NONFUEL MINERALS – THE FEAR OF SHORTAGES AND THE SEARCH FOR POLICIES

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FOREWORD

As one of the largest producers and consumers of nonfuel minerals, the United States greatly influences mineral markets and trade worldwide. Historically, the country has followed a policy of relatively free trade in mineral commodities, encouraging consumers to search abroad for low-cost supplies, and producers to sell wherever the price is highest. Of course, there are exceptions, but overall public policy favors trade, allowing huge quantities of minerals to flow across the country's borders.

In recent years, particularly as worldwide recession and depressed commodity markets have battered domestic mineral producers, a growing number of voices have called for a change in this policy, for more protection and greater domestic self sufficiency. Should such a change occur on a significant scale, it would have obvious, and serious, implications for every major mineral producing and consuming country. Even the modest movements toward protection over the last few years clearly demonstrate the potential of such a change to disrupt the existing economic and political relations among nations.

So it was without hesitation that I accepted an invitation to participate with Hans Landsberg in a Forum sponsored by Resources for the Future in the fall of 1982, which examined U.S. national interests and policies for three groups of natural resources – energy, minerals, and food. We were asked to focus on minerals.

The resulting paper, reprinted here, was originally published in Emery N. Castle and Kent A. Price, editors, *U.S. Interests & Global Natural Resources: Energy, Minerals, Food* (1983). This volume, which is available from Johns Hopkins University Press, also includes chapters on "The International Dimension" by Emery N. Castle and Kent A. Price, "Energy Is an International Good" by Milton Russell with Mary Beth Zimmerman, "The Internationalization of U.S. Agriculture" by Dale E. Hathaway, "U.S. Foreign Policy and Global Natural Resources" by Carl Kaysen, and "The Inevitability of the Unexpected" by McGeorge Bundy.

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chapter three

Nonfuel Minerals- The Fear of Shortages and the Search for Policies

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Hans H. Landsberg

Nonfuel minerals for some years have been greatly overshadowed by energy, and with good reason. The value of their combined U.S. production, for example, does not match that of either oil or natural gas and only moderately exceeds that of coal (figure 3-1). Similarly, U.S. net expenditures on nonfuel mineral imports are only a small percentage of its net outlays for the energy it acquires from abroad. In 1980 that percentage was as low as 5 percent. In 1981 it slightly exceeded 15 percent (figure 3-2). Between 1979 and 1981 the country's annual *net* trade bill for nonfuel minerals averaged only $6 billion.

Editors' note: This chapter draws heavily on three previous works that the reader may wish to consult for additional detail: Hans H. Landsberg, "Key Elements Common to Critical Issues on Engineering Materials and Minerals," Paper presented at the Seventh Biennial Conference on National Materials Policy, July 19–22, 1982, Harpers Ferry, West Virginia; Hans H. Landsberg and John E. Tilton, with Ruth B. Haas, "Nonfuel Minerals," in Paul R. Portney, ed., *Current Issues in Natural Resource Policy* (Baltimore, Md., Johns Hopkins University Press for Resources for the Future, 1982) pp. 74–116; and John E. Tilton, *The Future of Nonfuel Minerals* (Washington, D.C., Brookings Institution, 1977).

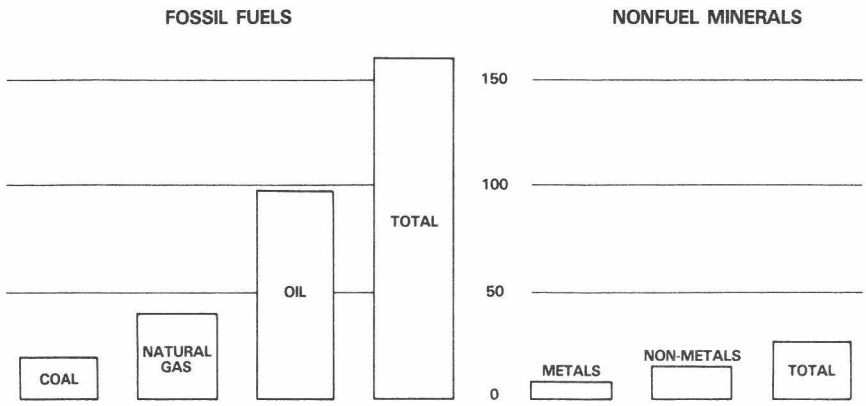

Figure 3-1. U.S. fuel and nonfuel minerals production for 1981, in billions of dollars. Data are from *Minerals Yearbook, Centennial Edition,* vol. 1, 1981, table 10; and Energy Information Administration, *Annual Report to Congress,* 1981.

Minerals differ from energy in other respects as well, and strikingly so. While in energy the spotlight shines brightest on oil, the source that is highest in value, public and policy concern in minerals focuses on a few commodities that carry a relatively low price tag. The big-ticket items—steel, copper, nickel, and aluminum—are not free of problems, to be sure, but rightly or wrongly they are not these days thought of as constituting the core of the minerals problem. Under the latter rubric fall a few metallic minerals such as cobalt, chromium, manganese, and platinum, none of which is produced in significant quantities in the United States and each of which runs up an *annual* import bill of $250 to $500 million, an amount equal to one to two *days* of imported petroleum (figure 3-3). Moreover, within the nonfuels group, the value at the mine of domestic production of nonmetallic exceeds that of metallic minerals by about two to one. Casual observers are surprised to discover that the combined value of U.S. output of stone, sand and gravel, and cement exceeds that of all metallic ores taken together (figure 3-4).

Yet another distinction is location. Secure foreign sources of minerals greatly outweigh insecure sources: Canada, Australia, Brazil, Peru, Mexico, and Venezuela are large suppliers to the United States. Canada, for example, sells to the United States more than forty, Mexico twenty, and Australia ten types of nonfuel minerals. The

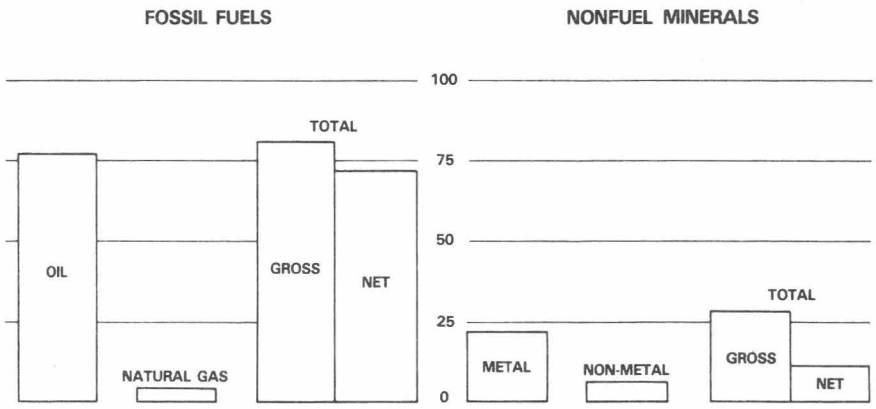

Figure 3-2. U.S. gross and net imports of fossil fuels and nonfuel minerals for 1981, in billions of dollars. Note that oil includes strategic reserve imports. Data are from *Minerals Yearbook, Centennial Edition,* vol. 1, table 10; and Energy Information Administration, *Annual Report to Congress,* 1981.

annual value of mineral imports from Canada alone represents between one-fourth and one-third of all U.S. nonfuel mineral imports. Compared with oil, then, nonfuel mineral exports to the United States are widely scattered, and to a substantial degree shipped from politically stable countries. Minerals exported from South Africa and the Soviet Union inject a note of concern, however, which will be discussed later.

