MMSD

Mining, Minerals and Sustainable Development

October 2001 No. 19

Mining and Economic Sustainability: National Economies and Local Communities

Roderick G. Eggert
Division of Economics and Business,
Colorado School of Mines, US

This report was commissioned by the MMSD project of IIED. It remains the sole responsibility of the author(s) and does not necessarily reflect the views of the MMSD project, Assurance Group or Sponsors Group, or those of IIED or WBCSD.

Copyright © 2002 IIED and WBCSD. All rights reserved

Mining, Minerals and Sustainable Development is a project of the International Institute for Environment and Development (IIED). The project was made possible by the support of the World Business Council for Sustainable Development (WBCSD). IIED is a company limited by guarantee and incorporated in England. Reg. No. 2188452. VAT Reg. No. GB 440 4948 50. Registered Charity No. 800066

iied
International Institute for Environment and Development

World Business Council for Sustainable Development

1 Introduction 3

2 Nations: Is Mining a Curse? 6

2.1 A Profile of the Mineral Economies 6
2.2 Possible Explanations For Poor Performance 8
External Market Forces 8
Internal Economic Stresses 9
Political Explanations 11
2.3 Systematic, Comprehensive Analyses 13
Implications 14

3 Local Communities and Regions: What Are the Economic Effects? 18

3.1 Geography, Location, and Localization 18
3.2 Understanding Economic Effects: A Regional (Top-Down) Perspective 20
Direct Effects 21
Linkages and Multipliers: The Concepts 22
Linkages and Multipliers: Estimates and Interpretation 23
3.3 Understanding Economic Effects: A Project (Bottoms-Up) Perspective 25
3.4 History And The Role Of Mining In Regional Development 31
Victoria and Western Australia 31
Three Models of Mining and Regional Development 33
The Strong-Linkage Model 33
The Weak-Linkage (Enclave) Model 34
Sustainable-Development: A Model Yet to be Defined Fully 34

4 Guiding Concepts for Management: Wealth, Capital, and Economic Rents 43

4.1 Wealth and Capital 43
4.2 Economic Rents 46

5 Managing Mineral Wealth: Challenges and Roles 53

5.1 Roles: A General Introduction 53
5.2 The Creation Challenge 55
Governments 55
Private Companies 59
Civil Society 59
5.3 Distribution Challenge 60
Philosophy and Principles 61
Critical Questions 62
5.4 The Macroeconomic And Political Challenge 63
External Factors 63
Internal Structural Change 65
Political Issues 65
5.5 The Investment Challenge 67
How Much To Save and Invest? 67
By Whom? 68
In What? 69
Where to Invest? 71
Investment Funds: In Trust or for Development and Other Purposes? 71

6 Summary and Conclusions 75

References 79

1 Introduction

Mining and mineral processing have the potential to be important sources of income and driving forces behind broader economic development. But this potential is not always realized. In fact, the mineral-dependent nations include some of the poorest and worst performing economies in the world. Mining does not always contribute to sustainable economic development.

The purpose of this study is to answer two questions: What are the economic effects of mining and mineral processing? Can we manage mineral wealth so that the economic benefits are enhanced in the short term and sustained over the long term, even as individual mines inevitably decline? The study examines these questions from the perspectives of both national economies and local communities. Chapters 2 and 3 consider the economic effects of mining on national economies and local communities. Chapters 4 and 5 then focus on managing mineral wealth. Chapter 6 summarizes the main findings and their implications.

This study is primarily a review of the literature and my interpretation of this literature. It concentrates on large-scale commercial mining; the special issues and considerations surrounding small-scale, informal, and artisanal mining are outside the scope of this study. Also largely outside the scope of this study are the environmental and socio-cultural consequences of mining; although important, they are not the focus here. This study, rather, concentrates on the economic aspects of mining and the sustainability of mining's benefits.

Before proceeding with the main part of this study, it important to consider the context of mining and economic sustainability.

Context

The terms s*ustainability* and *sustainable development* are both illuminating and confounding. They are illuminating because they remind us that unfettered markets, for all their advantages in organizing economic affairs, do not always bring us the outcomes we desire. Specifically, it is possible that some economic or commercial activities today may be unsustainable--in that they come at the cost of such significant environmental damage or social disruption that future generations are worse off than the present generation. Yet the concepts of sustainability and sustainable development are confounding because they have come to mean almost anything, which in turn implies that they are in danger of having no meaning other than as slogans.

What do I take these terms to mean? "Sustainability" is really a simple concept. It requires only that something be maintained at its current level--for example, environmental quality or economic well being. This term originally referred to the management of renewable resources such as a fishery or a forest; a resource was being managed in a sustainable manner if the harvest rate was no greater than the natural or biological rate of regeneration. "Sustainable development" is more recent, nuanced, and complicated. It requires that development be sustained. But what is development? It is first and foremost a multidimensional concept. One dimension is economic, reflecting the desire to improve

economic well being, which we might estimate as the per capita income of a nation. A second dimension is environmental and reflects the desire that improvements in economic well being not come at the cost of diminished environmental quality. A third dimension is socio-cultural and reflects the desire that improvements in economic well being occur in a manner that is socially just. Social justice relates primarily to fairness--in the distribution of the benefits and burdens (economic, environmental, and social) that result from economic growth, and of the process through which decisions about commercial activities and public policy are made. Sustainable development, in other words, requires that human beings act in ways that simultaneously sustain or enhance economic well being, the quality of the natural environment, and social justice.

How do mining and minerals fit into this picture of sustainability and sustainable development? At first glance, mining and minerals would seem to be quintessential unsustainable activities. Individual mines have finite reserves that once mined are gone. The earth's crust contains only a limited quantity of any mineral. Yet for several reasons, this view of mining and minerals is misleading. First, mining is more sustainable than it appears. Through mineral exploration and development, mining companies replace reserves that mining depletes. Through technological innovation, mining companies are able to discover or mine resources that otherwise would be technically or commercially unfeasible to mine. Second, recycling sustains the benefits of the materials made possible by mining, even if a mine itself is not sustainable. Third, and most important, even if a mine itself is not sustainable, in principle the economic benefits created by mining can be sustained indefinitely through appropriate investment in education, health care, infrastructure, and other activities that can create well being long after mining ceases. In other words, a depleting mineral resource can, in effect, be converted into a sustainable, renewable source of human well being through appropriate investment.

This study focuses primarily on this third issue--sustaining the economic benefits of mining, which is what I mean by the phrase *mining and economic sustainability*. Although this study concentrates primarily on the economic dimension of sustainable development, it acknowledges the importance of the environmental and socio-cultural dimensions and suggests how they might be incorporated, at least partially, into the analysis.

To this point, the study might sound like one of purely academic interest. Such could not be further from the truth. The extractive industries--mining, as well as oil and gas--have come under strong attack recently. For example, in September 2000, Friends of the Earth International released a position paper calling for the phasing out of public financing for mining and fossil fuel projects, arguing that

> *extractives [the extractive industries] do not foster sustainable development or alleviate poverty*

(Friends of the Earth, 2000). Ross (2001, p. 17) concludes his review of the oil, gas, and mining sectors in the developing countries with:

> We believe the best course of action for poor states would be to avoid export-oriented extractive industries altogether, and instead work to sustainably develop their agricultural and manufacturing sectors--sectors that tend to produce direct benefits for the poor, and more balanced forms of growth.

So, on the one hand, mining has the potential to contribute to sustainable development, if mineral wealth is created and appropriate investments are made to ensure that mining's economic benefits are sustained. On the other hand, the performance of a number of economies dependent on mineral production has been poor enough to lead some observers to call for nations and communities to avoid mining.
It is in this light that this study has been prepared.

2 Nations: Is Mining a Curse?

Do mineral resources enhance a nation's economic well being? The answer would seem to be self-evident: Minerals should be a blessing. They are a gift of nature available to be developed, sold, and used to better the lot of a nation's citizens. Mineral production generates income and foreign exchange (if exported), can stimulate local economies through the local purchase of inputs (see Chapter 3), and can be the basis for downstream processing and manufacturing industries. Mining companies employ workers, who earn income, some of which they spend on domestically produced goods and services. Governments receive tax revenues from mineral production, which are available to fund education, health care, roads, electric-power supplies, and other forms of infrastructure.

Yet often minerals seem to be a curse. Many nations blessed with abundant mineral resources have not performed well economically over the last several decades. Some observers even suggest that national economies would be better off leaving their mineral resources in the ground. Others, however, argue that there is nothing inevitable about poor economic performance in the mineral economies; poor performance, it is argued, is due to other (non-mineral) factors.

To assess whether minerals are a blessing or a curse, this chapter proceeds in two parts. The first part presents a profile of the mineral economies--those economies especially dependent on mineral production--and their performance. The second part examines the possible reasons for the under-performance of the mineral economies.

2.1 A Profile of the Mineral Economies

Which national economies can be considered "mineral economies"? What is their level of economic development? How have these economies performed over time? Taking the first question first, there is no universally accepted definition of the mineral economies. Anticipating the discussion later in the chapter of the possible resource curse, one could imagine at least three measures of mineral dependence (see Davis, 1995). First, if problems of mineral dependence originate in international trade and its effects on a national economy, then it would be appropriate to investigate mineral exports relative to total exports (e.g., mineral exports as a percentage share of total merchandise exports in a country). Second, if problems of mineral dependence are the result of mining and how it is linked (or not linked) with domestic economic activities, then it would be appropriate to examine the size of the mineral sector relative to the overall economy (e.g., value added in mineral production as a percentage share of gross domestic product). Finally, if problems of mineral dependence are caused largely by how government collects and uses mineral revenues, then it would be useful to look at government revenues from mineral production (perhaps as a percentage share of total government receipts).

Lack of data precludes estimating mineral dependence in all three ways. This chapter relies on international-trade data. More specifically, it defines a mineral economy as one in which

mineral exports represent 25% or more of total merchandise exports.[1] Using this figure (25%) as the cutoff is admittedly arbitrary, but it provides a starting point for examining the mineral economies. Table 2.1 ranks all countries for which data are available, based on mineral exports as a percentage share of total merchandise exports in 1999.

Thirty-four nations qualify, under my definition, as mineral economies. Examining the list of nations, the common themes are diversity and heterogeneity. Fourteen nations are primarily exporters of *ores and metals*, while 20 are *fuel* exporters. These nations are *geographically* diverse: 4 in East Asia and the Pacific, 5 in Europe and Central Asia, 7 in Latin America and the Caribbean, 9 in the Middle East and North Africa, and 9 in sub-Saharan Africa. These nations exhibit a wide range of *per capita incomes*: 13 are considered low-income countries by the World Bank (per capita gross national product in 1999 of US$ 755 or less), 11 are lower-middle income (US$ 756-2995), 7 are upper-middle income (US$ 2996-9265), and 3 are upper income (greater than US$ 9265) (Table 2.2).

Turning from income levels to *growth in per capita income*, we again see a considerable range among the mineral economies between 1975 and 1998 (Table 2.2)--ranging from +4.2% per year in Chile to -9.8% per year in Azerbaijan. By country group, only the high-income group of mineral economies had a growth rate greater than 1% per year over this period, compared to a average growth rate for all developing countries of greater than 2% per year.

The low-income mineral economies as a group had lower (real) per capita incomes in 1998 than in 1975. While 13 of the mineral economies had a higher GDP per capita in 1998 than 1975, 20 mineral economies had lower GDP per capita at the end of this period. Among the poorest performing economies were the former centrally planned economies of Kazakhstan and Tajikistan, in addition to Azerbaijan, noted above.

Income is not a complete measure of well being. So it is instructive to look at a broader indicator of development, such as the United Nations Human Development Index (HDI). This index combines three measures of development: per capita income, life expectancy, and adult literacy. The index numbers range from a maximum value of 1.0, representing the highest possible levels of income, life expectancy, and literacy, to a minimum value of 0. Looking at actual HDI figures in the mineral economies in 1998 (Table 2.2), the HDI index ranged from a high of 0.929 in Australia to a low of 0.293 in Niger. Not surprisingly, there is a crude relationship between per capita income and this broader measure of development--the higher the per capita income of a nation, the higher the HDI index. What is surprising, however, is the extent to which the HDI index for many mineral economies increased between 1975 and 1998, even though real per capita incomes fell over the same period--representing increases in life expectancy and adult literacy during a period when incomes fell; this is true for Bolivia, Democratic Republic of the Congo, Mauritania, Niger, Nigeria, Saudi Arabia, Senegal, South Africa, Togo, and Venezuela. The only mineral economy in which the HDI index fell between 1975 and 1998 is Zambia.

[1] This trade-based definition of mineral dependence is consistent with Auty (1999), although he defines mineral dependence as 40% or more of total exports coming from minerals. Alternatively, Sacks and Warner (1999) define resource dependence as resource exports as a percentage of gross domestic product. Davis (1995) combines both output and trade data to construct a mineral-dependence index.

Where does this leave us? It is clear that the mineral economies are diverse and difficult to describe in only a few, general terms. They are diverse geographically and in terms of the level of per capita income, life expectancy, and adult literacy. These nations include some with growth in per capita income greater than 4% per year between 1975 and 1998 (e.g., Chile and Indonesia), as well as nations with negative rates of per capita GDP growth (e.g., Niger and Zambia). Nevertheless, it also is possible to make some strong observations: The mineral economies include some of the poorest nations in the world and economies that performed very poorly over the last quarter of the twentieth century. The next part of this chapter examines more closely the possible links between mineral wealth, on the one hand, and economic performance, on the other.

2.2 Possible Explanations For Poor Performance

Observers have proposed a number of explanations for the relatively poor performance of at least some of the mineral economies. These hypotheses can be grouped into three categories or schools of thought.

External Market Forces

The first school of thought focuses on external market forces and their potentially detrimental effects on economies relying heavily on production and export of primary commodities, including minerals, as well as agricultural, fishery, forestry, and energy commodities. In turn, this line of reasoning has two variants. The first emphasizes *long-term* trends in commodity prices relative to the prices of manufactured goods. It argues that relative commodity prices are falling over the longer term and thus that national economies should concentrate on manufacturing and industrialization, rather than primary commodities. This hypothesis usually is attributed to Prebisch (1950) and Singer (1950). Whether commodity prices relative to manufactured-good prices are falling over the longer term has been the subject of much debate and empirical study. There are a number of issues over which analysts disagree, including quality of data, methods for constructing price indexes, and statistical techniques for analyzing the data. These issues notwithstanding, the World Bank (2000a) concludes in a review of recent studies that commodity prices fell relative to the price of manufactures between 1980 and 1999. Importantly this review finds that the decline in prices was due to a number of random shocks that were on balance more negative than positive; the fall in prices, therefore, does not represent a consistent, predictable trend. Even if commodity prices are declining, however, profits from mineral production need not be falling as long as the price decline is matched by reductions in production costs; in fact, many would argue that commodity prices have fallen over the longer term precisely because technological innovations have lowered costs of production.

The second variant in this category focuses on the *short-term* volatility of commodity prices. The argument is that commodity prices are more volatile than prices of other goods and services, and that this volatility makes it more difficult for governments and companies to manage their activities in a way that facilitates economic growth. Specifically: volatile prices lead to volatile revenues, which in turn creates greater uncertainty; the result is less investment than would occur if overall earnings were similar but more stable; less investment leads ultimately to less economic growth. This argument raises several

questions. Are commodity prices less stable than manufactures' prices? The World Bank (2000a) concludes that they indeed have been since the collapse of the Bretton Woods system in the early 1970s; prices for agricultural and mineral commodities have been less volatile than energy-commodity prices, although more volatile than manufactures' prices. Another question is, does greater volatility lead to lower economic growth? Not necessarily, although the evidence is mixed. Sachs and Warner (1995) find no relationship between terms-of-trade volatility and economic growth. Terms of trade represent the ratio of export prices to import prices. The World Bank (2000a) finds that commodity-price volatility did not adversely affect the growth prospects for exporters of agricultural and mineral commodities in Sub-Saharan Africa. Dehn and Gilbert (1999) find that uncertainty in commodity prices results in lower growth rates, although good public policies and foreign aid can offset this negative effect on growth.

The most relevant points here are: Although price volatility can lead to lower economic growth, such volatility does not have to result in lower growth. Not all volatility leads to uncertainty. That prices for primary commodities are unstable from one year to the next is well known and thus to some extent predictable. Moreover, there are ways to manage the potentially negative consequences of price instability through the use of commodity loans, derivative-market hedges, and appropriate public policies (see chapter 5 of this volume).

Internal Economic Stresses

The second school of thought focuses on a domestic (national) economy and the potentially detrimental effects of a large or expanding natural resource sector on other sectors in this economy. The starting point is a model known as the Dutch disease after internal stresses experienced by the Dutch economy in the 1960s and 1970s as a result of a boom in natural gas exports, made possible by huge natural gas discoveries in the 1950s (Kremers, 1986). As Caves, Frankel, and Jones (1996) note, the "disease" was the hardship experienced by traditional export sectors of the Dutch economy, which shrank as a result of expanding gas exports. Other sectors serving local markets (for example, services) experienced much less disruption as a result of the expansion of natural-gas exports. Other countries reliant on exports of primary commodities had similar experiences in the 1970s and early 1980s.

