I would recommend that the government should share the risk with newly founded firms. For example, the government might provide the ship and the firms in question, the vacuum cleaner. But I would not like to see the government paying the entire cost of development, because if the government did that it would insure the new firms against failure. What should be done is that firms should be placed in a sufficiently desperate position that they will do all they can to insure themselves against failure. Secondly, I really wonder whether it is a good idea to give any firms, new or old, permanent property rights, so to speak, for mining any specific part of the ocean floor. Perhaps the property rights should remain vested in governments. And perhaps on the basis of competition to develop the lowest cost equipment, the winning firm should be given a contract of limited duration to mine some

part of the ocean floor and, of course, royalities on its equipment to the extent used by other firms. This idea came to me when thinking about the railroads. Suppose the government had owned the right-of-ways and kept them in good repair, and suppose that the government then leased the lines on the basis of competitive bids. Is it not likely that the second approach would have provided the railroads with a far greater degree of dynamic efficiency? The rate of diffusion of innovations in the railroad industry has been slower than that of even the coal mining industry and the steel industry. Is it not conceivable that if the government had leased the lines progress would have been more rapid? But what the government did instead was to regulate the railroads in a way so as to protect their right to be a cartel. To be sure, this was done under the guise of protecting the public interest. But inasmuch as regulatory agencies prefer an environment with little uncertainty -- because such an environment provides a way to minimize bureaucratic risk -- regulation cannot protect the common interest. Only competition can do that.

Of course, people will say that in the case of ocean mining regulation will somehow produce entirely different results. But I do not believe it. When firms are not able to engage in risk-taking, they either manage to set up an implicit or explicit cartel or, failing that, they become regulated by the government. The only way to insure against that kind of failure is to assure that the industry in question is characterized by a good deal of rivalry.