Further differences are that, given the large variety of nonfuel minerals and nonmineral materials, significantly more opportunity exists for substitution among minerals than in energy. And unlike energy, nonfuel minerals are not destroyed in use. They differ in difficulty and cost of recovery, but in principle the stock is not significantly diminished, so much so that the phrase "above-ground" stocks has been coined to denote minerals in and after useful employment. Such differences caution against casual analogies between fuel and nonfuel minerals. They also suggest that conclusions and policy recommendations relevant for energy may not be appropriate for nonfuel minerals.

Despite their relatively small contribution to the gross national product and the balance of trade, a continuous flow of nonfuel minerals is essential to sustain the country's industrial base and to maintain its high standard of living. In addition, many mineral commodities produced in relatively small quantities are critical ingredients in specialty

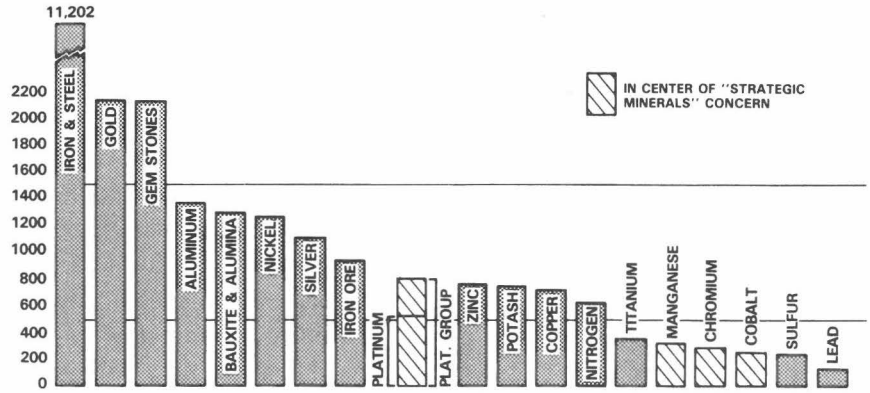

Figure 3-3. U.S. nonfuel gross mineral imports valued at more than $100 million each in 1981. Data are from *Minerals Yearbook, Centennial Edition,* vol. 1, table 10; and Energy Information Administration, *Annual Report to Congress,* 1981.

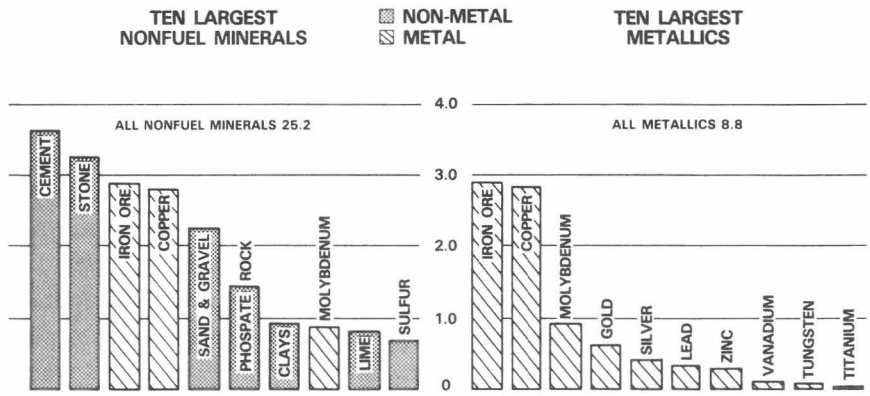

Figure 3-4. Ten largest nonfuel and metallic minerals produced in the U.S. in 1981, in billions of dollars. Data are from *Minerals Yearbook, Centennial Edition,* vol. 1, table 10; and Energy Information Administration, *Annual Report to Congress,* 1981.

materials used in the manufacture of military and other high-technology equipment.

So it is not surprising that from time to time concern arises in the United States and other industrialized countries over the future sustained availability of nonfuel minerals, even though the relatively low values suggest that the situation is amenable to management. In

materials used in the manufacture of military and other high-technology equipment.

So it is not surprising that from time to time concern arises in the United States and other industrialized countries over the future sustained availability of nonfuel minerals, even though the relatively low values suggest that the situation is amenable to management. In this chapter, we first examine the nature of these fears and provide a framework for categorizing them. We then focus on efforts through mineral policies to cope with perceived threats. More specifically, we consider the evolution of past policy, the current interest in mineral self-sufficiency and protectionism, and possible alternative policies for reducing the vulnerability associated with mineral import dependence.

Shortages and Fears

To most economists, a shortage occurs when the available supply of a commodity is not sufficient at the prevailing price to satisfy demand. This means that a shortage can be eliminated simply by allowing price to rise. At some point, the higher price will adequately stimulate supply and reduce demand to bring the two into balance.

For our purposes, however, and we believe for policy decisions as well, this is too narrow a definition. While an increase in price can constrict demand to the available supply, it creates dislocation and hardship for those consumers who find they no longer can afford to buy the commodity. The higher price may bring supply and demand into balance, but at a cost that society may not be prepared to pay. So here we define shortages more broadly to include situations where demand substantially exceeds supply at the prevailing price, as well as where price rises sharply in the short run or persistently in real terms over the long run. Armed with this definition, we now proceed to examine the different reasons why mineral shortages might occur.

Resource Depletion—A Long-Run Challenge for Technology

The first step in mineral production is extraction or mining. As known deposits are depleted, new ones must be discovered or eventually shortages arise.

Two very different views of this potential problem are found in the literature. The physical view, in logic both simple and appealing, points out that since the world is finite, the available amount of a mineral commodity is a fixed stock; this is so regardless of whether we are able to see its magnitude or boundaries at any given time. Demand, on the other hand, is a flow variable that continues year after year. As a result, it is only a matter of time before the latter consumes the former and the world faces shortages. Many who adhere to this view often see the end coming sooner rather than later, as they believe demand is growing exponentially over time. Probably the best-known example of this view is found in *Limits to Growth*.[1]

The second—or economic view—of resource exhaustion does not envisage the world literally running out of mineral commodities, but instead anticipates a persistent climb in real prices over time as the better, low-cost, mines are depleted and the world is forced to turn to poorer grade, more remote, and more difficult to process deposits—all characteristics that spell rising costs.

Physical versus economic. While the ultimate effect could be just as adverse if higher prices eventually force most or all consumers to do without, there are important differences between these two perspectives. Under the economic view, shortages resulting from resource exhaustion do not occur suddenly without warning, like a speeding automobile with a broken fuel gauge that runs out of gas. Rather, they take place slowly over a long period as prices rise higher and higher. There is time to adjust to adverse consequences. More important, shortages are not inevitable: while the depletion of low-cost mineral deposits tends to push prices upward, other developments and, in particular, technological change, can partially or totally offset this tendency. And while nonfuel minerals may be widely dispersed or degraded when used, they are not destroyed, though in a given instance cost may prevent recovery.

The future availability of nonfuel minerals thus hangs largely on the outcome of the race over the long run between the cost-increasing effects of depletion and the cost-reducing effects of new technology. In the past, technology clearly has won. The real cost of producing mineral commodities has declined substantially over the last century.[2] Whether this will continue to be the case indefinitely is hotly debated. Optimists point to the past and cite earlier prophecies of doom that

never have come to pass, and argue that there is no reason to believe the future will not unfold as has the past. They extol human ingenuity and note that impending shortages and higher prices encourage the technological progress needed to keep them from actually occurring. Pessimists, on the other hand, argue that the past probably is a poor guide to the future, especially in light of the tremendous growth in aggregate mineral demand during the last fifty years. They charge the optimists with blind faith in a technological "fix" to the depletion problem and consider this both simplistic and dangerous. Some also argue that the past record is deceptive in that material costs have declined largely because environmental costs associated with production have not been paid.

Which of these two views is closer to the truth, we simply do not know. Indeed, given the inherent uncertainty surrounding the future course of technological progress, there probably is no way of finding out: an early end to the debate is unlikely.