The Dutch disease is easiest to understand in a simple model of a national economy with three sectors:

- A booming commodity sector, which exports to a world market. The expansion or boom in exports may be caused by several factors, including an increase in world prices or an increase in domestic supply resulting from a large mineral (or oil and gas) discovery.
- A traditional export sector, which is not experiencing a boom. In many cases, this is manufacturing or agriculture.
- A non-traded sector, which produces goods or services that are not imported or exported because of prohibitively high costs of transport. Many services are non-traded.

One effect of expanding production and exports in the booming sector is a bidding up of input costs (such as wage rates) in the booming sector--necessary to attract the additional

inputs (for example, workers) needed to expand output. Focusing on labor costs, an increase in wage rates is likely to occur as long as there is not significant unemployment. If all three sectors of the economy draw on the same labor pool, then wage rates will increase in all three sectors. In turn, the increase in labor costs will squeeze the traditional export sector because the prices at which it sells its output are determined in world markets. The result usually will be a contraction in this traditional export sector. A similar effect results from an increase in other inputs costs. As for the non-traded sector, the adverse effects of the boom will be less severe than for the traditional export sector; in fact, the non-traded sector may even be better off on balance. Even though wage rates or other input costs increase, at least some of this cost increase is likely to be passed on to consumers; there is no world market price keeping a cap on the price of output from the non-traded sector. Moreover, demand for non-traded output may increase because of the additional income earned by the booming sector.

A boom in natural-resource exports also may affect a nation's exchange rate, especially when natural-resource exports are a large portion of its total exports. Specifically, the real exchange rate may appreciate--that is, a unit of domestic currency will purchase more units of a foreign currency than previously was the case. The effects of domestic-currency appreciation on the traditional export sector are adverse. Its revenues are determined by prices in world markets; these now decline in terms of the domestic currency. At the same time, their labor costs increased (see previous paragraph). The usual result is a further squeezing and contraction of the traditional export sector.

Is the Dutch disease really a "disease"? As Davis (1995, p. 1768) notes, "there is nothing inherently growth-inhibiting in mineral booms and any resulting Dutch disease phenomena." Total output and income for an economy increase as a result of the boom in natural-resource exports, even though traditional exports fall. Any market economy constantly evolves and changes. At any point in time, some sectors and companies rise while other sectors and companies are in decline. Fundamentally, the Dutch disease represents a change in the structure of a national economy during a period of boom-induced economic growth. It really is only a disease in an economic sense: (a) to the extent that there are stresses associated with adjusting to change, (b) if governments respond to political pressure and intervene to protect the industries hurt by the structural change, or (c) if the boom in mineral exports is temporary, and it is difficult to restart the traditional export industries that shrank as a result of the Dutch disease effects (Mayer, 1999a).

Another line of reasoning, however, says that minerals are detrimental to an economy simply because they have a lower potential for long-term economic growth than alternative economic activities, especially manufacturing. This lower-growth potential could exist if production of primary commodities has fewer beneficial backward and forward linkages with the rest of the economy than manufacturing (Hirschman, 1958; Seers, 1964; Baldwin, 1966). Or growth could be lower if there are more significant learning-by-doing externalities in manufacturing than in mining. In this case, the argument is that more of any learning-induced increase in productivity spills over to the economy as a whole in manufacturing than mining. Over the longer term, inputs used in mining could yield more significant economic growth if used in manufacturing, assuming that they were equally productive initially in both mining and manufacturing.

The empirical evidence on these theoretical possibilities--mining has fewer beneficial backward or forward linkages than manufacturing, or less learning-by-doing that is external to the firm--is far from conclusive. Estimates of the magnitude of linkages are available from a number of input-output and computable-general-equilibrium models. Porter (1984), for example, presents estimates of the output, income, and employment multipliers for agriculture, mineral production, manufacturing, and services in Australia. These multipliers range between 1.5 and 2.5 for mineral production, compared to about 1.5 for agriculture, 1.8-2.3 for manufacturing, and 1.2-1.6 for services. Stilwell, et al. (2000) present output and employment multipliers for South Africa; multipliers for the mining sector were either somewhat less than or comparable to the economy-wide multiplier averages for all economic sectors. These and other estimates do not suggest that mining is necessarily uncoupled from the rest of an economy. Rather they suggest a wide range of possible linkages--from enclave to well integrated. As for learning by doing, there has been less empirical analysis. In one of the few such studies (a cross-country econometric analysis), Sachs and Warner (1999) find little evidence that natural-resource dependent economies have lower rates of human-capital accumulation than resource-poor nations, which we would expect if natural-resource industries, including mining, had less learning-by-doing than other economic sectors.

Political Explanations

The third school of thought focuses on political or political-economy explanations. It argues that the relatively poor economic performance of some mineral economies is due largely to how governments and other groups in society respond to booming or large windfall revenues from mineral production. In effect, the argument here is that governments and society end up squandering the potential benefits of mineral abundance. There are several lines of reasoning:

The first suggests that some governments respond to expanding mineral production and prospect of contracting production of other exports (especially manufacturing and agriculture) by protecting these shrinking sectors through tariffs, quotas, or other trade restrictions. Governments with new-found mineral revenues find it hard to resist calls to protect those sectors adversely affected by the mineral boom. Contributing to the desire to protect domestic manufacturing is the almost religious fascination with manufacturing as a means to economic development. Over time, such trade protection leads to a mis-allocation of productive resources in an economy and less economic growth. Sachs and Warner (1999) find some statistical support for the proposition that resource-abundant economies are less open to international trade as a result of restrictive trade policies than resource-poor economies.

Another body of literature (reviewed and critiqued by Davis, 1998) focuses on the effect of mineral abundance on the strength and quality of government institutions. It argues that mineral wealth--with a considerable degree of determinism--leads to weak, inefficient, and sometimes corrupt institutions, which in turn lead to poor economic performance. Davis (1998, p. 220) notes that in this body of work: “societies that are not 'up against it' prefer to avoid policy changes that vested mineral interests view as potentially painful” and “governments tend to operate 'as a patron and dispenser of favors, not as an organizer of

productive energies' [Snider, 1996] (p. 67)". Mahon (1992) suggests that natural-resource poverty can be an *advantage*: large exports of natural resources leads to appreciation of a nation's exchange rate, resulting in a shrinking of export-oriented manufacturing and a deterrent to any new manufacturing for export, similar to the Dutch disease described above; moreover, the political power of the strong natural-resource sector is combined with the interests of many urban households, which benefit from a strong exchange rate because it makes imports relatively less expensive; overall these vested interests inhibit a government's ability to promote export-oriented manufacturing, which is viewed as beneficial, even critical, to overall economic development. Karl (1997), in a study of oil-exporting economies, argues that windfall gains led to predatory states in which rent seeking substitutes for rent creation:

> In this sort of state, the market has so penetrated all aspects of public life that almost anything is up for sale. Rentier behavior is the norm in both the public and private sectors; thus productive investment is less likely.
>
> (p. 236)

The result is wasteful spending on social programs and infrastructure and an ineffective state--to the benefit of special interests and to the detriment of broader economic development.

Ascher (1999) is more optimistic. He argues that most analysis of government policies and institutions in resource-rich countries has been overly simplistic:

> The depressing conclusion too often reached is that the unsound policies are simply a matter of greed or ignorance. When governments squander natural resources, critics usually assume that government officials are selfish, shortsighted, corrupt, incompetent, or poorly trained.. . .Indeed, the explanations for unsound government resource policies are much more subtle, and much more hopeful than the standard diagnosis that governments misuse resources out of a combination of greed, politics, and stupidity.
>
> (pp. 2-3)
>
> The trick is to grapple with the much more complex reality that government leaders have complicated programmatic objectives, while not being so naïve as to ignore their self-centered political motives.
>
> (p. x)

He organizes his analysis around sixteen case studies--two from mining, five from oil, and nine from agriculture, forestry, land, and water. These case studies illustrate a depressingly large number of policy failures--ill-defined property rights, mispricing of inputs and products, poor investment decisions by state agencies, wasteful spending by government agencies not accountable for their spending, and so on. Yet Ascher concludes that there is nothing inevitable about wasteful use of natural resources. In fact:

> natural resources represent potential wealth; without the resources, developing nations would be even poorer
>
> (p. 6).

One econometric study provides empirical support for the proposition that poor government institutions and policies have hindered the economic development of natural-resource-rich nations. Sachs and Warner (1999, p. 26) find that resource-rich nations are more likely to have "particularly low scores on international measures of bureaucratic efficiency and institutional quality." But they are quick to note that there is nothing inevitable about this correlation.

That some mineral economies have poor government and institutions, have mis-managed mineral rents, etc., is clear. Where there is disagreement, however, is over the inevitability of this seeming cause-and-effect relationship.

2.3 Systematic, Comprehensive Analyses

Most examinations of the relationship between mineral wealth and economic development have been based on case studies and generalized, stylized facts. There have been relatively few systematic, comprehensive studies.

The most recent and comprehensive studies are by Sachs and Warner (1995, 1999). Both papers examine cross-country differences in rates of economic growth. The 1995 study finds that the rate of economic growth is inversely related to natural-resource intensity--the higher a nation's natural-resource exports as a percentage share of GDP, the lower its growth rate, even after controlling for other factors important for growth, such as initial per capita GDP, international trade policy, government efficiency, and investment rates. The study models the growth rate of real per capita GDP (1970-1989) for some 100 developing countries. Sachs and Warner (1999), already cited in this chapter, find that natural-resource intensity is negatively associated with both the quality of legal and government institutions in a country and the degree to which an economy is open to international trade. That is, the more dependent a country is on natural-resource exports, the poorer the quality of institutions and the more closed an economy tend to be to international trade. Both factors--poor institutions and hindered trade--certainly can be argued to contribute to lower rates of economic growth.

Davis (1998) identifies five other comprehensive studies, which illustrate how difficult, even dangerous, it is to make generalizations about the relationship between mineral abundance and economic growth. Wheeler (1984) examines GDP growth between 1970 and 1980 for 25 countries in sub-Saharan Africa. He finds that (non-oil) mineral economies had *lower* growth rates than non-mineral economies. Mainardi (1995) finds that mineral economies and non-mineral economies have *similar* growth patterns, in his analysis of 70 developing countries and their growth rates between 1960 and 1985. Sala-i-Martin (1997) finds that a nation's rate of economic growth *increases* the higher the fraction of GDP in mining. Auty and Evans (1994) obtain mixed results; whether mineral economies performed better or worse than non-mineral economies depends on the period of analysis and the grouping of countries. All of these studies use GDP to compare the performance of national economies. Davis (1995) instead uses broader indicators of social development to compare mineral and non-mineral economies. These indicators include life expectancy at birth, infant mortality rates, calorie supply per capita, percentage of children attending primary school, and adult

literacy rates. He finds that the mineral economies made more progress in these areas than the non-mineral economies.

Implications

What are we to make of all of this--anecdotes, descriptive statistics, theory, comprehensive empirical analyses?

Taken to the extreme these arguments suggesting a resource curse imply a surprising set of conclusions for public policy (see Davis, 1995):

- A nation is better off if its minerals are not discovered. Therefore, make exploration illegal. Discourage geological mapping.
- If mining has to occur, make sure it is an enclave. Require that mining be undertaken by foreign companies. Discourage spillover effects by forbidding local purchase of inputs and labor.
- International organizations should penalize developing countries for developing their mineral resources.

Even Sachs and Warner (1995, 1999), who have the strongest systematic evidence that minerals (actually natural resources) are detrimental to national economic development, do not make these arguments. They conclude (1999, p. 26):

> We do not agree that this curse of natural resources is an iron law of political economy…
>
> There is much to be learned from studying the resource abundant developing countries that have done well in the recent past:
>
> Botswana, Chile, Malaysia, and Mauritius…
>
> Which is worse: the natural resource curse, or the policy errors made as countries attempt to avoid the curse?…
>
> Although [we do] find evidence for a negative relationship between natural resource intensity and subsequent growth, it would be a mistake to conclude that countries should subsidize or protect non-resource-based sectors as a strategy for growth.

The informed consensus is that minerals have the potential to contribute significantly to economic development (see, for example, Ascher 1999, Davis 1998, Deaton 1999, Mayer 1999b). Minerals are potential wealth. But, as we have seen, minerals also bring with them challenges for national economies--living with market instability; adjusting to booms, busts, and structural changes in an economy; dealing with rent-seeking behavior so that rents are created in the first place, and so on. Governments and their policies for managing mineral wealth play a decisive role in whether minerals are, in fact, a blessing or a curse.

Table 2.1 Mineral Dependence in the Structure of Exports, 1999 (% of Merchandise Exports)

Country	Ores and metals	Fuels	Total
Nigeria	0	99	99
Algeria	0	96	96
Libya	0	95	95
Yemen	0	93	93
Saudi Arabia	1	85	86
Venezuela	4	81	85
Kuwait	0	79	79
Oman	1	77	78
Guinea	71	0	71
Azerbaijan	1	69	70
Syrian Arab Republic	1	68	69
Niger	67	0	67
Zambia	66	..	66
Kazakhstan	22	42	64
Mongolia	60	..	60
Norway	7	50	57
Trinidad and Tobago	0	54	54
Russian Federation	11	41	52
Peru	40	5	45
Chile	43	0	43
Colombia	1	40	41
Egypt	4	37	41
Congo, Dem. Rep.	40	..	40
Mauritania	40	..	40
Australia	17	19	36
Papua New Guinea	35	0	35
Tajikistan	35	..	35
Ecuador	0	33	33
South Africa	21	10	31
Bolivia	23	6	29
Indonesia	5	23	28
Jordan	27	0	27
Senegal	10	17	27
Togo	27	0	27
Armenia	13	9	22
Bulgaria	11	8	19
Kyrgyz Republic	6	12	18
Greece	7	10	17
Lithuania	2	15	17
Morocco	15	2	17
Argentina	4	12	16
Albania	13	1	14
Canada	4	9	13

Ghana	8	5	13
Zimbabwe	11	2	13
Brazil	10	1	11
Kenya	3	8	11
Panama	2	9	11
Belarus	1	9	10
Croatia	2	8	10

Notes: The category Ores and Metals includes SITC divisions 27, 28, and 68 (nonferrous metals). The category Fuels represents SITC section 3 (mineral fuels). Exceptions: For the Dem. Rep. Congo, Mauritania, Mongolia, Tajikistan, and Zambia, the catogory Ores and Metals also includes SITC 522.66.

Sources: World Bank, World Development Indicators 2001 (Washington, D.C., World Bank, 2001). Exceptions: For the Dem. Rep. Congo, Mauritania, Mongolia, Tajikistan, and Zambia, the data on Ore and Metal Exports comes from UNCTAD, Handbook of World Mineral Trade Statistics 1994-1999 (New York and Geneva, UNCTAD, 2001)

Table 2.2. GDP Per Capita and Human Development Index for the Mineral Economies

	GDP Per Capita (1995 US $)			Human Development Index (HDI), max=1.0		
	1975	1998	Annual Ave % Growth, 1975-1998[b]	1975	1998	% Change, 1975-1998
High Income Countries						
Australia	14,317	21,881	1.9	0.841	0.929	10.5%
Kuwait	21,838	16,756	-1.3	..	0.836	..
Norway	19,022	36,806	2.9	0.853	0.934	9.5%
Mean	18,392	25,148	1.2	0.847	0.900	10.0%
Upper Middle Income Countries						
Chile	1,842	4,784	4.2	0.702	0.826	17.7%
Libya	..	..	..	..	0.760	..
Oman	3,516	5,668	2.4	..	0.730	..
Saudi Arabia	9,658	6,516	-1.7	0.588	0.747	27.0%
South Africa	4,574	3,918	-0.7	0.645	0.697	7.9%
Trinidad and Tobago	3,302	4,618	1.5	0.719	0.793	10.3%
Venezuela	4,195	3,499	-0.8	0.714	0.770	7.7%
Mean	4,515	4,834	0.8	0.674	0.760	14.1%
Lower Middle Income Countries						
Algeria	1,460	1,521	0.2	0.508	0.683	34.4%

Bolivia	1,010	964	-0.2	0.512	0.643	25.7%
Colombia	1,612	2,392	1.7	0.657	0.764	16.3%
Ecuador	1,301	1,562	0.8	0.620	0.722	16.5%
Egypt	516	1,146	3.5	0.430	0.623	44.9%
Jordan	993	1,491	1.8	..	0.721	..
Kazakhstan	2,187	1,281	-4.7	..	0.754	..
Papua New Guinea	1,048	1,085	0.2	0.438	0.542	23.7%
Peru	2,835	2,611	-0.4	0.635	0.737	16.1%
Russian Federation	2,555	2,138	-0.8	..	0.771	..
Syria	907	1,209	1.3	0.530	0.660	24.5%
Mean	1,493	1,582	0.3	0.541	0.693	25.3%
Low Income Countries						
Azerbaijan	1,336	431	-9.8	..	0.722	..
Congo, Dem. Rep. (former Zaire)	392	127	-4.8	0.416	0.430	3.3%
Guinea	501	594	1.4	..	0.394	..
Indonesia	385	972	4.1	0.465	0.670	44.2%
Mauritania	549	478	-0.6	0.344	0.451	31.2%
Mongolia	417	408	-0.1	..	0.628	..
Niger	298	215	-1.4	0.236	0.293	24.1%
Nigeria	301	256	-0.7	0.317	0.439	38.4%
Senegal	609	581	-0.2	0.309	0.416	34.6%
Tajikistan	788	345	-6.7	..	0.663	..
Togo	411	333	-0.9	0.400	0.471	17.7%
Yemen, Rep.	266	254	-0.6	..	0.448	..
Zambia	641	388	-2.2	0.444	0.420	-5.3%
Mean	530	414	-1.7	0.366	0.496	23.5%

Notes: [a]Mineral economies here refer to nations for which exports of ores, metals, and fuels represented 25% or more of total merchandise exports in 1999.
[b]For some nations, growth rates refer to periods shorter than 1975-1998 but use the latest available data. For Azerbaijan and Kazakhstan, the data on GDP per capital in the column 1975 represent 1987 data; for Guinea and Tajikistan, 1986; for Norway, 1981; and for Yemen, 1990.
The symbol ".." means data are unavailable.
Sources: World Bank, *World Development Indicators 2000*, CD-ROM (Washington, D.C., World Bank 2000); United Nations, *Human Development Report-2000*, Statistical Annex (New York, United Nations, 2000).