We suggest, however, that resource depletion does not pose an early threat. In particular, reserves—that is, the quantity of the mineral commodity in discovered deposits that are economic to mine given current prices and technology—are for most mineral commodities sufficient to last for the next thirty to fifty years, and for some way beyond. Moreover, where this is not the case, submarginal deposits are readily available that could be profitably exploited with only modest increases in prices.

In summary, for the near-to-middle term, future resource exhaustion does not appear to be a serious problem. Whether this happy situation will continue into the more distant future, we do not know and, indeed, cannot know. The answer depends on how successful technology is at holding the cost-increasing pressures of depletion at bay.

Investment—Two Conflicting Views

Even with high-quality reserves, shortages can arise if investment in mines and processing facilities is insufficient. Such shortages are likely to be self-correcting, for the surge in prices they generate normally will induce the needed investment. Still, new capacity cannot be built overnight. Major new mines, particularly those in remote and undeveloped areas, may take from five to seven years to bring into operation.

Ports, rail lines and roads, power plants, town sites, and other facilities may take as long to construct as the mines themselves. Naturally, if new capacity can be added by expanding existing facilities or by developing mines in established mining districts, the time required is shorter. Even in such cases, however, the delivery, installation, and breaking in of new equipment usually takes at least two years from the decision to proceed. Consequently, shortages caused by insufficient investment, though temporary and self-correcting, can cause serious problems for several years.

In examining the likelihood of such shortages, one again finds two very different views. Some observers are greatly concerned that we are not developing new mines and processing facilities to meet inescapable future demand. Many who adhere to this position are associated with major mining firms, which gives rise to suspicion that their alarm is self-serving. Yet these individuals as a rule are intimately familiar with their industries. They can cite the new mines being developed, where they are, and when they will be on-stream. They know the projects that have been stretched out, postponed, or canceled—the casualties of current market conditions. And they are familiar with how demand has grown in the past and have considerable experience in projecting it into the future. When questioned as to why they are not building more new capacity to take advantage of the favorable market conditions that the predicted shortage should produce, they point out that low profits and depressed stock prices make it impossible for them to generate internally the necessary funding. External funding from banks and other financial institutions, they argue, also is unavailable, not because the capital market has dried up, but rather because lenders—either conservative or myopic—will not lend large sums on the expectation that future requirements will drive prices up to profitable levels.

The opposing view, not surprisingly espoused by many members of the financial community, holds that the capital markets suffer from neither myopia nor other imperfections. Rather, adherents of this view maintain that external funding will be readily and amply available just as soon as there is some credible evidence that additional capacity is needed and will earn a competitive rate of return. They note that over the last decade the mineral industries in general have suffered from excess capacity, which has kept prices and profits depressed. They question whether economic growth in the industrialized nations during

the rest of this century will recapture the vitality it displayed during the 1950s and 1960s. If, as is widely believed, long-run economic growth will continue to be slow, they are not convinced that investment in the mineral sector indeed is inadequate and that serious shortages loom as a result.

Both views seem plausible. However, some evidence does exist indicating that mineral firms begin more new investment projects when markets are booming and delay or cancel more projects when markets are depressed.[3] Given the long gestation period involved in bringing a new mine or processing facility on-stream, one would expect new investments to be undertaken in response solely to long-run growth trends. The fact that temporary, short-term market fluctuations appear to be important as well suggests that current conditions may unduly influence the long-run view of the market held by investors. This lends some support to the view that investors are myopic, and that by discouraging adequate investment in new mineral capacity, current depressed market conditions are sowing the seeds of future shortages.

Interruptions in Trade—The Problem of Import Dependence

Even with ample reserves and adequate investment, shortages still may occur because of interruptions in mineral production or trade, and unexpected short-term surges in demand. The first of these potential problems is examined in this section, the second in the next.

As with oil, strikes, natural disasters, embargoes, war, and a host of other factors can threaten the flow of mineral commodities to U.S. consumers. Neither domestic nor foreign supplies are immune to such interruptions. U.S. copper production, for example, in the past has been shut down for months by industry-wide strikes. Similarly, low snow cover in the Pacific Northwest on occasion has seriously curtailed hydroelectric power generation and, in turn, aluminum reduction located in that part of the country.

Still, the United States depends heavily on foreign producers for bauxite, cobalt, chromium, manganese, nickel, tin, and other important metals, as figure 3-5 indicates. Much of the recent public concern over possible shortages has focused on the possibility that these essential

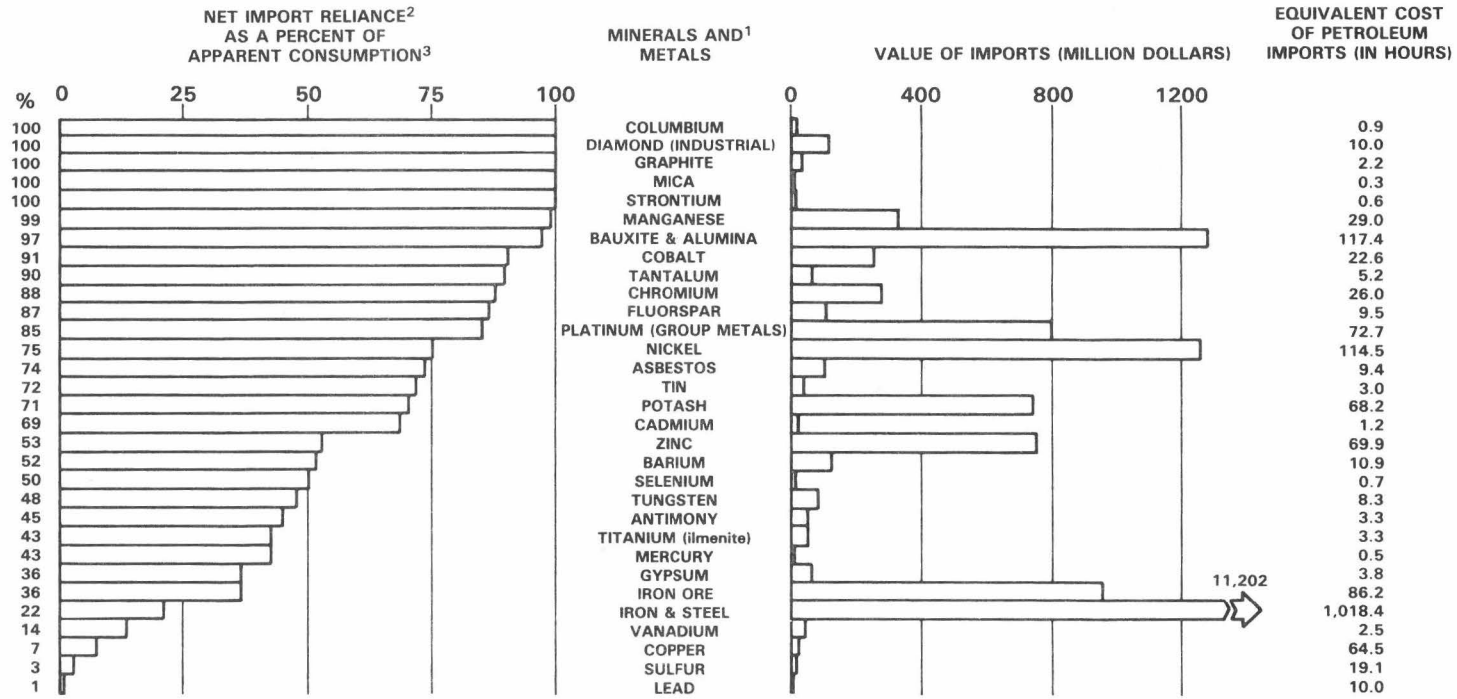

Figure 3-5. U.S. net import reliance of selected minerals and metals as a percentage of consumption for 1981, in billions of dollars. Data for left-hand portion of figure are from U.S. Department of Interior, Bureau of Mines, *Mineral Commodity Summaries 1983*; and from John D. Morgan, "U.S. Resource Dependence," paper presented at the U.S. Department of Energy Workshop on Resources from Coal Waste and Ash, held in Reston, Virginia, June 10, 1982. Data for right-hand portion of figure are from *Minerals Yearbook, Centennial Edition,* vol. 1, table 10; and Energy Information Administration, *Annual Report to Congress,* 1981. Hourly costs of petroleum imports taken as $11 million.

imports will be restricted or cut off. Threats posed by cartels, embargoes, civil disruptions, and a "resource war" have been singled out for particular attention. Indeed, it would be fair to say that this area constitutes "the minerals problem" for many participants and observers. Because it is sensational stuff, it dominates the treatment of minerals in the news media, to the detriment, we believe, of serious long-range but more pedestrian issues, such as investment. Yet, because it looms so large in the public debate, we deal with it in some detail.