3 Local Communities and Regions: What Are the Economic Effects?

Mining features prominently in the history and development of local communities and regions around the world. Antofagasta in northern Chile owes much of its development over the last century and a half to nitrate and copper mining. In Australia, much of the 19th-century growth in the states of Victoria and Western Australia derived from mining. In the United States, gold and silver mining helped settle the Rocky Mountain region. In South Africa, gold and diamond mining spurred economic development in Johannesburg. In Zambia, copper mining has been so important that one whole section of the country is referred to as the copperbelt. The region around Kiruna, in northern Sweden, developed largely around iron-ore mining.

The purpose of this chapter is to examine mining's contributions to and effects on local and sub-national regional economies. It attempts to provide part of the background and basis for the discussion later in the book on how to manage mineral wealth. The examination in this chapter is carried out in four parts. The first looks at mining as a localized activity, trying to understand the rise, persistence, and decline of mining in communities and regions. The second part of the chapter focuses on measuring the direct and indirect effects of mining from the macroeconomic perspective of a region. The third part looks at the same issue, measuring economic impacts, from the microeconomic perspective of a mining project and its benefits and costs. The final section of the chapter is broader and more qualitative; it examines how mining's contribution to regional economic development has evolved over time and ends with an identification of the important issues of today.

To simplify the language in the rest of this chapter, the words “region” and “regional” refer to any geographic areas smaller than nations; thus, as used here, these words refer to areas as small as local communities and as large as states, provinces, or territories within nations.

3.1 Geography, Location, and Localization

Mines are not distributed evenly among or within nations around the world. Mining is localized or locally concentrated--much more than, say, most services (such as medical care) and retail sales (such as grocery and clothing stores). Most communities have doctors and grocery stores, but most communities do not have a mine. Consider copper ore and concentrate. Chile accounted for 35% of world mine production of copper in 2000 (U.S. Geological Survey, 2001) and yet represents a much smaller percentage of the world's land area. Moreover, within Chile, the majority of copper is produced in a relatively small area in the north of the country.

Why are mines located where they are? Why is mining locally concentrated--that is, very important to a relatively small number of communities, and insignificant or nonexistent in most communities? At first, the answer seems obvious. A mine can only exist where there is a mineral deposit, and mineral deposits are not distributed evenly throughout the earth's crust. In fact, most mineral deposits are considered geologic anomalies, not common occurrences. Deposits of a particular geologic type often exist as clusters of similar deposits

in a region. A mineral deposit is not mobile like most other inputs to mining, such as labor and equipment, which can move (at least relatively) easily from one location to another.

Even though a mineral deposit is a necessary precondition for mining, it is not sufficient. At least four other factors can decisively influence the location and localization of mining.[2] The first two are standard in economic analysis (see Isard et al., 1998). The first is access to and costs of other inputs. Especially important is infrastructure such as water supplies and electricity--typically very expensive to provide initially. Lack of infrastructure can be a barrier to mine development in a region. Once provided, however, most types of infrastructure can be extended to new economic activities, including new mines, at relatively low cost. The second, often decisive, factor is access to and costs of transportation to markets. Part of this is an infrastructure issue, just discussed; roads, railroads, airports, ports and harbors, and so on. Part of this issue, however, relates to distance. As a first approximation, total costs of transporting a product to market can be considered a function of distance; the farther the distance, the higher the transportation cost. Thus for a remote deposit to be developed rather than a less-remote alternative, its geological and metallurgical qualities must give the remote deposit sufficiently low unit costs of production to offset the penalty it pays in the form of higher transportation costs to market.

The third, sometimes overlooked, factor influencing the location and localization of economic activity is agglomeration economies (Isard et al. 1998, Krugman 1991[3]). There are cost savings to individual firms that result from being located close to other similar firms. One type of agglomeration economy is a pooled market for workers with specialized skills. Firms benefit from having a larger pool of potential workers from which to choose. Workers benefit from having the opportunity to change jobs without having to move. Another agglomeration economy is greater availability of specialized intermediate inputs. A localized industry, in other words, can support specialized local suppliers of inputs. In the automobile industry, for example, it is not uncommon for suppliers of tires and engine components to be located close to the automobile manufacturers themselves (e.g., Detroit, Michigan, and the surrounding region in the United States). Still another agglomeration economy is technological (or knowledge) spillovers. Firms benefit from the knowledge spillovers from firms located nearby. A firm is able to operate more efficiently by learning from its nearby competitors. As Krugman (1991) notes, information flows more easily locally than over large distances. It is perhaps easiest to think of technological spillovers in the context of the high-technology sectors of the economy (e.g., the Silicon Valley, California, USA).

Agglomeration economies are major force behind urbanization generally; but they also play a role in mining. Consider Perth as a center or staging point for mining in the state of Western Australia. Perth and Western Australia benefit from labor-market pooling in Perth. A significant number of mines in Western Australia are run as long-distance commuting operations, in which the majority of workers at a mine have their households in Perth and commute to the minesite on some type of rotation (e.g., 10 days at the mine, 4 days at

[2] The analysis here ignores the role of government policies play in encouraging or discouraging economic activity in a community or region. Government policy is a major focus of Chapter 5.

[3] Krugman (1991) credits Alfred Marshall (1920) with presenting the seminal discussion of agglomeration economies.

home). The labor-market pool in Perth serves a large number of mines, which in turn reinforces the localization of mining in the state of Western Australia. Perth also is home to a large number of specialty suppliers of mine services--e.g., mining software, drilling companies, contract-mining firms. These suppliers, as well as the mining companies themselves, benefit from the knowledge spillovers that result from being located close to one another. All of these agglomeration effects reinforce mining in Western Australia. To be sure, mining could not occur there without mineral deposits. But the reinforcing effects of the agglomeration economies mean that an undeveloped mineral deposit in Western Australia is more likely to be developed than a similar deposit located somewhere without these economies.

The fourth factor influencing the location and localization of mining is historical legacy. Once mining exists in a region, it tends to persist. In part, this persistence is due to existing infrastructure--once a location or region has the infrastructure necessary to facilitate and support mining, it has an advantage over regions with similar mineral deposits but lacking the infrastructure. In addition, historical legacy is important because of the agglomeration economies noted above. An activity such as mining in a region tends to persist or become self-reinforcing because of the advantages of: a pooled labor market for equipment operators, mining engineers, and other workers; specialized input suppliers such as drilling companies and chemical assaying firms; and technological or knowledge spillovers.

To sum up, the preceding economic analysis tells us that:

- It takes more than a mineral deposit to make a mine. Mining becomes important to a regional economy not only because of good geology but also because of location and agglomeration economies. Examples of regional clustering include: Nevada, USA, for gold mining; northern Chile for copper mining; and Western Australia for mining of a large range of minerals.
- Mining often persists in a region even after the geologic quality of deposits declines because the existence of infrastructure and the presence of agglomeration economies give an existing mining region advantages over greenfield investment in new regions.
- Even with this persistence, there is a natural rise and fall to mining in any region. We should not be surprised when particular types of economic activity decline in a community or region. This is the way of the world--mineral deposits run out, populations shift, products and processes change.

The challenge is to plan for change and adapt.

3.2 Understanding Economic Effects: A Regional (Top-Down) Perspective

In light of this conceptual background, consider more closely the economic effects of mining on communities and regions. Mining contributes directly to a local or regional economy by employing workers and generating income at the mine. Mining also contributes more broadly through its links with other economic activities. The mine itself may purchase supplies, equipment, electricity, food, and other inputs from local or regional businesses. Miners and their families stimulate local production of household goods and services through their spending of income earned at the mine. On the other hand, mining--

like any other activity--involves costs, which may be both commercial and more broadly social and environmental in nature. Therefore, the extent to which a region benefits overall from mining depends on the balance between benefits and costs, broadly defined to include the full social effects of mining.

Not surprisingly, the extent to which a particular community or region benefits from mining varies considerably from case to case. This chapter does *not* present an exhaustive collection of data on mining's economic effects on communities and regions around the world. Rather, this chapter presents two perspectives on evaluating and measuring the economic effects of mining. The first perspective is that of a region as a whole, in which one or more mines exist. This perspective emphasizes the economic contribution of mining to the regional economy, as well as mining's links with other parts of the economy. Think of this approach as the aerial or bird's-eye view of mining and the community. The second perspective is narrower and focuses on a mining project. It evaluates a project and its effects on economic development by identifying and valuing the full social benefits and costs of the project mining project. Think of this approach as the ground-level or worm's eye view of mining and community. We begin with the bird's-eye perspective.

Direct Effects

A starting point for examining or measuring mining's contribution to regional economies is statistics on mining's share of gross state product. Gross state product (GSP) is an estimate of the value of goods and services produced in a state; it is a regional equivalent of the more-familiar concept, gross domestic product (GDP). Both measures, GSP and GDP, are useful for beginning to understand the level and structure of economic activity in an area. But they are incomplete; they do not include the value of non-market activities, such as such as unpaid housework, subsistence agriculture; environmental degradation, and social problems. These measures do not consider the distribution of income. Nevertheless, they are an essential starting point.

Table 3.1 presents data on mining's percentage share of GSP for selected regions in which mining is important, along with comparable data at the national scale. In Western Australia, for example, the mining sector represents about one-fifth of gross state product, about five times its share of Australian gross domestic product. In this case, about half of "mining's" contribution consists of oil and gas extraction, almost all of the rest is metal mining. Similar data from Canada indicate that mining is more important in the Yukon Territory, Northwest Territories, and Nunavut than for Canada as a whole. In Region II in northern Chile, home to much of the nation's copper output, mining accounts for some two-thirds of gross state product, compared to less than one-tenth for the nation as a whole. In the U.S. state of Nevada, metal mining is about five times more important than it is in the United States as a whole, when measured by its contribution to gross state product.

If we narrow our focus further, mining and its direct economic effects can be even more important at a local level. Table 3.2 illustrates this point with data on employment in several counties within the U.S. state of Nevada. These data clearly show the local concentration of mining in Nevada. There are five counties in which mining accounts for one-fifth or more

of total employment; in all other Nevada counties, mining accounts for less than 1% of employment.

Finally, another measure of mining's direct economic effect is hourly earnings. In most geographic areas, mining pays well. Table 3.3 illustrates this point with data from the United States. Average hourly earning in the mining sector are well above the average for all workers.

These indicators of mining's direct effects--the value of output, contribution to employment, and average earnings--only tell part of the story. Mining also contributes indirectly to a region's economy through its connections with other parts of a regional economy.

Linkages and Multipliers: The Concepts

Often these connections are referred to as "linkages". One important type of linkage is a *backward linkage*--the local or regional purchase of inputs. These often include food and catering services, electricity, transportation services, and raw materials. In turn, the regional suppliers of mining inputs purchase their own inputs, which further stimulate regional economic activity if purchased within the region. *Forward linkages* from mining represent: downstream processing of mineral ores or concentrates, including for instance, smelting, refining, semi-fabrication, fabrication, and manufacture of products. *Final-demand linkages* describe the income that miners and their households spend on goods and services produced in the region (e.g., groceries, clothing, entertainment, restaurant meals). Finally, *fiscal linkages* embody the tax and royalty revenues regional governments use to develop infrastructure such as hospitals and schools and to purchase other goods and services.

How large are these linkages between mining and the rest of a regional economy? Economists use measures called *multipliers* to summarize their estimates of the size of linkages. A multiplier is a ratio: the total effect of an economic activity (direct, indirect, induced) divided by the initial direct effect. For example, if an initial investment in mining of $1 million resulted in $2 million of total regional activity ($1 million of direct spending + $1 million of indirect and induced activity), then the multiplier would be 2.

How large are the multipliers associated with mining? The most important point here is: it depends. The size of a multiplier varies considerably from situation to situation, and it is dangerous to make gross generalizations. Nevertheless, it is possible to identify several guiding principles (see Armstrong and Taylor, 2000). The size of a multiplier depends fundamentally on what portion of the money injected into a region by mining is spent within the region. Any money spent within a region stimulates additional economic activity within the region, while money spent outside the region does not.[4]

[4] Warning: Be careful here. One is tempted to conclude that regions should require local purchase of inputs and downstream processing as a condition of investment. This is dangerous and flawed thinking. Such purchases or investments may not stand on their own merits. Full social benefits and costs need to be considered, as discussed in the next section of the chapter.

Three factors importantly influence what portion is spent within a region and, in turn, the size of the multiplier. The first is a region's size. The larger a region, the less likely it is that mining companies will need to purchase inputs from outside the region and that mining households will spend their income on "imported" goods and services. The second important factor is a region's industry structure. The more diversified a region's economy, the more likely it is that the region is capable of supplying inputs and of satisfying the demands of households for goods and services. The third factor is a region's location, which is important in several respects. If a region is located such that most workers commute from other regions, then the multiplier will be smaller than if all workers lived within a region; workers are likely to spend their income where they live. If a region is located close to another region with extensive shopping opportunities, then the multiplier will be smaller than if there were no nearby shopping opportunities. Therefore, multipliers are very region specific, even for a given type of injection into the region. That is, an injection of new mining activity may result in quite different multipliers from one region to another, even if the mining activity itself is identical in both regions.

The role of all three factors can be clarified with an example. Consider the state of Western Australia, in which mining and mineral processing represent about one-fifth of gross state product (see Table 3.1). In the late 1990s, Western Australia had 37 towns that could be considered mining towns, defined as towns with populations of at least 200 and in which more than 15% of the workforce worked directly in the mining industry (Moore, unknown date). Leonora is one such town, of 1000 or so people located about 800 kilometers from Western Australia's capital of Perth, a city of 1-2 million. Since the late 1800s, Leonora has relied largely on gold mining for its existence. (Before he became U.S. President, Herbert Hoover was the chief mining engineer for the Sons of Gwalia mine near Leonora.) During the late 1990s and early 2000s, the Leonora area has experienced an investment boom in nickel mining. Would one expect the multiplier from this injection of mining investment to be larger for Leonora or the state of Western Australia as a whole? The answer is: Western Australia. Many of the inputs such as materials and various mining and financial services are purchased in Perth (backward linkages). To be sure, some of the backward linkages benefit the local community; one could imagine food and catering services being provided by local business. It is likely that much of the work force will live in Kalgoorlie, a larger mining town 100 kilometers or so south of Leonora; thus the final-demand linkages in the form of increased household expenditures are likely to benefit Kalgoorlie than Leonora. The multiplier associated with the nickel boom in Western Australia, therefore, is likely to be larger for the state of Western Australia than for the town of Leonora. Returning to the three factors determining the size of a multiplier, Western Australia's economy is *larger* and *more diversified* than Leonora's ever will be, and so a larger portion of the mining inputs will be purchased from the state as a whole than from Leonora itself. Leonora's *location* and the fact that much of the workforce can commute from Kalgoorlie means that the final-demand linkages are likely to be larger with Kalgoorlie than with Leonora.

Linkages and Multipliers: Estimates and Interpretation

Tables 3.4 and 3.5 provide multiplier estimates for Western Australia and Region II of Chile. They are interesting in their own right as evidence of the extent of linkages between sectors

of the economy; they also are a useful vehicle for illustrating the limitations of multiplier analysis and the pitfalls of interpretation.