Cartels

Following the sharp increases in oil prices in 1974, it was widely believed that other mineral producers soon would join together and raise their prices. At first, a number of events seemed to bear this out. Unilateral price increases by Jamaica on bauxite and by Morocco on phosphate rock, which were followed by a number of other producing countries, appeared to confirm this concern. So, too, did the flurry of activity at about this time that led to the formation of producer associations in iron ore, bauxite, and other mineral commodities.

It now is clear that the danger of cartels in the nonfuel minerals sector was exaggerated, if not wholly unfounded. The association of major copper-exporting countries tried and failed to restrict output and maintain prices. Morocco and other phosphate rock producers soon had to rescind their price increases. Jamaica and the other Caribbean bauxite-producing countries that followed its lead in raising export taxes watched helplessly as new investment moved to other countries and their own enterprises stagnated.

To assess the future prospects for cartels, it is important to know why the expectations following the oil price increase were not realized. Are there fundamental differences between oil and the nonfuel minerals that preclude the successful creation of nonfuel cartels? Or does the explanation lie more in the long, deep slumber that overtook most mineral markets during the mid-1970s? If the latter is true, does this mean that new cartel efforts can be anticipated once the world economy recovers, and that these efforts then are likely to be more successful?

In answering such questions, we need to examine the conditions that favor the formation and maintenance of cartels. The number of

such factors is quite large, but for our purposes they can be conveniently consolidated into four necessary conditions.

Limited membership. First, the number of major producing and exporting countries must be limited. The difficulties of reaching an agreement on market share, price, and other terms, acceptable to all parties, increase sharply with the number of potential participants. For most mineral commodities, this condition is satisfied, as 75 percent or more of world mine output comes from the eight largest producing countries. For chromium, nickel, platinum, tin, and many other metals, the level of concentration exceeds 90 percent.

Inelastic demand. Second, the responsiveness or elasticity of demand to changes in price must be small. Otherwise, any effort to raise price will cause a sharp loss of sales and result in lower rather than higher profits.

This condition is satisfied for most minerals in the short run—up to three years or so—but not in the long run. The reason for this is that minerals are used primarily to make metals and other materials, which in turn are inputs into final consumer and producer goods. Rarely do they constitute more than a small percentage of the total costs of the final goods in which they are embodied. The steel in an automobile, for example, accounts for no more than 5 percent to 10 percent of a car's price, and the cost of the copper or aluminum is even less significant. This means that the price of a mineral commodity can rise significantly without greatly affecting the price and hence output of the final goods from which its own demand is derived. Any significant decline in the demand for a mineral commodity caused by a rise in its price comes about through efforts by the manufacturers of final goods to substitute other, now cheaper, materials. While such substitutions often are possible, few can be made quickly. In the production of automobiles, for example, plastics and other materials can be used in place of aluminum, but such changes take several years to incorporate into the production process. It is for this reason that demand responds little to a change in price in the short run, but much more over the longer run.

Inelastic supply. Third, the responsiveness or elasticity of supply outside the control of cartel members must be small. Otherwise, an

increase in price will result in a sharp loss of market share for cartel members, as producers elsewhere expand their output.

Once again, it is necessary to differentiate between the short and long term. As noted earlier, it takes from three to seven years to build new mines and processing facilities. Consequently, if an industry is operating at capacity and if available private and public stocks are small, prices can rise sharply in the short run without attracting much additional supply into the market. Over the long run, however, this is not the case, for sufficient time exists for building new capacity outside the control of the cartel.

Cartel cohesion. Fourth, the bonds among cartel members must be strong enough to prevent individual members from deserting the cartel or secretly cheating. The history of most mineral cartels again indicates that this condition may hold in the short run, but not over the long. Few cartels celebrate their fifth birthday, and only the rare exceptions have lasted ten years or longer. The DeBeers Central Selling Organization, which for almost a century now has controlled the world diamond market, truly is unique in this respect.

Just why the bonds holding most cartels together dissolve after a few years is not entirely clear. Presumably the explanation lies largely with the increased difficulties of keeping all members satisfied when the cartel's total market and profits are being eroded by the increased output of outside suppliers and by the substitution of alternative materials by consumers. And it is, of course, true that any member for which a short-term advantage is critical can reap it by violating cartel terms.

These considerations suggest that the necessary conditions for successful mineral cartels may be satisfied in the short run, except where idle production capacity or significant stocks exist outside the control of the cartel. However, since these conditions do not hold in the long run, cartels once established are likely to founder within a few years.

According to current conventional wisdom it seems irrational for producing countries to trade long-term market growth and profits for temporarily higher prices; therefore, mineral cartels are unlikely to arise even under better economic conditions. This conclusion, however, implicitly assumes that producing countries are fully aware of the adverse consequences associated with cartel participation, and that

their governments are not faced with such pressing problems that they feel compelled to maximize the immediate returns from their mineral sector, regardless of the longer-term consequences. Since these assumptions may not always hold, future attempts to form mineral cartels cannot be completely ruled out.

Embargoes

Although both restrict trade, embargoes differ from cartels in several respects. Most basically, cartels are designed to raise the prices and profits realized by their members, while embargoes are imposed to relieve domestic shortages or to pressure foreign governments. For example, the United States on occasion has restricted exports of metal scrap to provide assistance to domestic consumers that claim they could not pay prices high enough to keep the scrap from flowing abroad. In a brief but celebrated instance in 1973, the U.S. government limited exports of soybeans to Japan and other countries to relieve excess pressure on supplies. This country's trading partners never fail to resurrect the memory of the soybean embargo whenever U.S. reliability as an exporter is discussed.

Examples of embargoes to pressure foreign governments are equally easy to find. For many years, exports of chromium from Rhodesia (now Zimbabwe) were proscribed under United Nations sanctions in retaliation for that country's unilateral declaration of independence from the United Kingdom and for its racial policies. In 1973 the Arab oil-exporting countries embargoed exports to the Netherlands and the United States to protest Middle East policies of these two countries and, in particular, U.S. support for Israel. The United States itself for a long time prohibited trade in minerals and other commodities with mainland China, and still imposes such sanctions on trade with Cuba.

Perhaps of greater importance than the difference in objectives is the fact that embargoes may completely cut off trade. For example, those imposed for security reasons, such as sensitive military and high-technology goods and services, are designed precisely to prevent trade in those items. Obviously, cartels will not go to this extreme, for this would eliminate rather than increase member profits.

Rarely are embargoes very successful, at least when imposed for political reasons. In addition, the long-run costs often are high for the imposing countries. Shortly after World War II, the Soviet Union

embargoed manganese shipments to the United States and other Western countries. At the time, this action created considerable concern, for the Soviet Union was a major world supplier of manganese. The result, however, was not the intended change in U.S. policies, but instead the development of new manganese mines in India and elsewhere and the loss of Soviet world markets for this mineral commodity. Similarly, U.S. trade sanctions against China and Cuba appear to have had little success in achieving their desired objectives. Nor have U.S. embargoes of grain shipments to the USSR, which merely shifted Soviet purchases to alternative suppliers, as world harvests were plentiful.

Despite this poor record, embargoes continue to be attractive because they provide a visible means of expressing disapproval. When the use of stronger measures is ruled out, they give the appearance of bold action, whether or not they actually inflict any hardship on the offending country. Similarly, in countries beset by shortages and domestic inflation, they appear as constructive steps to the general public. In such situations, they even may provide some temporary relief, though at the expense of the country's foreign customers who are likely to turn to more reliable sources as soon as they are able. So, for appearances, governments are likely to continue to impose embargoes from time to time, and in the process disrupt the flow of mineral commodities in world trade.

War and Civil Disruption

Interruptions in mineral trade resulting from cartels and embargoes are the result of deliberate policies. With war and civil disruption, trade is more a hapless casualty of the breakdown in order. Twice during the late 1970s, for example, rebels based in Angola invaded the Shaba province of Zaire and overran that country's principal mining regions. As Zaire is the world's largest cobalt producer, the resulting interruption in production sent prices soaring and consumers in the United States and elsewhere scrambling for alternative sources of supply.

Past and potential flashpoints that involve mineral supply cuts could be multiplied many fold, but the point needs no belaboring. Until the world is free of war and civil disruption, production and trade of

minerals—and other location-bound commodities—will continue to be vulnerable to such disturbances.

Resource War

Over the last several years, a school of thought has emerged, especially in the United States, warning of a "resource war" with the Soviet Union that threatens the security of mineral supplies from abroad, and particularly from southern Africa. In its most pointed version this is seen as part of a long-run comprehensive plan to deny the West access to the mineral wealth of southern Africa and as such is looked upon as complementing a Soviet desire to control the oil resources of the Middle East, with the invasion of Afghanistan as an alleged preliminary step.

What is not clear in these speculations is how the Soviet Union could pursue a resource war (even assuming it actually wanted to: the evidence on that point is hardly convincing, as has been pointed out in some detail in a number of recent studies).[4] Clearly the country does not have the foreign exchange to outbid western consumers for mineral supplies from southern Africa. Moreover, even if it did, this only would raise prices and stimulate expanded sources of supply in the future. Nor does it seem likely that the Soviet Union is prepared to commit large numbers of its ground forces to the region, given the logistical difficulties and the political repercussions. If it were prepared to confront the West so openly, it would find the Middle East an easier and, with its oil, a more attractive target. The ups and downs in Soviet production and trade combined with the uncertainty surrounding statistical information leave a wide-open field for speculation about motivations of policy, but the resource war interpretation seems based on thin premises.

This leaves the possibility of the Soviet Union's exploiting political and tribal conflicts and supporting indigenous opposition to South Africa and its racial policies. Such a strategy can be pursued with much less risk and cost. While offering the possibility of Soviet influence in the area, it is unlikely to lead to actual control. With fresh memories of their colonial past, the new nations of Africa will not meekly surrender their hard-won independence to a new foreign power. Moreover, their own national interests, not those of the Soviet Union or world socialism, are likely to receive highest priority. Indeed, Soviet

pressures to embargo mineral exports to the West probably would backfire, for such exports correctly are perceived as a vital source of foreign exchange and economic development. In fact, when new Marxist governments have come to power—even with the help of the Soviet Union, as in Angola, Guinea, Mozambique, and Zimbabwe—they have tried to encourage, not cut, their mineral exports to and economic ties in general with the West.

For these reasons, the resource war thesis appears implausible. Not that imports of manganese, cobalt, chromium, platinum, and the other mineral commodities from southern Africa may not from time to time be interrupted. This region is going through a turbulent transition as it sheds its colonial past and moves toward black majority rule. The odds are far from trivial on wars, embargoes, rebellions, and even cartel attempts as these newly independent states grapple with their internal difficulties and hostile neighbors. But to attribute the insecurity of mineral supplies from this region to Soviet policies in pursuing a resource war misses the fundamental causes of this insecurity. This is important not for ideological reasons, but because a mistaken diagnosis is apt to lead to inappropriate and unnecessarily costly and divisive policies.

Dependence in perspective. Because it is so central to the question of import dependence, and in a way constitutes the heart of the case, we turn for a moment to figure 3-5. This impressive chart of net import reliance, published annually by the U.S. Bureau of Mines, also shows the value of U.S. imports for the same commodities for the same year. The result is illuminating. The two items showing sharp fluctuations, and of little relevance here, are gold and silver. They have been eliminated so as not to bias results in a given year. (Results will differ from year to year, but not severely.) In 1980 the total value of imports of the top five ("100 percent") entries, which contribute to the strong visual impression of dependency, was $155 million, equivalent to what in that year the United States paid for fourteen hours of oil imports. If we aggregate the import value of all minerals—omitting gold and silver—that show a dependency greater than 50 percent, the total is $6.3 billion; and of this group, four of the five largest, representing two-thirds of that total—nickel, bauxite and alumina, zinc, and potassium—present no import security problem, coming as they do from reliable sources, mostly in the Western Hemisphere. The large

import values are at the bottom of the chart, but here import dependence is small and, at times, not very meaningful in the context we are dealing with. The largest item by far, of course, is iron and steel products, with a 19 percent import dependence. And here the problem lies in a different sphere altogether, that is, U.S. industrial competitiveness. What this juxtaposition suggests is that in value terms the disconcerting aspect of the graph on the left reflects only half the story. The full truth is that the country faces a number of separable supply issues involving commodities with modest dollar amounts, and thus more easily amenable to management, rather than a general threat to its survival. Modest value, while not indicating absence of a problem, does suggest manageability. While for lack of a nail a horse may be lost, it should be feasible to see to it that sufficient nails—or substitutes—are at hand. We shall return to the matter presently when we discuss remedies.

Surges in Demand

Recent concern regarding future mineral shortages has focused primarily on embargoes, civil disruptions, and other threats to the smooth flow of mineral trade, and to a lesser extent on resource depletion. Meanwhile, an equal or possibly greater problem has been largely ignored. From time to time unexpected surges in demand push demand substantially above its long-run trend. On such occasions, even though long-term supply is adequate, severe shortages occur that may persist for several years.

Military emergencies and booms in the business cycle are the most common causes of demand surges. The manufacture of arms and other military equipment requires large amounts of specialty steels, copper, aluminum, magnesium, and other metals. Consequently, when a country becomes embroiled in a war, it finds that its immediate need for mineral commodities jumps substantially above peacetime requirements.

Similarly, an economic boom can cause sharp surges in mineral demand. This is because the demand for most mineral commodities is derived largely from four end-use sectors—construction, capital equipment, automobile and other transportation, and consumer durables. The output of these sectors fluctuates with the general level of economic

activity, but much more severely. When the economy is weak, their output may contract by 20 percent or more. Then when the economy recovers, their output rises sharply. However, as pointed out earlier, once full capacity is approached in the minerals industries, neither demand nor supply responds quickly to short-run changes in price. So, during an economic boom, either mineral prices must rise greatly to keep supply and demand in balance or producers must allocate or ration their available supplies. In either case, the result is shortages of mineral commodities.

Strong cyclical swings are not new to the mineral industries. For example, many mergers at the turn of the last century led ultimately to the formation of the U.S. Steel Corporation, with command at that time over some two-thirds of the country's steel-making capacity; a major force driving the mergers was the desire by producers to gain some control over the volatile steel market. Still, several recent studies suggest that the disruptions caused by such market instability may be growing more severe.