Table 3.4 contains three types of multipliers for the state of Western Australia. These multipliers provide estimates of the backward linkages (purchase of inputs by a sector) and of final-demand linkages (induced consumption spending by households). The output multipliers represent the statewide increase in output associated with a $1 increase in sectoral output. For example, for every $1 of increased sales by firms engaged in metallic-mineral mining, the increase in output economy wide is $2.10, consisting of the $1 of mining sales and $1.10 of purchased inputs and induced spending on household consumption. The income multipliers are similar in definition, except that the calculation is based on income (such as wages, salaries, and other benefits) rather than output. So again looking at the table, for every $1 in income earned in metallic-mineral mining, there is a statewide increase in income of $3.00--$1.00 in the mining sector plus $2.00 of non-mining income. Finally, the employment multipliers represent the total number of jobs created per job additional job in the sector experiencing increased output. For example, for every job created in metallic-mineral mining, a total of 4.1 jobs are created statewide, consisting of 1 job in metallic-mineral mining and 3.1 jobs in other sectors.

Table 3.5 contains output and employment multipliers for Region II of Chile, which as noted earlier accounts for more than half of Chile's copper output. The open-system multipliers exclude the effects of induced consumption spending by households made possible by an increase in sales by a particular sector, such as agriculture or mining. The closed-system multipliers include this induced household spending and assume that all of this induced spending is on goods and services produced in Chile's Region II (the closed-system multipliers are comparable in definition to the multipliers in Table 3.1 for Western Australia). Thus for any specific sector, the open- and closed-system multipliers can be thought of as lower and upper bounds on actual linkages.

Several cautions and warning are appropriate when examining these and other multipliers (Armstrong and Taylor, 2000; Isard and others; 1998, Porter, 1984). Multiplier estimates are simplified versions of reality, in several ways. First, all the estimates in the tables above come from static input-output models, which assume unlimited supply of inputs available at fixed prices. This assumption is often acceptable for small regions or local communities, which can draw on external communities for inputs, especially labor, without bidding up the prices of these inputs. But if constraints or limits exist on the availability of inputs, then the spillover benefits of increased activity in a sector such as mining will be smaller than the estimates suggest. Second, static input-output models--and in turn most multiplier estimates--ignore changes in technology. They assume a fixed relationship between inputs and outputs, reflecting technology as it exists at a point in time. Again, changes in the relationship between inputs and outputs over time as economic conditions change typically result in smaller multiplier effects than suggested by estimates derived from input-output models. Third, multiplier estimates are silent on the issue of time. That is, it is important to realize that it may take a significant amount of time (up to several years) for all of the multiplier (spillover) benefits to occur.

Leaving aside how accurate or true the estimates are, multipliers often are mis-used. First, using multipliers to show how important a sector such as mining is to a region's overall

economy tends to exaggerate the sector's importance. For example, consider a mining sector that accounts for 20% of regional product and an output multiplier of 1.8. The usual interpretation would be that the mining sector accounts for 38% of regional product (20 x 1.8). Suppose however, that we make the same type of calculation for each sector of the regional economy (i.e., make a similar calculation for agriculture, services, manufacturing, etc., each of which has a multiplier greater than 1.0). Then by considering the economy as a whole, we could conclude that "regional GDP" is responsible for more than 100% of regional GDP. What the multipliers indicate is the estimated extent to which total output, income, or employment would be affected by an injection of new spending in a sector.

Second, using multipliers to rank how desirable specific sectors are for regional development is inappropriate. As Porter (1984, p. 14) notes, "multipliers are not good indicators of social desirability." A larger multiplier does not necessarily make one sector more desirable than another. Output and income multipliers reflect total effects *per dollar* of increase in final sales; thus it is possible for a sector with a smaller multiplier to have a larger regional effect on output or income than a sector with a smaller multiplier--if the total dollar value of increase final sales in the sector is large enough. Moreover, and just as important, a full consideration of all the social benefits and costs of a project or activity is needed to assess social desirability, the topic to which we turn now.

3.3 Understanding Economic Effects: A Project (Bottoms-Up) Perspective

Private mining companies evaluate the commercial worthiness of projects by comparing the benefits of a project with the associated costs, adjusted appropriately for time and risk. Such evaluations can be *ex ante*, when considering whether to undertake an investment opportunity, or *ex post*, when reviewing the performance of previous investments. Consider the *ex ante* evaluation of whether to develop a mine out of a known but undeveloped mineral deposit. The benefits of mine development would be the expected revenues from sale of the mineral to be mined. A number of costs would be important: upfront costs of mine design, construction, and equipment purchase; ongoing costs of operation, maintenance, new-reserve development, and environmental remediation; and final costs of closure. A sometimes-overlooked cost is the minimum-acceptable profit that investors require before they will fund the project. Sunk costs, such as previous exploration expenditures, are ignored because they cannot be changed regardless of whether the mine is developed.[5] All future revenues and costs are discounted to account for the time value of money; a dollar today is worth more than a dollar tomorrow because of the opportunities foregone by waiting until tomorrow to receive money (for example, the dollar could be earning interest, or it could provide enjoyment by being spent on a consumer item). Risk is important because investors usually prefer a safe investment to a riskier alternative of the same expected value.

Governments and other entities can evaluate the social worthiness of a project (that is, the overall impact of a project on economic development) using the same overall framework,

[5] In this example, exploration costs are sunk and thus are to be ignored. This is not always the case. For example, they would be included in an *ex post* evaluation of the mining company's investments. Also, the expected benefits and costs of exploration activities obviously need to be evaluated and considered when making decisions about investments in exploration.

but modified to include the full social benefits and costs of a project. The key issue here is: under what circumstances and in what ways will the perspective of society as a whole differ from the commercial perspective of a private mining company? If markets "worked well" in all cases, then society arguably would be served best by the independent decisions of the many private households and firms that make up society; and in many if not most circumstances, markets do work well. But when private revenues and costs observed in markets do not fully reflect the full social benefits and costs of an activity, economists estimate what are known as shadow prices to use as proxy measures (see Boardman et al., 2001, and Squire, 1989).

The starting point for a full social assessment of benefits and costs of a project is the private assessment of commercial worthiness--that is, the private revenues and expenditures leading to a project's after-tax profitability or rate of return. It is important to remember that a mining company, its workers, and providers of financial support are society members whose perspectives need to be considered in any social assessment of a project's worth. But private benefits and costs may need to be adjusted for several reasons. The first is the presence of external effects. External effects, or externalities, are spillover or side effects not considered in private-sector decisions. External effects can be positive (external benefits) or negative (external costs). External benefits can come in several forms. Workers may earn higher wages or salaries than otherwise would be the case. Workers may receive education and training that benefits them in later jobs. Local businesses and households may benefit from improved infrastructure--such as roads, air strips, water supplies, sanitation systems, electric power--that is built for the mining project but which is also partially available for other community entities. Local suppliers of inputs may enjoy greater sales and profitability because the project purchases some of its inputs locally. On the other hand, some externalities are costs. Examples here include environmental damage and social disruptions (for example, damage to local and indigenous cultures, social and human-health damages from increased alcoholism and prostitution that sometimes accompanies a booming new economic activity). In principle, economic values can be assigned to all of these externalities, although in practice some values are easier to determine than others. Even if full valuation is not easy or possible, external effects of a project should be noted.

A second reason private benefits and costs may need to be adjusted to fully represent social values is the presence of market distortions due to government. Consider, for example, tax payments and subsidies. Tax payments are costs to a private company in its calculation. Yet they represent a benefit to government. As such, they are transfer payments; their net effect is zero. If, however, they are not added back into the social assessment of benefits and costs the analysis is incomplete. Government subsidies to a company are similar. They are benefits (or negative costs) to a private company and should be subtracted in the calculation of social net benefits. Other adjustments may be necessary when import tariffs and quotas influence the price of internationally traded goods and services.

A third adjustment is necessary when society as a whole has different time and risk preferences than private companies. Time and risk preferences are reflected in the discount rates, noted earlier, used to adjust the values of future benefits and costs. With respect to time, discount rates increase as the preference for the present and near-term future increases (the higher the discount rate, the stronger the preference for the present and the near-term future, and vice versa). With respect to risk, the greater the riskiness of a project, the higher

the discount rate. Most private companies use discount rates determined by markets for financial capital, which reflect market preferences for time and risk. For social benefit-cost analyses, however, it can be appropriate to use either a higher or lower discount rate than the market rate. A higher rate would be appropriate if society as a whole placed a greater weight on immediate economic development than did private companies and financial institutions making investment decisions affecting economic development. On the other hand, a lower-than-market rate would be appropriate if society placed greater weight on the well being of our children and of future generations than do participants in private capital markets.[6]

Up to now, we have focused on adjustments to private benefits, costs, and discount rates so that they reflect full social values. Let us now turn to two issues that challenge and bedevil practitioners of social benefit-cost analysis. The first challenge is deciding "*whose benefits and costs count*" [emphasis added] (Boardman, et al., 2001, p.9). It sometimes is called the issue of standing--that is, who has standing in the analysis of benefits and costs? This is an issue of scope. Should the analysis include only those costs and benefits affecting residents of the local community? The state or province? The nation? The world? Whether the net benefits of a project are positive or negative often depends on how narrow or broad the scope of the study is. A local community, if concerned only about benefits and costs in the community itself, would consider tax payments to a national government as costs, even though from the perspective of the project as a whole they are benefits. Similarly, a national government would consider profits send abroad as a cost. Whose perspective is correct? It depends. Perhaps the most useful way to think about a project and its effects is from the perspective of the project and its interested and affected parties, regardless of where they reside. In this way, if one party is on balance negatively affected (that is, on balance worse off) even though the project as a whole has positive net benefits, discussions can focus on using some of the net benefits to compensate the party that is negatively affected.

The second challenge is a related but somewhat different aspect of scope: *which benefits and costs count*? More specifically, the challenge is deciding how to treat the secondary, indirect, or multiplier effects of a project. Everyone agrees that the primary or direct effects of a project need to be considered. For example, a mine's environmental degradation or expenditures on pollution control should be considered as primary or direct costs of the mine; and project revenues clearly are a primary or direct benefit. But should the following be counted as project benefits: spending by mine workers of their income at local businesses, and, in turn, the local purchases made by employees of these local businesses; the purchase of electricity from a local power company and, in turn, the spending by employees of the electric power company on local goods and services; and so on? Boardman, et al. (2001, p. 114) argue: "one should be very cautious in counting revenues from local projects that are generated by secondary market effects and multiplier effects as project benefits." In many cases, increased spending in one community simply represents a change in the location of spending from one community to another. For example, if the mine workers in our example would have been employed in another community at the same wage had the mine not been developed, then their spending levels would have been similar in both cases--just the location of spending would have changed. To be sure, this spending can be a benefit from the narrow perspective of the mining community, but from the

[6]For more on the choice of an appropriate discount rate, see Boardman and Greenberg (1998), Lind et al. (1982), and Portney and Weyant (1999).

broader perspective of society as whole such spending is simply a transfer from one place to another. Moreover, if an analysis is restricted to the narrow perspective of a local community, then an analyst must be careful to: (a) eliminate any net benefits that accrue to nonresidents of the community (for example, nonresident owners of local businesses), and (b) subtract out the costs incurred to generate the secondary, multiplier benefits.

An exception to this general caution about including multiplier or indirect benefits in a benefit-cost analysis occurs when there is significant local unemployment or idle productive capacity and these workers or productive capacity are immobile. In this case, there can be significant multiplier (net) benefits to the community as long as the unemployed workers or idle capacity are actually put to work as a result of the new project (Boardman et al., 2001).

Once a ledger of social benefits and costs has been assembled and appropriately discounted, the next task is to interpret the results. The usual interpretation or decision rule, for an *ex ante* assessment of an investment opportunity, is to undertake a project if the discounted net benefits are positive.[7] Analogously, for *ex post* evaluations of previous projects, a project is considered worthwhile if its discounted net benefits are positive. An important aspect of this interpretation "projects with positive net benefits are worthwhile" is that in such cases, it is in principle possible to compensate those who are worse off as a result of the project and still have positive net benefits for those who gain from the project. For example, consider a mine with positive net social benefits, and a neighborhood whose residents were worse off because of the mine due to the noise and air pollution generated by the mining activity. It would be possible to use some of the net benefits to compensate these residents.

The idea that projects and activities with positive net benefits are worthwhile reflects the underlying goal of *economic efficiency*: allocating resources--people, land and other natural resources, and capital--to their highest-valued uses, so that they create the highest level of human satisfaction or well being, broadly defined to include not just purely economic determinants of well being, but also broader social and environmental determinants. For nearly all projects, economic efficiency is an important goal, but it may not be the only one. Of other economic goals, the most common is *equity*: a fair distribution of the benefits and costs of an activity. In other words, economic efficiency focuses on maximizing net benefits or total well being to society, whereas equity focuses on the distribution of benefits, costs, and income within society. A project that maximizes net benefits may also make the distribution of income more or less equal. Or a project that does not maximize net benefits may make the distribution of income more equal.

Whether and how to incorporate the pursuit of equity into benefit-cost analysis are subjects of much debate. The initial challenge is to define what is equitable or fair. At one extreme, one could argue that the distribution of benefits and costs is irrelevant. Or one might argue that benefits should be distributed to interested parties in proportion to the costs they incur.

[7] This is the simplest case in which a single, independent project is being assessed. In the case of two or more mutually exclusive projects, undertake the project with the largest positive net benefit. If a decision involves funding one or more projects out of a limited budget, then projects should be ranked according to the net benefit provided per dollar of initial expenditure; then select projects, starting with the project having the highest net benefit per unit of initial expenditure, until the budget is exhausted.

There are almost an infinite number of possible definitions for equity and fairness. However, especially where the existing distribution of income (or wealth) is very unequal, it is often accepted that projects making the income (or wealth) distribution more equal are to be preferred over similar projects that do not make the distribution more equal. Given this definition of equity, it is possible to incorporate this notion of equity into the benefit-cost framework through a weighting scheme. An analyst would estimate the net benefits for groups with different levels of income or wealth. Then a system of weights would be established in which weight are inversely proportional to income or wealth; the greater the income or wealth, lower the weight, and vice versa. Finally, the weighted net benefits are summed to determine whether total net benefits are positive or negative. Some analysts have suggested, in this case, presenting two benefit-cost analyses for a project: an unweighted standard analysis emphasizing the economic-efficiency implications of the project, and the weighted analysis incorporating distributional (or equity) concerns. A problem with weighted analyses is the essentially arbitrary nature of the weights chosen for different income or wealth groups.

A number of these issues and challenges surrounding benefit-cost analysis can be illustrated and amplified with an example. Consider the Kori Kollo gold mine in Bolivia. The basic, factual information for this case comes from Bouton (1999), who describes qualitatively and semi-quantitatively the impact of the mine on the economic development of the local community and region. First, some background. In 1979, a Bolivian mining company obtained rights to a mining claim in an area of known gold and silver deposits, which had been mined as early as prior to the arrival of the Spanish conquistadors. But little mining had occurred since early in the 20th century. In 1982, the Bolivian company and Westworld (a U.S. company) formed Inti Raymi S.A. Inti Raymi proceeded to develop and produce oxide ores using heap-leaching technology; the scale of operation was relatively small--5,176 ounces of gold in 1984-85, increasing to some 50,000 ounces in 1992. Development of refractory sulfide ore required greater capital investment and more sophisticated technology. As a result, Inti Raymi searched for a partner and found U.S-based Battle Mountain Gold, which acquired an initial 33% interest in the Inti Raymi in 1989, increasing to 88% in 1995. With partial financing from the International Finance Corporation, Inti Raymi developed the sulfide ores and constructed a carbon-in-leach processing facility. By 1996, annual gold production in Kori Kollo exceeded 300,000 ounces. Table 3.6 summarizes some of the local effects of the Kori Kollo mine. A cursory examination of the table indicates that the mine has had considerable direct economic impact; it also has facilitated improvements in local health, education, and infrastructure. The mine is the largest business in the area. The infrastructure, improved health and education facilitated by the mine, and the investments made by the Kori Kollo Foundation all create the possibility of sustained economic development, even after mining. But a deeper understanding of the project's benefits and costs would require a more systematic examination.

Anyone conducting a benefit-cost analysis of the mine first would have to frame the analysis. Who has standing (whose costs and benefits are to be considered)? If only the perspective of the local community is considered, then only those benefits received and costs incurred by the local community and its residents are included. The profits earned by the non-local (Bolivian and U.S) owners would be irrelevant, as would tax revenues received by the national government and other benefits received by non-local companies and people (for example, increased profits earned by local businesses supplying input to the mine but which

are owned by non-locals). Such an analysis would provide important insights into the perspective of one "participant" in the project. But it clearly would be incomplete.