Increasing volatility. On the basis of a detailed examination of monthly fluctuations in the industrial production of the United States, Japan, Britain, France, the Federal Republic of Germany, and Italy, Chien concluded that the volatility of world industrial production, after declining from the 1950s to the 1960s, rose sharply during the 1970s.[5] His data indicate that this recent jump is due mainly to two factors—an increase in the amplitude of the business cycle of the United States and other major countries, and a growing synchronization of business cycles among the major industrialized powers. Consistent with this finding is the fact that the last major wave of mineral shortages took place during 1973 and early 1974 when the economies of the industrialized countries all were experiencing a strong economic boom. It was this situation that motivated Congress to establish the Supplies and Shortages Commission.

Some recent evidence provided by Grubb also suggests that, over the last thirty years, mineral producers, fabricators, and speculators may have reduced their willingness to vary their inventories in a countercyclical manner.[6] In particular, he found that the combined refined copper stocks held by producers and fabricators rose by an average 700 tons when monthly copper consumption dropped 1,000 tons below its five-year average in the 1950s. By the 1970s, this average

inventory adjustment had declined to less than 400 tons, suggesting that when the economy is expanding the mineral stocks accumulated during the previous market downturn and available to help meet a possible surge in demand are likely to be far smaller than was the case twenty to thirty years ago. To the extent this finding holds for other countries, for other mineral commodities, and for copper at other stages of production, it raises the likelihood that future shortages due to cyclical surges in demand will be more severe and disruptive than in the past. High interest rates, by raising the cost of carrying stocks, can be a powerful factor in this area.

Summing Up

To recapitulate, there are four potential threats to the future availability of mineral commodities—resource depletion, insufficient investment in mines and processing facilities, interruptions in production and trade, and unexpected surges in demand. In designing appropriate mineral policies for coping with shortages, it is important to note that resource depletion differs from the other threats in three respects.

First, shortages caused by depletion occur over many years as real prices rise gradually, but persistently. In contrast, insufficient investment, interruptions in trade, and surges in demand are difficult to foresee and typically occur suddenly, with little or no warning. As a result, they tend to produce large jumps in price or actual physical shortages as producers ration their limited supplies.

Second, depletion-induced shortages, should they occur, can be expected to persist for many years and perhaps indefinitely, as the technology required to offset the price-increasing effects of depletion cannot be generated quickly. The other threats to the availability of minerals, while they may produce severe problems for several years, are not likely to result in lasting shortages. Insufficient mine and processing capacity can be rectified within a few years by new investment. Similarly, strikes, cartels, embargoes, civil disruptions, and other interruptions in trade usually are relatively short lived; if longer-lasting, new sources of supply can be developed in unaffected areas. While this may require the mining of submarginal deposits at somewhat higher costs, the extra costs typically are not great. Unexpected surges in demand also tend to be temporary, whether they result from booms in the business cycle or military buildups. Again,

new capacity can be built within a few years if a surge in demand persists. To sum up this point: mineral shortages other than those generated by resource depletion are temporary. The disruption they cause generally is greatest immediately following their imposition, and then dissipates with time as consumers switch to alternative materials and producers develop new sources of supply.

Finally, while new technology may or may not be able to hold the cost-increasing effects of depletion at bay indefinitely, depletion is very unlikely to produce shortages over at least the next few decades, for reasons already discussed. This means that policies to prevent mineral shortages over the rest of this century, or to alleviate their adverse consequences, should be designed to cope with the short-term—though potentially severe—shortages produced by insufficient investment, interruptions in trade, and sudden demand surges.

Policy

What role might policy play in reducing the probability of shortages and their potential adverse consequences? While certain government actions can enhance security of supply with little or no cost, most such actions already have been taken. Consequently, greater security usually must be bought, in the sense that it can be acquired only at a cost. Often the cost involves consumers paying higher prices for mineral commodities.

In developing policies to protect the country from shortages, the government resembles an individual buying insurance. Two decisions are paramount. First, how much protection is desired? The answer depends on the cost of the insurance, the probability that shortages in fact will occur, the estimated adverse effects if they do, and the country's collective aversion to such risks. Second, how can the desired level of protection be acquired at least cost? Alternative policies must be reviewed in terms of the protection they afford and their costs.

Complicating the analysis is the fact that protection is a multi-dimensional concept. Some policies, for example, offer immediate—but only temporary—relief from shortages. Others have longer lead times, but once in place provide permanent protection. Certain policies may be particularly effective in preventing shortages, but of little

assistance in alleviating shortages should they occur. Still other policies may be useful in dealing with particular types of shortages—those due to insufficient investment, for example—but not with other types.

How best to reconcile these various aspects or dimensions of protection, how much protection overall is desirable, and what combination of policies offers that level of protection at least cost? Judgments differ greatly, and so it is not surprising that U.S. mineral policy has been the focus of lively debate for years. The central elements of that policy since World War II, the recent push toward greater self-sufficiency, and an alternative policy that would rely primarily on stockpiling for greater protection against mineral shortages are examined next.

Past Mineral Policy

Many claim, usually with distress, that the United States never has had a mineral policy. And in the sense of a policy that is both comprehensive and internally consistent, they are right. Calls for such a policy, however, in our view are naive. As this volume documents in part, mineral policy is intertwined with energy, environmental, taxation, foreign, and defense policies. Government decisions in each of these areas affect and thus help shape mineral policy. The latter simply is not of such importance that these impacts always are consistent from the perspective of those for whom minerals form the primary focus.

In addition, the United States is among the world's largest mineral producers as well as consumers. So when mineral markets are out of balance—no matter in which direction—certain domestic groups are adversely affected and likely to turn to the political system for relief. As a result, mineral policy is not entirely shaped by fears of shortages and other consumer concerns, but rather is the product of a political process that takes into account the interests of producers and other special groups. Unsurprisingly, therefore, decisions made during shortages, when consumers are hard pressed for supplies and prices are rising sharply, often work at cross purposes with policies formulated when markets are depressed and producers in distress.

Finally, the diversity within the mineral sector calls into question the feasibility of a comprehensive policy. The governmental decisions

needed for tin are quite different from those appropriate for aluminum, chromium, or molybdenum, let alone steel or copper.

For these reasons, one should not expect to find in the past—or in the future, for that matter—a comprehensive and consistent U.S. mineral policy, except perhaps as a call for a "sound and prosperous U.S. minerals industry" as is usually found as a preamble to a bill passed by Congress or a study sponsored by the White House. This does not mean, however, that there has been no policy. Myriad governmental decisions have shaped mineral policy; many are inconsistent in their effects on the mineral sector, and few are comprehensive in that they influence all or most mineral products. While an effort to identify all of these decisions would be futile, it is possible to identify two important elements or tenets that have characterized past U.S. mineral policy.

Least-cost supplies. First, the federal government not only has permitted, but even has encouraged domestic consumers to obtain mineral supplies at lowest cost, regardless of where they are found. In this connection, it has helped U.S.-based mineral firms develop mines in Canada, Peru, Australia, and other countries by offering low-cost loans, favorable taxation on foreign earnings, and insurance against expropriation and other political risks. The government also has resisted pressure from domestic producers for protection from imports. Of course, there have been some exceptions. President Eisenhower approved voluntary restrictions on lead and zinc imports in 1954, but only after efforts to appease hard-pressed domestic producers through expanded stockpile purchases proved inadequate. More recently, the carbon and specialty steel industries have received some protection but, again, only grudgingly. The more typical response to the pleas of domestic producers has not gone beyond the commissioning of studies or public pronouncements regarding the importance of a strong domestic mineral industry. The mounting of a study, which postpones at least for several years the need for any concrete action, has proved especially effective in the highly cyclical mineral sector: by the time a study is completed, markets often have recovered.