Probably more useful would be to be frame the analysis in terms of the project and all its participants or affected parties--mining company, workers, local community, input suppliers, Bolivian government at all relevant levels, and so on. Lysy (1999) advocates such an approach for evaluating projects of the World Bank in developing countries.

The starting point for such an analysis would be the private benefits and costs of the private owners of the project, yielding the after-tax profits of the mine; clearly these are net benefits from the perspective of the mining company. Bouton (1999) notes that the after-tax (private) rate of return for the project is estimated at 21%. From the perspective of Battle Mountain Gold, however, its ultimate return on investment will be relatively small unless additional reserves are developed, given Battle Mountain's upfront payment for shares in Inti Raymi.

From this starting point of private revenues and costs, a number of adjustments would have to be made, reflecting the external effects of the project and market distortions:

- Add the net benefits received by mine employees as a result of the mine. These include the net additional compensation (including benefits) they receive from the mine, over and above what they would have received in alternative employment were they not employed by the mine. Thus it is not the entire direct economic impact of wages, salaries, and benefit shown in Table 2.6; rather only the net additional compensation resulting from mine employment should be added as a benefit. Also included would be the net benefit of enhanced worker productivity attributable to training provided by the mine, to the extent that this benefit spilled over to jobs beyond the mine or to other parts of the economy.
- Add the net benefits received by suppliers of inputs, to the extent that these net benefits are new and not simply transfers (that is, net benefits that would have been earned by supplying the same inputs elsewhere). Table 3.6 shows that while the mine has purchased significant amounts of electricity, lime, food, and other inputs locally, it purchased an even larger amount externally (most if not all of these imported inputs are not available locally).
- Include as a cost the value of increased environmental damage caused by the mine. But also include as a benefit any improvements in human health or other aspects of environmental quality that result from expenditures already included in the initial listing of benefits and costs.
- Add as a benefit the value of improvements to infrastructure, to the extent that there are benefits to the community above and beyond those benefits received by the mining company.
- Add as benefits the value of tax payments to local and national government that appear as costs in the initial private listing of benefits and costs. Similarly subtract as costs the value of any government subsidies that in effect appeared as private benefits to the mining company.

Such a ledger of benefits and costs not only would permit a better understanding of the net effects of the mine on all its affected parties. It also would provide a starting point for understanding distributional (or equity) issues, especially those related to the sharing of net benefits among the various affected parties: mining company and its owners, local community, and various levels of government.

Summing up, a benefit-cost framework for assessing the effects of a mining project is useful, even essential, for evaluating the impact of a mining project on the economic development of a local community or region. Such a framework focuses our attention on a number of critical issues: What is the overall effect of a project? What are the costs, and are the parties bearing the costs being compensated? What are the net benefits and how are they distributed? Even if not all specific benefits and costs can be valued accurately or precisely, simply having a ledger of benefits and costs and their relative magnitudes provides a basis for rational discussion and decision making.

3.4 History And The Role Of Mining In Regional Development

This final section of the chapter takes a broader, more qualitative, and historical look at mining and regional economic development. The starting point is the observation made at the beginning of the chapter that mining has been the centerpiece at certain points in time in the development of many communities and regions around the world. Let us consider two specific regions, the Australian states of Victoria and Western Australia during the 19th and early 20th centuries. These examples illustrate two features of mining and a region that are difficult to discern from the linkage and benefit-cost approaches of the previous two sections: the strains and short-term adjustments associated with mineral booms and busts, and the possibilities for long-term economic development that mining provides.

Victoria and Western Australia

It is not an exaggeration to say that gold mining was critical to the economic development of Victoria and Western Australia. In Victoria, gold was discovered at Ballarat and Bendigo in the early 1850s, and for the following two decades, Victoria accounted for more than three-quarters of all Australian gold production. In what became Western Australia, there was little or no gold production prior to the middle 1880s; by the end of the 1890s, a number of gold discoveries and subsequent mines--especially in and around the towns of Coolgardie and Kalgoorlie--made Western Australia the leading gold-producing state in Australia. Doran (1984) argues that the regional economic effects of gold mining were positive over the longer term, even though the immediate effects of mining were disruptive, even chaotic. The gold rushes in Victoria in 1850s and Western Australia in the 1880s and 1890s led to massive populations shifts:

> Usually without warning, gold finds attracted a sudden influx of population: miners, prospectors and, on their heels, shopkeepers, merchants, carriers, and vendors of other services, legal and illegal… Farmers and town workers deserted their occupations. Public servants and police absconded; seamen abandoned their ships in the harbours. Those who remained on their jobs demanded higher wages; in 1859 it was calculated that average money wages were double those which had prevailed in 1850.
>
> (Doran, 1984, p. 40)

The population of Victoria grew from less than 100,000 in 1851 to over 500,000 in 1860. Western Australia's population increased four-fold between 1890 and 1900. Mining booms in remote areas such as Coolgardie and Kalgoorlie strained the abilities of government, which had difficulty providing, for example: basic infrastructure, such as water supplies; police protection; schools; and transport facilities.

Over the longer term, however, Doran (1984) argues that gold mining had a decisive and positive influence on the development of Victoria and Western Australia. In both states, gold in some sense justified the creation of independent political entities there in the first place. Victoria had separated from New South Wales just prior to the discovery of gold, the mining of which provided a basis for general economic expansion. In Western Australia,

> Gold discoveries in the Kimberley district, the Pilbara, the Murchison, Yilgarn, and later in the southeastern fields of Coolgardie and Kalgoorlie, guaranteed the viability of the Western Australian economy, satisfying an important condition for the granting of responsible government.
>
> (Doran, 1984, p. 49).

More broadly, Doran argues that gold mining in Victoria and Western Australia: attracted investment funds (foreign and domestic) not only for mining but for other industries; contributed to the development of regional infrastructure (roads, railways, and telegraph facilities); and boosted the rise of other economic activities, especially in agriculture, communication, manufacturing, and transportation.

Inevitably, the long-term impact of gold mining on specific communities was more variable. Those able to sustain or expand their production of minerals, such as Kalgoorlie, continue to derive much of their well being from mining. Other communities were able, in effect, to invest a portion of the proceeds from mining in alternative economic activities that now provide the lifeblood of the community. In still other communities, alternative economic activities were not to be found, and once the mines ran out of ore, the towns disappeared. As Moore (unknown date, pp. 2-5) writes:

> Mining towns in Western Australia have had a dynamic and volatile history. Periods of rapid growth have been matched by periods of equal rapid decline and, in many cases, eventual abandonment…
>
> The first 60 years of European settlement in Western Australia produced little mining activity, apart from quarrying of stone, clay, and sand for building construction.
>
> The situation changed dramatically in the 1890s with the discovery of gold in the Kimberley, Pilbara, Ashburton, Murchison, Yilgarn and Eastern Goldfields. Thousands of prospectors were attracted to Western Australia and lived in mining camps wherever gold was discovered…
>
> The state's first goldmining boom peaked in 1903. It was followed by a period of decline, during which hundreds of mining centers disappeared as rapidly as they had been created. Those which survived experienced cycles of growth and decline in response to the economic fluctuations of the mining industry.

> A second dramatic period of mineral development has been experienced during the last 30 years [since the middle 1960s]. It has been based primarily upon the discovery and mining of vast deposits of iron ore, nickel, mineral sands, petroleum and natural gas, diamonds, base metals, and bauxite. There also has been a resurgence in goldmining, and a rejuvenation of many of the existing Goldfields towns…
>
> Single-purpose mining towns have an unpredictable lifespan. The vast majority of Western Australian goldmining settlements established during the 1890s experienced a short period of prosperity, followed by an equally rapid downturn and eventual abandonment.
>
> Only a handful have continued to exist after a century of mining activity, during which they have experienced cycles of growth and decline associated with the fluctuating profitability of the goldmining industry. Even among the new generation of company mining towns, several, such as Shay Gap and Goldsworthy, have been closed and dismantled after existence of less than 30 years. Some such as Meekatharra, Kalgoorlie-Boulder and Collie have become regional centers, while others such as Coolgardie, Norseman, and Tom Price are developing their tourist potential.

Periods of decline obviously create challenges for a community, even if the long-term benefit to a region is positive.

Three Models of Mining and Regional Development

A more general and broader look at history suggests three models of mining's role in regional development and how it has varied over time (see Radetzki, 1982, and Strongman, 1998). These models are generalizations, caricatures if you will. As with any model, they represent simplified versions of reality designed to focus our attention on a few fundamental aspects of a situation. As such, they mask or hide the complexity and richness of the real world. They are simplifications. Nevertheless, these models help us understand how we arrived at current concerns about mining and regional development.

The Strong-Linkage Model

Mineral development in the latter part of the 19th century and the first few decades of the 20th century typically served local or regional populations and industry. Mines were located close to industrial centers where mineral ores were processed and in many instances made into products (in the case of metals) and sold to consumers. An example in the Great Lakes region of the United States is iron-ore and coal mining and its proximity to regional steel mills. In Europe, iron-ore and coal mines served the emerging iron and steel industry of the time.

Regional economic linkages were strong. Mines purchased most of their inputs locally or regionally. Relatively high costs of transportation discouraged long-distance transport of raw-material or equipment inputs. Moreover, relatively simple technologies of mining meant that inputs were not terribly specialized, reducing the need to look far afield for inputs. Moving from the purchase of inputs to the processing of mineral ores, most processing was done in the region of the mine. Again, transportation costs played an important role; relatively high costs discouraged the shipping of bulky, low-value ores and

instead favored the shipping of higher-valued semi-finished or finished products. As Radetzki (1982) notes, cause and effect worked both ways in the ferrous sector: (a) iron and steel production was attracted to regions with iron-ore and coal deposits, and (b) the development of iron-ore and coal mines was stimulated by proximity to centers of industrial activity and final consumers. All of this is another way of saying that during this period, most mineral markets were regional rather than fully global in extent.

The Weak-Linkage (Enclave) Model

By the middle of the 1960s, transportation costs, especially those of long-distance ocean transport of bulk materials, had fallen significantly (see Manners, 1971; and Lundgren, 1996). Reduced transport costs meant that mines could be located farther from final consumers and that mineral-processing facilities could be located farther from mines (and closer to other important inputs, such as cheap hydroelectric power). Also, as mines became larger and more technically complex, the expertise and equipment necessary to run a mine efficiently became more specialized and often were not obtainable locally; so multinational companies and purchase of inputs outside the mine region became prominent features of mine development at the same time that the geographic spread of mining expanded.

As a result, regional economic linkages were smaller than they had been when mines were simpler and located closer to industrial centers. From the perspective of a local community or region, a mine became an enclave--isolated from the non-mining sectors of a region, especially in developing countries and remote locations (Strongman, 1998).[8] Compared to earlier times, a greater portion of the inputs was purchased outside of the mining region. Less processing was done close to the mine. Multinational companies took income home with them outside the region. Royalty payments tended to go to national governments rather than to the region itself. To be sure, mining companies often built town sites and more generally funded regional infrastructure; but most of this activity, not surprisingly, focused on the direct needs of the mine and its workforce. Finally, national governments and mining companies tended to make most decisions about mine development without significant input from local communities and regions.

Sustainable-Development: A Model Yet to be Defined Fully

Since the 1980s, there have been growing concerns about: (a) lack of appropriate regional linkages and in turn the sustainability of regional economies as a mine inevitably declines, (b) lack of appropriate compensation for non-market costs borne by mining regions (primarily environmental and social costs), (c) insufficient sharing of the benefits with mining regions, and (d) lack of regional representation and involvement in decision making. In other words, some argue that mining regions often bear a disproportionate share of the costs of mine development for which they are not compensated adequately, receive an inappropriately small share of the net benefits, and do not participate adequately in decision making that leads to a mine. These concerns have led to a number of efforts aimed at enhancing the contribution of mining to local communities and regions.

[8] As Radetzki (1982) notes, mineral enclaves were discussed as early as the 1950s and 1960s by Myrdal (1956), Meier and Baldwin (1957), Seers (1959), and Baldwin (1966).

Stated slightly differently, the critical issues involve both substance and process. The issues of substance are: How to create mineral wealth in a way that is consistent with environmental and social values? How to appropriately compensate communities and regions for the costs, often environmental and social, that they bear? How to ensure that communities and regions share appropriately in the net benefits of mining? How to use the proceeds from mining to invest in other forms of capital to prepare for the day when mining no longer supports an economy? The issue of process is simply how to involve local communities and regions in answering these questions.

Thus, more than anything else, the sustainable-development model--in the context of communities and regions--represents a set of concerns and a commitment to figuring out how to deal with them.

This chapter provides several empirical and conceptual lenses through which to view the discussion later in this volume on managing mineral wealth from the perspective of local communities and regions:

- Mining is a localized activity, on which many communities and regions depend. Mining itself depends fundamentally on the presence of a gift a nature--a mineral deposit. Mining can persist, sometimes for decades, in a community or region through continued development of new mineral reserves during mining. It can persist even after the physical quality of deposits declines (for example, size, grade, metallurgical quality) because of advantages given to a community in the form of existing (already paid for) infrastructure and agglomeration economies. Nevertheless, a mineral deposit eventually is depleted. Local communities and regions need to plan for this inevitability.
- Mining has the potential to create significant direct economic benefits in the form of employment and income. It also can lead to indirect benefits through its linkages with other sectors of a regional economy.
- Assessing a mine's impact on local and regional economic development is powerfully aided by a careful examination of the mine's full social benefits and costs. To be sure, some benefits and costs are devilishly hard to quantify; nevertheless, without at least a preliminary ledger of benefits and costs, it is difficult to have a thoughtful and rational discussion of the critical issues surrounding mining and the community.
- History suggests that even where the long-term effects of mining on economic development are positive, this long-term gain comes at the cost of short-term disruption and adjustment associated with booms and busts in the mining sector. Moveover, over time, mining's role in regional economic development has evolved and changed, along with broader changes in technology and society. The critical economic issues of today involve both substance and process.

Table 2.1 Mining's Contribution to Regional and National Economic Output

	Mining's Share of Gross State Product (%)	Mining's Share of Gross Domestic Product (%)
Western Australia, Australia	18.6	4.3
Nevada, USA	2.4	1.2
of which:		
Metal mining	2.3	0.1
Coal mining	0.0	0.1
Oil & gas extraction	<0.1	0.9
Nonmetallic minerals, except fuels	0.2	0.1
Yukon Territory, Canada	5.9	3.5
Northwest Territories and Nunavut, Canada	21.0	3.5

Sources

Western Australia and Australia: Australian Bureau of Statistics (www.abs.gov.au, accessed April 18, 2001). Data are for 2000.

Nevada and USA: Bureau of Economic Analysis, US Department of Commerce (www.bea.doc.gov, accessed April 17, 2001). Nevada data are for 1998. US national data are for 1999.

Yukon Territory: Yukon Bureau of Statistics (www.yukonweb.com/government/ybs, accessed April 18, 2001). Data are for 1999.

Northwest Territories and Nunavut: Northwest Territories Bureau of Statistics (www. stats.gov.nt.ca, accessed April 18, 2001). Data are for the two areas combined is for 1996.

Canada (national statistics): Statistics Canada (www.statscan.gov.ca, accessed April 18, 2001). Data are for 2000.

Notes

In all cases, the category Mining includes metal mining, coal mining, oil and gas extraction, and non-metallic minerals. Mineral processing is not included here; it is considered part of Manufacturing in all political jurisdictions represented in this table.

Table 2.2 Employment in Selected Nevada Counties, Mining and Total, 1988

County	Mining Employment	Total Employment	Mining as % of County Total
Elko	1,300	25,287	5.1
Esmeralda	138	432	31.9
Eureka	4,147	4,944	83.9
Humboldt	2,083	10,304	20.2
Lander	1,151	3,286	35.0
Pershing	831	2,912	28.5
Other	5,560	1,088,215	0.5
Nevada Total	15,210	1,135,380	1.3

Source: Regional Accounts Data of the Bureau of Economic Analysis,
U.S. Department of Commerce (www.bea.doc.gov, accessed April 17, 2001).

Table 2.3 Average Hourly Earnings for U.S. Workers by Industry, 2000

	US$/Hour
Mining	17.14
Construction	18.76
Manufacturing	14.38
Transportation & Public Utilities	16.22
Wholesale Trade	15.18
Retail Trade	9.45
Finance, Insurance, Real Estate	15.07
Services	13.88
Government	na
All Workers	13.74

Source: Bureau of Labor Statistics, U.S. Department of Labor (http://stats.bls.gov, accessed April 17, 2001)

Notes
(1) na = not available
(2) For the mining, construction, and manufacturing industries, the figures are for production workers. For all other industries, the figures are for nonsupervisory workers.
(3) The Mining industry here includes metal mining, coal mining, oil and gas extraction, and non-metallic mineral mining.