Stockpiling for security. But second, while encouraging domestic consumers to search worldwide for the lowest-cost sources for their mineral supplies, U.S. mineral policy has not completely ignored

security issues. Here, however, instead of promoting self-sufficiency, it has relied primarily on stockpiling.

Legislation authorizing the federal government to stockpile mineral commodities goes back to 1939. However, wartime needs and then higher budgetary priorities during the immediate postwar period delayed the actual accumulation of stocks. It was the start of the Korean conflict in June of 1950 that eventually induced Congress to provide substantial funds for stockpiling. After this war was over, stockpiling continued, in part to bolster prices and assist the depressed domestic mineral industry. In addition, as Eckes has noted,[7] President Eisenhower took a personal interest in maintaining and increasing the stockpile:

> Through the mid-1950s, the Eisenhower administration pursued a systematic policy of building up materials stock piles, and the explanation for this vigorous policy rests with Eisenhower himself. The old general believed raw materials were better than gold; "the materials within our stock piles represent insurance against disaster," he told friends at a White House stag dinner. In 1956, when other members of the National Security Council suggested the government economize and cut back on its mobilization stock pile, because raw materials reserves caused uncertainty in the commodities markets and because these inventories seemed anachronistic in an age of atomic war, Eisenhower stood firm.

By the end of the 1950s, the United States had in place a substantial stockpile, containing many of the mineral commodities it imports.

Since that time, the stockpile has received much attention. Its size and composition, as well as the conditions under which its stocks are released, all have been subjected to considerable scrutiny and questioning. During the Kennedy and Johnson administrations, stockpiling goals were reduced by assuming a one-year, rather than a three- to five-year, war. This allowed the government to declare its holdings of some commodities in excess, and to sell off parts of the stockpile to alleviate inflation, domestic shortages, and budgetary constraints. More recently, goals again have been set on the assumption of a three-year war. As a consequence, the government now is buying certain minerals, such as cobalt, that no longer meet stockpile goals, while selling others, such as tin. At present, the composition of the stockpile is badly out of balance when measured against its objectives. Forty

percent of its holdings are surplus to goal; on the other hand, its gross acquisition needs are equal to the total value of the stockpile.

Despite such imbalance, the United States has for twenty-five years possessed substantial public stocks of the major mineral commodities that it imports. These stocks over this period have constituted the country's principal defense against an unexpected interruption in foreign supplies.

Growing Pressure for Greater Self-Sufficiency

As a result of the policy just described, the United States—despite its tremendous mineral wealth—relies heavily on imports for many mineral commodities. This dependence often is contrasted with the almost complete self-sufficiency of the Soviet Union, which, for a number of reasons, has followed a deliberate policy of resource autarky. This has been quite costly in some instances, but the Soviet Union does produce almost all of the mineral products it needs.

Contrary to some popular argument, however, the United States has not passed through a major transformation over the last thirty years, moving from the status of a "have" to a "have-not" nation, from relative self-sufficiency with a net export balance to critical dependence on imports. The case for dramatically increased vulnerability—apparently perpetuated by the country's experience with petroleum—simply is not valid for the nonfuel minerals. For years, the United States has acquired most or all of its supplies of many important mineral commodities from abroad. In 1950, for example, foreign mines provided 71 percent of the country's bauxite, 77 percent of its manganese, 80 percent of its tungsten, 91 percent of its platinum, 92 percent of its cobalt, 99 percent of its nickel, and 100 percent of its chromium. This is basically the same list of commodities that generates most of the attention and concern today. Moreover, for some commodities, such as tungsten, domestic production actually has increased and import dependence decreased.

What then has changed? Why the growing interest in greater self-sufficiency?

Increasing imports. The United States has become a major importer of iron ore and steel, while in the early years after World War II it

was largely self-sufficient in iron ore and a net exporter of steel. Imports of bauxite and alumina also have increased over the years, though, as noted, bauxite from abroad already accounted for nearly three-quarters of domestic consumption more than thirty years ago.

Processing shifts. Some shift in processing capacity overseas also has taken place. Aluminum now is being imported as alumina as well as bauxite. Zinc is entering the country primarily in the form of refined metal rather than as ores and concentrates, and the processing of ferroalloys increasingly is taking place abroad. Such shifts raise questions about the usefulness of domestic low-grade ores: can they bear the costs of having to be shipped abroad for processing or will they become submarginal? The transfer of processing also increases the steps in the production chain over which the United States has no direct control, and so is widely presumed to increase the country's vulnerability to supply interruptions. This, however, need not be the case. For example, alumina-producing plants are built to treat a particular type of bauxite. If imports are disrupted, other types of bauxite cannot readily be substituted. Alumina, on the other hand, is a homogenous commodity, so domestic aluminum producers can feed their smelters with alumina from anywhere in the world. This increases the choice of alternative sources of supply in the event of an interruption. The lower cost of shipping processed minerals, as they contain less waste, also tends to increase the distances from which alternative supplies can be shipped economically.

Consumption growth. Perhaps a more significant development over the last thirty years has been the substantial growth in total consumption and variety of end-use applications of a number of mineral products the United States imports. Specialty steels and other alloys, in particular, have found their way into many new high-technology and military products. Consequently, unless counteracted by stockpile releases, an interruption in supplies today could have more extensive and serious consequences than in the early postwar period.

Political changes. Finally, two important political developments apparently have increased the risks associated with mineral imports. The British Commonwealth, the French Community, and the other

colonial empires that once controlled much of the developing world largely have disappeared as operating entities. The newly independent states that have emerged in their place are not always able to maintain the security and political stability required for continuous mining operations.

In addition, the economic nationalism and the fear of foreign ownership that swept through the former colonies, and also the developing countries of Latin America and developed countries, have undermined the major multinational mining corporations that for decades have dominated the production of mineral commodities, from exploration to marketing. In some countries the properties of these firms have been nationalized and now are run by the government. Other countries have forced companies to divest partial ownership to domestic interests, and still others have imposed taxes or regulations that have threatened the economic viability of company operations. For decades, the United States and other major industrialized countries have relied on these firms to supply minerals their economies require. Their waning influence calls into question their ability to continue to perform this function.

Reducing Dependence

Although import dependence is not new, the recent interest in greater self-sufficiency in the United States is not hard to understand. By increasing domestic production and lowering imports, so the argument goes, the country can reduce its exposure or vulnerability to mineral shortages.

Protectionism. Among the various measures advanced for promoting domestic production is more protection from imports. Here the advocates of greater self-sufficiency have enjoyed some success in recent years. As noted earlier, voluntary quotas, trigger prices, and other forms of protection in particular have limited specialty and carbon steel imports. There also have been efforts to curtail imports of copper, zinc, and ferroalloys, although they have not been as successful.

Tax changes. Changes in tax policy that would reduce the incentives for U.S. mineral firms to invest abroad also are being advocated.

Removal of the depletion allowance on foreign mining and the deferral of taxes on income earned abroad until repatriation have been suggested. In addition, the government-sponsored Overseas Private Investment Corporation could discontinue offering to domestic mining companies investing abroad insurance against expropriation and other political risks.

Regulatory relief. Also proposed is the relaxation of worker health and safety and environmental regulations that have been imposed on industry over the past two decades. These regulations raise domestic production costs, particularly in the mineral sector, and so increase the attractiveness of developing new mines and processing facilities abroad. The recent decision of Anaconda to close its smelter at Butte, Montana, and to ship copper concentrates to Japan for smelting often is cited as an illustration of this point, as this decision was made in part—according to the company—to avoid the costs of meeting environmental standards at the Butte smelter.