Table 2.4: Output, Income, and Employment Multipliers: Western Australia, 1995

	Output Multiplier	Income Multiplier	Employment Multiplier
Mining			
Metallic Minerals	2.1	3.0	4.1
Coal, Oil, and Natural Gas	1.8	2.2	3.6
Services to Mining	3.0	3.1	3.2
Mineral Processing			
Basic Metal Products	2.3	3.4	4.7
Chemical, Petroleum, and Coal Products	1.9	3.8	4.3
Average for All Sectors in Western Australia	2.2	2.4	2.6

Source:K.W. Clements and Q. Ye, A New Input-Output Table for Western Australia (Nedlands, Western Australia, Economic Research Centre, University of Western Australia, 1995).

Notes
1. Metallic minerals includes the mining of iron ore, bauxite, gold, nickel, titanium minerals and other metal ores.
2. Coal, oil, and natural gas excludes the processing of natural gas into LPG and LNG
3. Basic metal products is dominated by nickel smelting and refining and alumina refining.
4. Chemical, petroleum, and coal products consists mostly of the production of LNG and LPG, along with other refined petroleum products, processed titanium minerals, and fertilizers.
5. These multipliers include induced consumption.

Table 2.5: Output and Employment Multipliers: Region II of Chile, 1999

	Output Multipliers		Employment Multipliers	
	Open System	**Closed System**	**Open System**	**Closed System**
Agriculture	1.02	2.33	1.06	1.13
Fishing	1.35	2.08	1.22	1.25
Mining	1.28	1.80		
Private mining firms	nr	nr	4.10	6.71
Other mining firms	nr	nr	2.04	2.76
Construction	1.21	2.20	1.20	1.57
Transportation and Communication	1.27	2.35	1.12	1.22
Utilities	1.66	1.92	4.54	6.29
Manufacturing	1.28	1.79	1.39	1.57
Retail	1.31	2.54	1.10	1.27
Business Services	1.41	2.93	1.45	2.34
Real Estate Services	1.02	2.33	1.01	1.34
Other Services	1.11	2.52	1.04	1.21
Public Administration	1.47	3.96	1.03	1.09

Source: Aroca (2000).

Notes:
1. nr = not reported
2. Open-system multipliers do not include induced household spending
3. Closed-system multipliers includes induced household spending and assumes all of this induced spending is on goods and services produced in Region II of Chile

Table 2.6 Local Effects of the Kori Kollo Mine, Bolivia, 1999

Direct Economic Impact		
	Annual Wages, Salaries, Benefits	Employment
		(number)
Inti Raymi	$5.2 million	396
Sermat	$2.4 million	187
Comba	$0.6 million	44
Annual Purchase of Intermediate and Capital Inputs		
Imported	$42.0 million	
of which:		
Sodium cyanide	$19.0 million	
Grinding balls	$7.0 million	
Diesel fuel	$4.6 million	
Spare parts	$2.9 million	
Other	$8.5 million	
Local Purchases	$18.0 million	
of which:		
Electricity	$6.9 million	
Lime	$1.4 million	
Food, construction materials, supplies	$1.2 million	
Other	$8.5 million	
Health, Safety, Training		
Company health clinic and related activities	Open to all employees and their families Emphasis on work-related injuries and preventive care Health and educational courses Prenatal and neonatal care Testing of local drinking water Vaccinations Monitoring of mine safety	
Training	Company-funded opportunities for both professional staff and production workers	
Infrastructure		
Towns	Improved supplies of electricity, potable water, and sewerage Building and maintenance of schools, health centers, sports fields	

Mine infrastructure (built with the mine in mind, but with potential to benefit local communities and the region)	42-kilometer road to mine site Improvements to 230-kilometer road between mine and the border with Chile 55-kilometer power line to the mine 39-kilometer natural gas pipeline 3300-meter airstrip

Inti Raymi Foundation

Private, nonprofit foundation, run independent of Inti Raymi

Provides funding for social programs to benefit families and communities in the region of the mine

Funded primarily from annual contributions by Inti Raymi of about $840,000

Eventually management will be transferred to the local government

Areas of emphasis: health care, rural education, training

Source: Laurence Bouton, "Bolivia: Mining Gold, Empresa Minera Inti Raymi S.A.," 1999 www.ifc.org, accessed April 26, 2001

4 Guiding Concepts for Management: Wealth, Capital, and Economic Rents

Part I of this study focused on understanding the economic effects of mining and mineral processing at two scales: nations, and the perspective of local communities and surrounding regions, and nations. It provided the necessary starting point for the normative discussion in Part II of how best to manage mineral wealth. This chapter explores three concepts that cut across all aspects of managing mineral wealth: wealth, capital, and economic rents.

4.1 Wealth and Capital

The economist Alfred Marshall wrote (1920, p. 81):

> …the terms Capital and Wealth are used as synonymous almost perforce…[W]e should speak of Capital when considering things as agents of production; and…we should speak of Wealth when considering them as the results of production, as subjects of consumption and as yielding pleasures of possession. Thus the chief demand for capital arises from its productiveness, from the services which it renders, for instance, in enabling wool to be spun and woven more easily than by the unaided hand, or in causing water to flow freely whenever it is wanted instead of being carried laboriously in pails…On the other hand the supply of capital is controlled by the fact that, in order to accumulate it, men must act prospectively: they must 'wait' and 'save,' they must sacrifice the present to the future.

Wealth and capital have a number of related meanings. To an individual or family, wealth represents the value of its assets--land, a house, an automobile, shares of stock and other financial instruments, bank accounts, and so on. Wealth may be inherited or accumulated over time through saving and investment. Wealth is different than income; it is a stock of value at a point in time, whereas income is a flow of value during a period. Wealth is related to income, in that wealth represents the result over time of saving and investing some or all of one's income. Wealth also is capital in that it can be used as an "agent of production" to use Marshall's words; through investment, today's wealth can generate future income.

In a broader sense, wealth and capital embody more than material goods (a house) and financial assets (shares of stock). They include everything with the potential to generate well being, including but not limited to monetary income. In this sense, we can think of human capital as the skills and qualities embodied in educated and healthy people. We can think of natural capital in the form of land, air, water, flora and fauna, and mineral and energy resources. We have social capital in the form of governments, universities, and other societal institutions. Finally, we have man-made, physical capital in the form of, for instance, buildings, equipment and processes, roads and other transportation systems, and electric-power systems. Thus capital and wealth can be thought of as coming in four forms: human, natural, social, and man-made physical.

It is in this context that we consider *minerals* as *wealth*. Minerals have the potential to create well being, if they are discovered, developed, and mined in a way that appropriately protects environmental quality and that is fair to all interested parties involved in or affected by mining.

In an economic sense, sustainability depends on two conditions. First, mineral wealth needs to be created before it can be sustained. Undiscovered and undeveloped minerals represent only potential wealth. Second, even if mining itself is not sustainable at a particular location, the economic benefits of mining are sustainable by investing in the creation of other forms of capital. A nonrenewable mineral resource, in other words, can be converted into a renewable resource by saving a portion of the revenues from mining and investing them in human, social, and man-made physical capital.

To better understand how the wealth of nations differs around the world, the World Bank assembled estimates of national wealth and its components--in this case, natural capital, produced assets, and human resources/capital (see World Bank, 1997; and Kunte, Hamilton, Dixon, and Clemens, 1998). The data are for 1994. Natural capital includes the estimated value of land, forests, and subsoil metals, minerals, and fossil fuels. Produced assets represent the value of buildings and structures, machinery and equipment, and urban land. Finally, the category human resources/capital includes what I referred to previously as both human and social capital--that is, the skills and talents embodied in people and their social institutions (more precisely, the World Bank estimates represent the values added by education, raw labor, institutions, and other social structures). Table 4.1 summarizes the wealth estimates by income group. Not surprisingly, the higher the income, the higher the wealth; the total wealth per capita in the high-income countries is eleven times higher than in the low-income countries. Looked at slightly differently, there is a gap in per capita wealth of $291,000 between the high-income and low-income countries. Seventy-four per cent of this gap is due to differences in human resources/capital, 23 percent in produced assets, and only 3 percent in natural assets.

Turning to the mineral economies (see Chapter 2), Table 4.2 summarizes the wealth of these economies and its components. Not surprisingly, the mineral economies in each income group have a higher percentage share of their wealth in natural capital than the average of all nations in the comparable income group.

Over time, increases in wealth can come about only if a nation saves a portion of its current income and invests the savings in assets. The World Bank augments its estimates of national wealth with what it calls *genuine saving*. These estimates start with traditional estimates of investment contained in national income and product accounts; more precisely, gross domestic investment, the value of spending on investment goods such as buildings, equipment, and machinery. Then a number of adjustments are made:

- subtract depreciation of produced assets (an estimate of the extent to which produced assets have declined in value), also sometimes referred to as consumption of fixed capital,
- add expenditures on education (investment in human capital),
- subtract the value of natural resource depletion (in effect, a portion of the depreciation of the stock of natural assets), and

- subtract the value of pollution damage (representing additional depreciation of the stock of natural assets).[9]

To be sure, estimating most of these adjustment values is not simple and straightforward. But the provide a starting point for considering and evaluating the extent to which nations save and invest.

Table 4.3 summarizes estimates of genuine saving by income group in 1999. Again not surprisingly, the higher the income, the higher the genuine savings, both as a percentage of GNP and per capita. A positive rate of genuine saving suggests that a nation is increasing its overall wealth and its stock of capital and in turn its overall ability to generate well being. A negative rate of genuine saving implies that a nation is not sustaining its capital stock; its overall wealth is declining. These are estimates at a point in time and thus a negative rate of genuine saving does not mean that a nation is doomed to unsustainable development; it simply means that in a specific period of time it used up part of its wealth.

Table 4.4 summarizes data for the mineral economies as a percentage of GDP in 1997, as well as for the entire set of countries in each income group. An important caveat in interpreting the numbers is that the estimation method undoubtedly over-estimates the magnitude of energy and mineral depletion; the degree of over-estimation is larger, the larger the share of depletion in GDP (Hamilton 2000). Notwithstanding this limitation, although significant differences exist among individual countries, the mineral economies as a group in each income category saved less than the income group averages: -8.0% versus 13.5% for the high income countries, 3.9% versus 15.0% for the middle income countries, and -3.3% versus 4.8% for the low income countries. Comparing the mineral economies with the broader income-group averages, the mineral economies generally had lower rates of gross domestic savings.

Hamilton (2000), the source of the genuine-saving data in Table 4.4, examined the relationship between (a) the genuine saving rate and (b) depletion's share of GDP (energy, mineral, and net forest depletion). He found a weak statistical relationship--more specifically, that a 1% increase in the depletion share of GDP is associated with a 0.82% decline in the rate of genuine saving. Another way of stating this result is that 82% of the net benefits of resource extraction tended to be consumed rather than saved and invested.

Despite the preliminary nature of these data on wealth and genuine saving, these data focus our attention on the importance of wealth and capital in economic development. For development to be sustainable, wealth--broadly defined to include natural and human, as well as produced, assets--must increase. For this to happen, the rate of genuine saving--again broadly defined--must on average be positive. For the mineral economies, the important lesson is that an appropriate portion of the revenues from mineral production must be saved and invested in other forms of assets for economic development to be sustainable. But what is the "appropriate" portion of mineral revenues to be saved and invested? The answer to this question depends on an understanding of the concept of economic rents.

[9] In addition, the adjustments include deducting net foreign borrowing and adding net official transfers.

4.2 Economic Rents

The term "economic rent" is a slippery concept. It has a number of related but not identical meanings. Thus it is important to define terms here in the interest of clarifying later discussion of the challenges of managing mineral wealth.

At the most general level, ***The New Palgrave: A Dictionary of Economic Concepts*** (1987) defines economic rent as: "payment for use of a resource, whether it be land, labor, equipment, ideas, or even money." So landowners, for instance, earn a rent in exchange for allowing others to farm on their land. Laborers earn a rent known as a wage or salary in exchange for providing their labor. Songwriters earn a rent known as a royalty. Lenders of money earn a rent known as interest. The size of the rent payment is a function of the productivity or desirability of the resource. Highly productive workers receive a higher wage than less-productive workers. Highly productive agricultural land commands a higher rental payment than less-productive lands. Analogously, the owner of a high-quality mineral deposit should receive a higher payment per unit of mineral than the owner of a low-quality deposit.

Two specific types of rent are important in understanding the value of mineral resources. The first is known as *Ricardian* or *Differential* rent. It is named after David Ricardo, who wrote in the early 1800s about agricultural lands. He observed that agricultural lands differ in quality from one tract to another. More fertile tracts, those that yield more agricultural output per acre, earn higher rental rates than less fertile tracts. It is an easy step to extend the concept to mineral resources. Some mineral deposits are of higher quality than other deposits; they may be larger, higher grade, easier to process, located close to transport facilities, etc. In a market place for mineral deposits, these high-quality deposits will fetch higher prices per unit of mineral than low-quality deposits. Ricardian rent, therefore, is consistent with the general definition of economic rent; it represents payment for use of a mineral resource.

Equivalently, Ricardian rent can be considered a *surplus*--because the size of the rental payment will be a function of the size of the surplus. A surplus exists if mineral prices exceed costs of production, including a minimum acceptable profit. High-quality deposits earn Ricardian rents precisely because they have low production costs. Lower-quality deposits have higher production costs, have smaller surpluses, and thus command a lower price in the market place. Thus Ricardian rent can be viewed equivalently as both compensation for use of a resource and as a surplus.

What determines the size of the Ricardian rent or surplus associated with a particular mineral deposit? First, as noted earlier, a portion of the rent is due to purely geologic and economic considerations that influence a mine's costs of production--for example, size, grade, metallurgical character, and location. Second, public policy often influences the size of surplus. Public policy directly influences costs of production though government-imposed costs or subsidies. The indirect effects of public policy, however, my be even more important. The more stable that investors perceive policies to be, the lower the risk premium they will demand, and, in turn, the larger the Ricardian rents will be. The important point here is that a risk premium is part of the minimum acceptable profit

demanded by investors. Third, managerial expertise influences production costs and the magnitude of rents; a well managed mine will have lower costs and earn higher rents than the same mine managed poorly. Fourth, monopoly (or market) power is a source of rent in the sense that a firm able to influence the price at which it sells its output can achieve a higher surplus than otherwise.[10]

When viewed as a surplus--revenues in excess of those required to bring a deposit into production, or of those required to keep an existing operation in production--Ricardian rents can be viewed as available for sharing. As a surplus, Ricardian rents are attractive to many entities--mining companies, organized labor, governments at all levels, local communities, and other entities. This focus on rent sharing, however, brings with it two potential problems. First, what is an equitable distribution of a surplus? What is deemed equitable or fair to one individual or group may be viewed by others as completely inequitable or unfair. Second, there is the very real danger that the existence of surpluses or rents encourages people and organizations to give higher priority to getting a share of the surplus than to creating the surplus in the first place. Both potential problems are the focus of more detailed discussion later in this study.

The second specific type of economic rent that is important for mineral resources is known as *Hotelling* rent. It is named after the economist Harold Hotelling and is that portion of the value of a mineral deposit attributable to the limited physical availability of the resource. Hotelling rent is a scarcity premium, unrelated to differences in quality among different mineral deposits. It sometimes is called scarcity rent. Hotelling rent is consistent with the general definition of economic rent given at the beginning of this section; it is that portion of the price at which a mineral deposit is sold in the market place that is due to physical scarcity. Hotelling rent, however, is *not* a surplus available for sharing--at least not without significantly distorting the incentives facing investors. Hotelling rent is part of the expected return that investors require to justify investing in mineral exploration or mine development. As Daniel (1992, p. 83) notes:

> In the real world, the closest counterpart to scarcity rent is the additional return investors in mineral seek to compensate for the expected cost of finding new deposits of an increasingly scarce resource. In the Ricardian sense, this is not rent at all, but part of the market-determined rate of return required to secure the initial commitment of capital.

Thus, if governments tax away the Hotelling rent, then private companies will not have the incentive to invest in risky mineral exploration, unless governments in some way encourage or subsidize exploration.

---

[10] Strictly speaking, surpluses due to favorable location, favorable or stable public policies, good management, or market power are not "Ricardian" rents. Ricardo focused on differences in the fertility of different tracts of agricultural lands, analogous to differences among mineral deposits in size, grade, metallurgical character, and other physical and chemical characteristics. But to simplify the presentation, I consider any rents that are surpluses and arguably available for sharing to be Ricardian rents.

Let us now tie together the concepts of wealth, capital, and economic rents. The concepts wealth and capital are essentially synonymous. Both embody the ability or capacity to generate well being--including but not limited to monetary income. We use the term wealth when something of value is the result of production and the term capital when something is an agent of production. Minerals in the ground are only potential wealth. They do not become actual wealth until they are discovered, developed, and mined; mineral wealth is the result of these human activities. Mineral wealth then becomes capital when it is used to create additional well being in the future through productive investment.

What is the appropriate measure of the value of mineral wealth or capital? The answer is, the sum of the differential (or Ricardian) and scarcity (or Hotelling) rents. Therefore to sustain the economic benefits created by mining requires that we undertake activities that convert the mineral rents into other forms of capital--human, social, and man-made physical.

Table 4.1 National Wealth Estimates, by Country Income Group, 1994

Country Group	Total Wealth	Human Resources	Natural Capital	Produced Assets	Human Resource	Natural Capital	Produced Assets
		(000 US$ per capita)			(percent of total wealth)		
High Income	319	236	11	72	74	3	23
Upper Middle Income	115	87	10	19	76	9	17
Lower Middle Income	70	52	6	11	74	9	16
Low Income	28	20	3	5	71	11	18

Notes: Estimates are based on purchasing-power parity (PPP) exchange rates and a discount rate of 4%.

Source: Website of the World Bank, Environmental Economics and Indicators (http://www-esd.worldbank.org/eei/), accessed October 2, 2001.

Table 4.2 National Wealth and Its Components, the Mineral Economies, 1994

	Total Wealth	Human Resources	Natural Capital	Produced Assets	Human Resources	Natural Capital	Produced Assets
		(000 US$ per capita)			(percent of total wealth)		
High Income							
Australia	297	195	35	67	66	12	33
Kuwait	Not available						
Norway	302	172	30	99	57	10	33
Mean	300	184	33	83	62	11	33
Upper Middle Income							
Chile	148	116	14	17	79	10	12
Libya	Not available						
Oman	Not available						
Saudi Arabia	171	69	72	30	40	42	18
South Africa	83	62	4	17	75	5	20
Trinidad and Tobago	128	77	12	39	60	9	30
Venezuela	110	57	21	32	52	19	29
Mean	128	76	25	27	61	17	22
Lower Middle Income							
Algeria	Not available						
Bolivia	36	21	6	9	59	17	25
Colombia	85	67	6	12	79	7	14
Ecuador	67	41	11	14	61	17	22
Egypt	52	33	2	16	64	5	31
Jordan	64	48	1	16	74	2	24
Kazakhstan	Not available						
Papua New Guinea	39	25	7	6	64	19	17
Peru	59	40	5	15	67	8	25
Russian Federation	Not available						
Syria	Not available						
Mean	57	39	5	13	67	11	23
Low Income							
Azerbaijan	Not available						
Congo, Dem. Rep.	Not available						
Guinea	Not available						

Indonesia	60	45	7	8	75	12	13
Mauritania	24	14	5	4	60	22	18
Mongolia	Not available						
Niger	23	8	12	2	36	54	10
Nigeria	Not available						
Senegal	32	22	5	4	70	17	13
Tajikistan	Not available						
Togo	18	11	3	4	64	15	21
Yemen	Not available						
Zambia	15	5	5	4	38	38	25
Mean	29	18	6	4	57	26	17

Source: Arundhati Kunte, Kirk Hamilton, John Dixon, and Michael Clemens, *Estimating National Wealth: Methodology and Results*, Environmental Economics Series (Washington, D.C., World Bank, 1998).

Table 4.3 Genuine Saving, by Country Income Group, 1999

	Percent of GNP	Per Capita (US$)
High Income	15	4127
Upper Middle Income	11	484
Lower Middle Income	8	158
Lower Income	-3	-5

Source: Website of the World Bank, Environmental Economics and Indicators (http://www-esd.worldbank.org/eei/), accessed October 2, 2001.

Table 4.4 Genuine Saving and Its Components, the Mineral Economies, 1997 (percent of GDP)

	Gross Domestic Savings	Consumption of Fixed Capital	Net Domestic Savings	Education Expenditure	Energy Depletion	Mineral Depletion	Net Forest Depletion	Carbon Dioxide Damage	Genuine Domestic Savings
High Income									
Australia	20.7	14.6	6.1	4.7	1.2	1.5	0.0	0.4	7.6
Kuwait	25.2	8.6	16.6	4.3	44.5	0.0	0.0	..	-23.6
Norway	..	16.4	..	6.7	5.9	0.0	0.0	0.2	..
Mean-High Income Mineral Economies	23.0	13.2	11.4	5.2	17.2	0.5	0.0	0.3	-8.0
Mean-All High Income Countries	21.4	12.4	9.0	5.3	0.5	0.0	0.0	0.3	13.5
Upper Middle Income									
Chile	24.5	6.8	17.7	3.2	0.1	6.4	0.0	0.4	14.1
Libya	..	..	..	..		0.0	0.0	0.0	..
Oman	..	..	..	..	..	0.0	0.0	0.0	..
Saudi Arabia	34.6	10.0	24.6	5.8	43.6	0.0	0.0	1.0	-14.2
South Africa	17.0	13.8	3.2	6.6	2.1	1.9	0.1	1.4	4.4
Trinidad and Tobago	29.1	11.2	17.9	4.1	10.8	0.0	0.0	1.8	9.4
Venezuela	26.9	7.1	19.7	4.1	22.5	0.7	0.0	1.1	-0.4
Mean	26.4	9.8	16.6	4.8	15.8	1.3	0.0	0.8	2.7
Lower Middle Income									
Algeria	34.5	9.3	25.2	6.3	2.4	0.1	0.0	1.1	27.9
Bolivia	10.1	8.1	2.0	2.6	0.9	1.1	0.0	0.7	1.8

Colombia	15.8	6.5	9.4	2.8	4.4	0.1	0.0	0.4	7.3
Ecuador	21.2	6.9	14.2	2.7	12.0	0.0	0.0	0.7	4.2
Egypt	13.0	7.9	5.1	4.8	3.2	0.1	0.0	0.7	5.9
Jordan	5.5	9.7	-4.2	3.4	0.0	1.2	0.0	1.1	-3.1
Kazakhstan	13.5	7.4	6.1	0.0	18.5	0.0	0.0	5.5	-17.9
Papua New Guinea	33.2	11.0	22.2	5.8	6.7	8.2	0.0	0.3	12.8
Peru	20.8	4.3	16.6	3.1	0.6	0.8	0.0	0.3	18.0
Russian Federation	24.7	19.3	5.3	4.1	9.3	0.0	0.0	1.8	-1.6
Syria	19.0	3.5	15.5	2.8	22.5	0.1	0.0	1.6	-5.9
Mean	19.2	8.5	10.7	3.5	7.3	1.1	0.0	1.3	4.5
Mean-Middle Income Mineral Economies	21.5	8.9	12.5	3.9	10.0	1.3	0.0	1.2	3.9
Mean-All Middle Income Countries	26.2	9.2	17.0	3.5	3.8	0.5	0.2	1.1	15.0
Low Income									
Azerbaijan	9.5	14.0	-4.5	0.0	21.8	0.0	0.0	5.1	-31.4
Congo, Dem. Rep.	9.0	5.0	4.0	0.7	0.0	0.6	0.0	0.2	3.8
Guinea	18.7	6.1	12.6	2.3	0.0	18.8	0.0	0.2	-4.1
Indonesia	30.6	5.0	25.6	0.9	3.8	0.8	0.7	0.9	20.5
Mauritania	8.5	8.6	-0.1	4.9	0.0	14.6	0.0	1.7	-11.5
Mongolia	17.5	7.6	9.9	5.9	0.0	9.6	0.0	6.2	0.1
Niger	3.3	4.5	-1.2	1.9	0.1	0.0	0.0	0.4	0.2
Nigeria	21.9	2.4	19.5	0.8	30.7	0.0	0.0	1.5	-12.0
Senegal	13.2	5.3	7.9	4.1	0.0	0.4	0.0	0.4	11.1
Tajikistan	..	5.3	..	..	0.0	0.0	0.0	..	..
Togo	9.8	5.1	4.7	5.3	0.0	2.4	0.0	0.3	7.4
Yemen	12.8	7.7	5.1	3.9	34.7	0.0	0.0	..	-25.7
Zambia	9.8	9.9	-0.1	3.8	0.1	1.3	0.0	0.4	1.9
Mean-Low Income Mineral Economies	13.7	6.7	7.0	2.9	7.0	3.7	0.1	1.6	-3.3
Mean-All Low Income Countries	17.0	8.0	9.1	3.4	4.2	0.6	1.8	1.2	4.8
World	22.2	11.7	10.5	5.0	1.2	0.1	0.1	0.4	13.6

Source: Kirk Hamilton, *Genuine Saving as a Sustainability Indicator*, Environmental Economics Series, Paper no. 77
(Washington, D.C., World Bank, 2000).

5 Managing Mineral Wealth: Challenges and Roles

The discussion to this point--on the economic effects of mining on communities and nations, and on the concepts of wealth, capital, and economic rents--suggests that managing mineral wealth for sustainable economic development consists fundamentally of meeting four challenges:

- That mineral wealth be created in the first place, efficiently and in a manner consistent with social preferences for environmental quality and other social and cultural values. I call this the Creation Challenge.
- That, once created, mineral wealth be shared equitably--more specifically sharing of the surpluses or economics rents from mineral production, among private mining companies, government at all levels, local communities, and other organizations and entities. I call this the Distribution Challenge.
- That the broader economic and political effects of mineral development, and their potential problems, be understood and managed. I call this the Macroeconomic and Political Challenge.
- That the economic benefits of mining be sustained--even as a mine inevitably is depleted--through appropriate investment in human and other forms of sustainable capital. I call this the Investment Challenge.

Governments, private companies, and civil society each play important, but different, roles in meeting these challenges. Although their roles are discussed in the context of each challenge later in the chapter, the next section considers in general the roles of governments, private companies, and civil society in a market economy.

5.1 Roles: A General Introduction

Governments at all levels--local, regional, national--have roles that extend far beyond the issue of mining and sustainable development. In fact, government's role in mineral development can only be understood in the context of its broader responsibilities. Fundamentally, governments are responsible for establishing the overall framework for economic development in a nation. More specifically, as the World Bank (1997, chapter 3) notes, governments need to find the right mix of government and private activities ensuring that the five preconditions for economic development exist in a nation: a foundation of law and property rights, a nondistortionary policy environment (including macroeconomic stability), investment in people and infrastructure, protection of the vulnerable, and protection of the environment. In delimiting the appropriate roles for government and private entities in these five areas, most economists argue that governments should limit their activities to those that: (a) facilitate market activity (through, for example, establishing well-defined property rights and a system of money and banking), (b) promote economic efficiency when markets to do not perform well (for example, to correct market failures, such as excessive environmental pollution, or to provide public goods, such as national defense), or (c) pursue the equitable distribution of income, wealth, and more generally of the benefits and costs of various human activities. In this light, the first precondition for economic development, a foundation of law and property rights, almost requires

government activities to establish this foundation. A nondistortionary policy environment, the second precondition, promotes economic efficiency and has to be provided by government. The third precondition, investment in people and infrastructure, is at least partially a public good; thus governments need to provide or subsidize the provision of these activities, which otherwise are likely to be under-provided by markets alone. Protection of the vulnerable, the fourth precondition, is an aspect of equity. Finally, protection of the environment can be viewed as promoting economic efficiency if this protection is carried out with the goal of internalizing previously external costs.

The role for government outlined above is generally, even if not universally, accepted. The appropriate role for private companies, in contrast, is the subject of much less agreement. What might be called the conventional economic view comes from microeconomic theory: that companies act in society's best interests by striving to maximize profits, within a framework defined by government policies and broader societal requirements and preferences. In this view, direct action toward achieving other societal goals, such as reducing environmental pollution and eliminating poverty, is best left to other entities, such as governments, charitable groups, religious organizations, and individuals in society. There is a long tradition, however, of opposition and objection to profit maximization as the major objective of firms. In recent years, much of the discussion has occurred under the banner of corporate social responsibility or corporate citizenship. In this debate, many business ethicists argue that companies do indeed have broader social responsibilities, including protecting the environment and furthering social justice. As Barry (2000, p. 68) summarizes:

> Business ethics now seems to be imposing positive moral values on commercial enterprises. They are now required to perform duties which private persons are not expected to perform: that is, actions which go beyond the observance of basic and conventional rules, respect for property, contract and conventionally established rights. They are not merely to refrain from wrongdoing but are to act positively for the public good. The rationale for the imposition of such duties on corporations derives largely from the claim that their existence depends solely upon a grant of privileges from the state. It would seem that they owe something to society in return for this (in addition to supplying wanted consumer goods and creating employment).

He goes on to write (p. 73):

> The type of corporate social responsibility that is usually suggested involves such things as the diversion of a certain portion of profits to community purposes, the protection of jobs and established working conditions in such things as takeovers and plant relocation, the enforcement of affirmative action in hiring policy, zealous protection of the environment and the inclusion of non-owners in important decision-making.

To be sure, a certain amount of "responsibility" is in the narrow self-interest of a company. By channeling a certain portion of profits to a local community, a company is enhancing its reputation and engendering goodwill in the community; if, in turn, these actions make workers happier, more productive, and more loyal, long-term profits are enhanced. Similar arguments can be made to justify including non-owners in important decision-making and protecting the environment beyond what public policy requires. But once commercial enterprises are expected to act positively for the public good, rather than simply looking out

for the best interests of their owners, defining and delimiting an appropriate role for these enterprises becomes much more difficult. One argument is that corporate social responsibility is a substitute for government action in situations where government capabilities are insufficient to carry on what normally would be a political activity. The difficulties and ambiguities associated with company responsibilities at the community level will become clearer later in this chapter.

My personal view is that we are treading on dangerous ground by expecting companies to focus on much more than their own interests. Placing broader social responsibilities on companies asks them to do things for which they are not particularly well suited. A better approach would be to develop greater capabilities in governments and civil society.

The third major group with important roles in mineral development then is civil society--which really is not one group but rather all interested parties to mineral development other than governments and private mining companies (and other market participants, such as banks and financial institutions). As such, civil society encompasses community groups, philanthropic foundations, advocacy groups, faith-based organizations, labor unions, and international organizations. They typically are non-profit groups unaffiliated with government. Given the diversity of organizations and interests, it is difficult to generalize about the role of civil society. Nevertheless, one can say that civil society's primary role is to fill voids left by government and the market--ensuring that societal preferences and values other than those represented in government and the market are considered appropriately. Civil society, in some sense, serves a watchdog role, there to make sure that governments and market participants are operating within broader societal norms. Civil society has an especially important role to play in circumstances where government institutions are weak or non-existent.

In light of these general roles for government, private mining companies, and civil society, let us now turn to the four challenges of mining and economic sustainability.

5.2 The Creation Challenge

As noted earlier, before mineral wealth can be sustained, it must be created. If minerals remain in the ground, the are simply potential wealth. But the creation of mineral wealth must occur in a manner consistent with social preferences for environmental quality and other social and cultural values.

Governments

Governments play a critical *facilitating* role in the creation and sustaining of mineral wealth. They largely determine and establish the legal and political framework in which actual mineral development by the private sector occurs. Much of this framework has nothing to do with the mineral sector in particular. Rather the framework--and the stability of the framework--provide the preconditions for economic development, as noted above.

Focusing specifically on the creation of mineral wealth, governments facilitate this creation by establishing a nondistortionary policy environment--*nondistortionary* in the sense that policies facilitate the flow of investment to those areas with the greatest commercial

attractiveness, whether in the mineral sector or elsewhere in the economy. Policy generally should not distort or steer investment toward particular sectors, unless there are spillover effects on the economy as a whole that otherwise would not be considered by private decision makers. A nondistortionary regime for mineral policy is one that strives for economic efficiency. What exactly constitutes mineral policy varies somewhat from case to case. In some cases, national mineral policy is essentially limited to statements of principle, with actual rules contained elsewhere (for example, in broader land-use rules or environmental legislation). Other mineral policies are comprehensive. In still other cases, mineral policy is *de facto* in that there is no single document called "mineral policy"; rather mineral policy represents the combined effects of many different policies. Nevertheless, mineral policy typically consists of rules governing: (a) ownership of both mineral resources and equity in mineral-production facilities, (b) collection and dissemination of basic geologic information, (c) land access and security of tenure for mineral exploration, mine development, and production, (d) mineral royalties and taxation, and (e) environmental protection. A recent review of mineral policies worldwide concludes that mineral policies should:

> provide greater access to mineral resources, offer clear and transparent licensing arrangements, security of tenure and the freedom to transfer exploration and mining rights, and allow companies to market their output on commercial terms. These laws are complemented with provisions, sometimes in investment or tax laws, that provide reasonable freedom to dispose of foreign exchange earnings, apply profit-based taxation on
>
> internationally competitive terms, and guarantee stability of those terms for a reasonable period of time.
>
> (World Bank and Metal Mining Agency of Japan, 2001, as summarized in **Mining Journal**, September 7, 2001, p. 184.)