Exploiting federal lands. The opening of more federal lands to mineral exploration and development also is favored. Such lands account for about one-third of the country's surface, including Alaska, and contain many of the geologically more promising areas. Over the last twenty years, a large portion of this publicly held territory was set aside for other purposes, though there is much controversy over how large that portion really is, and how severe the restrictions are.

Direct subsidies. More direct subsidies, such as long-term purchase contracts at guaranteed prices, also are being proposed. Such supports, established in the Defense Production Act of 1950, were used in the early 1950s to encourage the rapid expansion of mineral capacity during the Korean conflict. Today they could be used to stimulate domestic production. For example, at the Blackbird cobalt deposit in Idaho, production might be feasible at four to five times the 1982 spot price of about $6 per pound of imported cobalt. Platinum in Montana is another possibility.

This incomplete list of the various measures being advocated to promote self-sufficiency illustrates the breadth and diversity of the proposed responses to the growing pressure for a major shift in U.S. mineral policy. While the push for change is largely the result of greater

concern over the security of mineral supplies, it has been reinforced and accentuated by the deep and prolonged recession in mineral markets that has forced domestic producers to look to the government for relief. So far this alliance of interests has not fundamentally altered the postwar policy of relatively free mineral trade. Some government actions recently have been more consistent with the policy of self-sufficiency than free trade, but they still are exceptions. Whether the old policy eventually will crumble and make way for one emphasizing self-sufficiency is unknown. The possibility certainly exists. Whether such a change is desirable is considered next.

The Stockpiling Alternative

A shift in mineral policy toward greater self-sufficiency is attractive politically, as it would help the distressed domestic mineral sector while enhancing the security of supplies for consumers. However, greater security can be acquired only at a cost. If the country wants to buy more protection or insurance against the threat of shortages, it can do so in different ways. The rational policy is the one that buys the desired level of protection at the lowest possible price. This raises the question, Is greater self-sufficiency the most efficient way to reduce the country's vulnerability? Or can other policies provide the desired protection at lower costs?

No single answer is valid for all mineral commodities. For some, particularly those where marginal domestic producers are almost competitive with foreign firms supplying the U.S. market, self-sufficiency may be relatively inexpensive and so the best policy. However, for most mineral commodities, this is not likely to be the case.

The cost of greater self-sufficiency can be high in both economic and political terms. Poorer-grade and more difficult to process domestic ores are more expensive to exploit. The resulting higher prices that domestic consumers must pay are not merely transfer payments from them to producers, but entail real costs in the sense that more labor, capital, and energy must be consumed to meet the country's mineral needs. Nor do these costs occur just once or for a temporary period: they continue year after year for as long as public policy requires or encourages the use of poorer-quality domestic resources. The social and political costs associated with self-sufficiency involve the sacrifice of other social and public objectives, such as a cleaner environment,

safer working conditions, or the preservation of wilderness areas. They also may compromise various foreign policy goals, such as the economic integration of the Western world through greater trade, or the economic development of Third World countries.

In addition, a policy of self-sufficiency implicitly equates vulnerability with import dependence. While dependence is one determinant of vulnerability,[8] there are many others—the diversity of foreign suppliers, the particular countries from which imports are obtained, domestic opportunities for material substitution, the economic and strategic importance of the end uses of mineral imports, opportunities for recycling, and the level of public and private stocks. As a result, no simple linear relationship exists between vulnerability and import dependence. Vulnerability can be high even in the absence of imports, and low despite considerable import dependence. A policy that emphasizes self-sufficiency and neglects the other factors that determine vulnerability is not likely to be efficient, but it may be very expensive.

A First Line of Defense

What then are the alternatives? In our view, stockpiling in many instances is likely to offer the most protection for the least cost, and deserves far more attention in the current debate over U.S. mineral policy than it is receiving. If the shortages the country is likely to encounter in the future will be of relatively short duration, as was concluded earlier, stockpiles are ideal. They provide an alternative source of supplies when normal channels are disrupted, without diverting investment and production from low-cost areas. Thus, they minimize the adverse effects of short-term shortages in a way that does not reduce over the longer run the efficiency of world production and the benefits of trade. Even at worst—if shortages persist for longer than expected and exhaust accumulated stockpiles—stockpiling still serves as an effective first line of defense by providing a cushion of time that allows the country to increase domestic production, to substitute alternative materials, or to develop other more permanent adjustments.

Stockpiling often is dismissed as too expensive. This conclusion, however, usually rests on a misunderstanding that confuses the real costs of stockpiling with its acquisition costs. The funds expended to purchase or accumulate stocks reflect merely the exchange of one asset for another. Just as an individual is no poorer after he draws

down his savings account to buy a house, the government is no poorer after it has exchanged public revenues for copper, chromium, cobalt, or other mineral products. It may have a liquidity problem in marshaling the necessary funds, but the cost of the purchase does not reflect the consumption of real resources.

There are, of course, real costs associated with stockpiling. First, and most important, are the interest or opportunity costs on the capital tied up in maintaining stocks. Other resources also are consumed in holding and administering stockpiles. However, these costs generally are much lower than those incurred in promoting self-sufficiency, for stockpiling does not divert mining and processing from low- to high-cost areas.

This suggests that the recent push for greater self-sufficiency is misdirected, and that the postwar policy of encouraging access to low-cost mineral supplies should be continued, using stockpiles to reduce the country's vulnerability to shortages. Such a policy, however, places a heavy burden on stockpiling, and calls for a careful review of its proper role.

Disposal Policy

In the past, the government has accumulated and held strategic stockpiles under legislation that authorizes their disposal only during military emergencies. In practice, the government has used stockpile purchases and sales to stabilize mineral markets and for other non-military purposes. However, as Gauntt has shown,[9] such efforts have not been particularly successful, in part because their primary military purpose eventually constrained their flexibility in dealing with other mineral problems. A broader role for stockpiling that encompasses more than just military emergencies may be needed.

Such a change in the role of stockpiling would require a clearer specification of the purposes of stockpiling and the conditions under which sales were to occur. On occasion, the government has used stockpile sales to reduce the federal budget deficit, and to prevent producers from raising prices. Ways to prevent such unintended uses of the stockpile are needed, particularly if its role is extended.

This raises the possibility that part or all of the stocks that mineral policy supports as insurance against shortages might be held by firms and other private interests rather than by the federal government. This

could make it more difficult for public officials to use the stockpile for unintended purposes, and might increase support for a broader stockpiling policy from the mineral industry, which views stockpiling with substantial misgivings. If properly designed, such a policy also might reduce the adverse effects that public stocks have on the incentives of firms to hold their stocks. The government could encourage such holdings through various measures that would help the private sector defray the additional costs.

Thus, while continuing a U.S. mineral policy that favors free access to low-cost mineral supplies worldwide and uses stockpiles to protect the country against shortages has much to commend it, stockpiling's part in the policy could be enhanced. In particular, a broader role that envisages the use of stockpiles for more than just military emergencies—as is now the case for petroleum stockpiles—with the private sector playing a more direct and active role in the actual accumulation and maintenance of stocks, seems worthy of serious consideration. More narrowly, a review is overdue of the military scenario underlying the stockpile objectives, as of the rules governing both acquisition and release decisions.

Summing Up

In summary, there are legitimate concerns for the uninterrupted flow to U.S. industry of a variety of minerals, some for the long run and some more of a short-term nature. The market provides for the needed adjustments, but temporary imbalance between supply and demand, signaled by changes in prices, cannot be avoided. When the cry of "shortages" goes up, care must be taken to diagnose the cause or causes, lest public policy, responding to pressures, thwart rather than support these adjustments.

Yet there are some potential perturbations in production or trade that call for government intervention in the form of policies that are best thought of as buying insurance. A thorough review and rethinking of concepts as well as implementation seems indicated, but all things considered, adequate stockpiles at present remain the most readily available and lowest-cost remedy.

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