Three important notes. First, governments importantly influence perceptions of geologic potential, which in turn influence the geologic attractiveness of investment in mineral exploration and mine development. Perceptions of geologic potential are determined largely by the level and quality of basic geologic information. For regions or countries with long histories of mining, the legacy of mining by itself may be enough to create a perception of good geologic potential. In other areas, perceptions of geologic potential depend critically on the availability of basic geologic information, on which explorers base their searches. Basic geologic information, of the type typically provided by government geological surveys, usually will be under-supplied from the perspective of society as a whole if left to the private sector alone. Part of the explanation relates to risk aversion. Private entities usually are more risk averse than society as a whole. In this case, they will require quicker payback on investments than society as a whole. As a result it will invest less in activities with long durations and uncertain rewards (such as preliminary or early-stage exploration which, consist largely of collecting basic geologic information) than is optimal from society's perspective. In addition, the private sector finds it difficult to fully appropriate the benefits of basic geologic information it collects; as a result, it will invest less than is socially optimal because it will not fully profit from the expenditures it makes on collecting information. Basic geologic information, once collected and provided to one paying customer, tends to be difficult if not impossible to keep out of the hands of other, nonpaying customers. For

example, the fact that a company drills on a geochemical anomaly identified in the basic geologic information signals to others that the region has geologic potential.

Second, tax and fiscal policies influence whether mineral wealth is created. It goes without saying that the overall tax system--the combination of mining-specific royalties and taxes, and the general tax code applying to all businesses--influences how attractive a specific province or country is for mineral investment. It is obvious that tax rates matter; the higher the rate, the less attractive a location is for investment, other factors being equal.

Less obvious is that the form of taxation or royalty matters. A tax or royalty based on net income generally will discourage investment less than a tax on gross revenues or total production. The reason is that a gross-revenue or production royalty acts just like a cost; for an investment to be profitable, revenues must be sufficient to cover this payment to government, as well as other costs. A net-income royalty, on the other hand, considers a company's ability to pay; when net income is high, royalty payments are high, and vice versa. Gross-revenue royalties do not distinguish between highly profitable and marginally profitable mines and thus discourage investment to a greater degree than net-income royalties. The form of a royalty or tax influences the sharing of risk between government and mining company. A gross-revenue royalty allocates the financial risks to the mining company. Government gets its "take" off the top before profits are determined. A net-income royalty, on the other hand, can be thought of as a risk-sharing partnership between government and mining company. Government receives royalty payments only when there are surpluses or profits and not just when a mine is in production.

A mining royalty based on net income also tends to come closer to being a tax on differential rents than one based on gross revenues or production. Recall from Chapter 4 that differential (or Ricardian) rent is surplus revenues accruing to high-quality, low-cost mineral deposits. When viewed as a surplus, differential rents can be thought of as available for sharing. They understandably are attractive to may entities--mining companies, organized labor, community groups, and environmental organizations, among others. Governments also are attracted to differential rents. Taxation of these rents would seem to be both economically efficient and fair. A tax on differential rents would be efficient (or neutral or nondistortionary) in that it, by definition, would not alter the profit-maximizing rate of output at existing operations; over the longer term it would not influence whether an investment in mining occurs because a differential rent--again by definition--is revenue in addition to that required to bring a deposit into production. Turning to fairness, taxing differential rents is arguably fair in the sense that these rents are due largely to a gift of nature, a high-quality mineral deposit, and thus governments have just as much call on the rents as any other claimant.

However, in practice most tax or royalty systems do not capture the differential rents as intended. Systems based on gross value do not use rents as that tax base. Systems based on net income have to create accounting systems of allowable costs, which tend to skew incentives and encourage re-allocation of costs for tax purposes rather than rent creation. Over the longer term, no tax or royalty is completely neutral, in the sense that it has no effect on business decision making. If a tax or royalty reduces expected profitability, then less investment will occur.

No fiscal system system is ideal in all respects. Governments tend to prefer royalties based on gross revenues or production, even though such royalties discourage investment to a greater degree than net-income royalties. Gross revenue royalties involve less risk for government in the sense that government gets its share before profits are determined. Such royalty payments also tend to come sooner in the life of a project, are more stable, and are more predictable. They also tend to be easier and less expensive to administer than net income royalties. They do not require detailed accounting rules (to define what costs are allowable) and control systems (to ensure that companies do not under-report their net income).

Companies, on the other hand, tend to prefer mining taxation based on net income. Such taxation is based on the principle of ability to pay and involves a greater sharing of risk between company and government. Royalty tend payments tend to be low early in the life of a project, while it is recovering its up-front capital costs. For more on mining taxation, see Garnaut and Clunies Ross (1983), and Otto (1995), and Eggert (1999).

Third, a policy regime can only be truly nondistortionary and efficient if it includes or incorporates social preferences for environmental quality and other social and cultural values into decision making about mineral development. This is perhaps the key challenge within the Creation Challenge. From an economic perspective, incorporating social preferences into decision making can be thought of as including the external costs and benefits of mineral development into decisions. In other words, if social preferences are different than the narrower preferences of a mining company and a national government, these differences represent external costs or benefits. An external cost might include damage to flora, fauna, or human health from water pollution in a region surrounding a mine, or the disruption to traditional ways of life for an indigenous community. An external benefit might be the spillover (or multiplier) effects of a new or expanded mine on other business activities in a mining town. Quantifying these external costs and benefits (social preferences for environmental and other values) is neither simple nor straightforward. A partial way forward is for governments to encourage or require formal analytical studies of the full costs and benefits of mining project, along the lines suggested in Chapter 3. But even with the best of analyses, large uncertainties will remain about the magnitudes of full costs and benefits. In the end, the extent to which social preferences for environmental and other social and cultural values will depend on process--that is, the *process* through which decisions about mineral development occur.

The critical issue is: Who decides whether proposed mineral development occurs, and on what basis? Who decides whether a proposed mine is consistent with social and cultural values and preferences in a community or nation? In an ideal world, government would act on behalf of society at large. The various approvals and permits that new projects are required to obtain in most countries would ensure that society's perspective is included in decision making. There would be an appropriate degree of public participation. The decision process would be open and transparent.

But rarely do governments, acting by themselves, fully represent their societies. Moreover, many of the most promising areas for mineral development are remote and without well-developed government institutions. Thus in practice some form of public participation is appropriate, even necessary, in decision making. The challenge is designing a process that is

efficient, equitable (or fair), and predictable--efficient in the sense that the process results in appropriate public participation at lowest cost in terms of time and expense; equitable in that the process gives each interested party to mineral development, owners as well as other community members, an appropriate opportunity to be heard; and predictable in that the process itself is understood by all parties (that is, a clear understanding of who can participate, what are rules for discussion, on what basis will decisions be made, and so on). On this last point of predictability, I am not arguing that the outcome of the process should be predictable, in the sense that a mining company would know beforehand whether its proposed mining project would be approved; rather that the process through which approval is requested is understood and predictable.

Private Companies

Once government establishes a framework in which mineral development occurs, mining companies have the central role in creating mineral wealth. By acting in their narrow self interests, to maximize the value of their activities to their owners, mining companies create mineral wealth that has the potential to benefit society at large. Private firms have strong incentives to be efficient. They have to compete for financial capital with other ways of investing or spending this capital. Firms need to optimize their use of inputs, such as labor, electricity, and raw materials, especially if they have no control over the prices at which they sell their mineral products.

For a private company to be efficient and maximize profits in the short run is relatively simple; it involves minimizing costs at existing operations through the ongoing pursuit of technical and managerial efficiencies. Over the longer term, maximizing profits involves a more complex set of strategic issues--choosing from among a set of potential sources of economic profits. One important source is Ricardian rents (see Chapter 4), those surpluses due to a high-quality mineral deposit (high grade, large size, ease of metallurgical processing, location, and so on); a range of strategies exist to pursue Ricardian rents, including grassroots exploration, acquisition of undeveloped mineral deposits, and opportunistic purchases of assets underpriced assets. Another potential source of profits is technological innovation that reduces costs of exploration, mine development, or operations.

Still another potential source of profitability over the longer term is interacting effectively with local communities, because of the opportunities that are not available if community relations are not effective. Humphreys (2000) argues that the costs of not being more engaged with communities have risen. Communities have increased ability to "stop the show". There is increased pressure from consumers and shareholders to "produce it right". There are possible reputational benefits for a company by being a good citizen in the communities in which it operates. In effect, one might argue that companies now have to work with local communities to obtain their "social license" to operate.

Civil Society

Civil society has a critical *process* role in creating and sustaining mineral wealth--through its role in ensuring that the social and environmental effects of mining are considered in decision making about mine development. This is especially important when local or

regional government institutions are poorly developed or absent. At the community level, Strongman (1998) argues that civil society needs to: (a) be organized in a democratic way, (b) develop mechanisms to resolve internal conflict, (c) develop good leaders, (d) avoid a culture of dependence (or a handout mentality), (e) build up infrastructural assets, and (f) start early to plan for mine closure. Clearly some of these issues extend beyond the challenge of creating mineral wealth, but as a set they constitute a good starting point for discussing the role for local communities in discussion of mineral development.

5.3 Distribution Challenge

If the Creation Challenge has been met, then mineral wealth has been created--efficiently, in a manner consistent with social preferences for environmental values and other social and cultural values, and such that those bearing any external costs have been compensated. The next challenge is to share or distribute this wealth equitably among private mining companies, government at all levels, local communities, and other organizations and entities. I call this the Distribution Challenge.

The Distribution Challenge is particularly vexing for economists because it is primarily an issue of equity (or fairness) rather than efficiency (or optimization, such as minimizing costs for a given level of production). It is easy to describe distributions of surplus, but much more difficult to agree upon an *appropriate* distribution of this surplus. One numerical distribution of rents (e.g., 40% mining company, 50% government, 10% local community) is not appropriate for all cases.

During the 1990s, there was growing concern that the distribution of economic rents between local community and nation was inappropriate in many specific cases. Specifically, local communities in which mining occurred became increasingly vocal that: (a) they bore the environmental and social costs of mineral development, many of which were uncompensated, and (b) shared in very little of the surplus, which tended to go to national governments and then spent on program in other parts of the nation. One result has been a move toward devolution of power and responsibility from national to regional and local governments.

The Distribution Challenge consists of two sub-challenges. The first and more fundamental is philosophical--what are the appropriate principles to guide us in the allocation of surplus. What principles shall we use to determine what distribution is appropriate? The second sub-challenge is more practical--how to design mechanisms and institutional arrangements that achieve the desired distribution. These arrangements include--at the project level--rules governing public participation in the process of determining whether a proposed mine is approved and--in the realm of fiscal policy--the level, form, and disposition of taxes and royalties.

Philosophy and Principles[11]

What is equitable? What is a fair distribution of outcomes? Most answers to these questions define equity in one of three ways. *Parity* is an allocation in which all interested parties are treated equally, either because they are viewed as equals or because it is difficult to distinguish among parties. *Proportionality* is an allocation that recognizes differences among parties; the actual allocation is in proportion to these differences. *Priority* means that entity with the greatest claim on an outcome gets it. While parity, proportionality, and priority describe the structure of different allocations, these concepts are not normative principles.

There are a number of such principles. One is attributed to Aristotle and a specific example of proportionality--an outcome is allocated *in proportion to each party's contribution*. This principle appeals to us because it seems reasonable that each party deserves an outcome that is in proportion to its contribution to that outcome. So it seems fair that business partners share profits in proportion to how much financial capital each contributed to the project. But many situations are more complicated. It often is not simple to determine or agree upon what each party's contribution is. Consider a new mine. One approach would say that if a mining company contributes all the financial capital to a project, then it should receive all the surpluses, as long as the company already has compensated all parties that have borne external costs of the project. But what if the mine benefits from publicly funded infrastructure, such as roads, electric power, or water? It seems fair to compensate government for its contribution of infrastructure. Going even further, it might be argued that a mine benefits from a gift of nature, a quality mineral deposit; this mineral deposit, it also might be argued, rightly belongs to society at large, and thus society at large should either be compensated for use of the deposit or share in the surpluses because of its contribution of the mineral deposit to the mining operation. It now becomes much more problematic to quantify what each party's contribution is.

A second equity principle is attributed to Jeremy Bentham and the utilitarian philosophers, namely that outcomes should be allocated such that the distribution *creates the greatest good for the greatest number*. In this case, the goal is a distribution that maximizes the total welfare of all interested parties. Again, this notion of fairness is appealing--it seems reasonable or fair that something should be allocated among those who can put it to best use, or to those who need it the most. The difficulty is putting this principle into practice. Consider a mine in very poor community and $100 of surplus revenues. Where is the greatest good? Does this surplus revenue create the most well being in the hands of the mining company and its owners, who might invest it on mineral exploration and the creation of additional mineral wealth? In the hands of the local community, which might spend it on improved schools and health care in the community? Or in the hands of a national government, which uses the surplus to fund education in an even poorer community elsewhere in the country? To be sure, the method of benefit-cost analysis (Chapter 2) provides a framework for analyzing the effectiveness of alternative allocations; but accurately and precisely quantifying the rate of return on social investments is difficult.

[11] The basic theory in this section is based largely on Young (1994).

A third equity principle comes from John Rawls: *the least well-off group in society should be made as well off as possible*. When assigning priority among various parties, the less well off a party is, the higher its priority. Young (1994, p. 10) is quick to note that Rawls's theory of justice is more complicated and nuanced than those of Aristotle and Bentham:

> Contrary to first appearances it is not a welfarist conception of justice, because "well-off" does not refer here to a person's subjective level of satisfaction. Rather it refers to the means or instruments by which satisfaction or happiness can be achieved. Economic income is one such means; others include opportunity, power, and self-respect. Rawls calls these primary goods.
>
> If we restrict our attention just to one primary good, such as income, the principle says that income should be distributed so that the person with the least income has as much income as possible. This does not necessarily imply that everyone has equal income, however, because redistributing income from the rich to the poor may reduce or eliminate the incentive for the rich to become rich, thereby impoverishing everyone. Rather, the principle refers to the effective distribution of income after economic incentives are taken into account.

Again consider a mining project and the distribution of surplus. Rawls would say give priority to those interested parties who are least well off in terms of income, opportunity, power, or self-respect. The real challenge is doing so in a way that does not eliminate or reduce the incentives for a mining company to create the surplus in the first place.

Critical Questions

Aristotle, Bentham, and Rawls provide the foundations on which much equity theory is based. In practice, however, designing equitable allocations of outcomes is more complicated than simply applying one of the principles or rules described above. Equitable distributions are the result of mechanisms and institutional arrangements that answer the following six questions (modified from Young, 1994, chapter 9):

1. *What form should the allocation take*? For example, should governments take their shares of mining surpluses in the form of cash, which they then spend on public projects? Or should they require that mining companies make certain types of expenditures directly in, for example, roads and other forms of infrastructure, hospitals, and schools?
2. *What are the eligibility criteria*? Who is eligible for a share of mining surpluses? Just the mining company and national government? Local or regional governments? Nongovernment members of civil society? Anyone who claims to be an interested party in mining?
3. *What counts in the distribution and what are the relevant principles*? Given that two or more entities are eligible for a share of the surplus, what determines the relative priority or share given to each party? What makes one party more or less deserving than another? Need? Contribution to the mining project? Something else? Among the various specific factors that might be important are: (a) the size of the surplus (the larger the surplus, the further down the priority list of claimants one can go), (b) the level of development and needs of the local community at the minesite and in the surrounding region relative to other parts of a nation (the greater the relative needs of the local community, the larger its share of a surplus), and (c) whether the local community

receives compensation for environmental and social costs of mineral development or rather would prefer to share in the surplus in lieu of such compensation.

4. *What are the relevant precedents*? Are there other allocation schemes already in use in similar circumstances? If so, do they provide a useful starting point or basis for a new allocation scheme?

5. *How should competing principles and criteria be reconciled*? Suppose, for example, that discussions to date have led to agreement that the allocation of surplus revenues shall be proportional both to contribution to the project and to need. What mechanism will be used subsequently to put this agreement into practice, to combine these allocation principles at an operational level? One possibility is to identify an overarching allocation rule, such as half of the surplus will be allocated in proportion to a party's contribution to the project, while the other half will be in proportion to need. Other possibilities might be to have interested parties vote on relative weights of each allocation principle or to conduct a public opinion survey.

6. *What incentives does a rule create*? In other words, what effects does an allocation rule have on the behavior of the interested parties to a mining project? For example, what is the effect on the level of mineral exploration in a region if fiscal rules are changed so that government receives a larger share of surplus revenues in the past?

With regard to the distribution mining surpluses, there are no simple rules that will apply in all circumstances. We should not expect any. What is appropriate will vary from case to case. By focusing procedures on the six questions above, however, we can avoid allocations that are arbitrary or based simply on the power or negotiating strength of participants.

5.4 The Macroeconomic And Political Challenge

Governments have the primary responsibility for managing the broader economic and political effects and problems of mineral development. Much of government's role here is simply sound macroeconomic management. To be sure, mining companies and civil society have important roles to play as participants in society. But government activities are central to meeting this challenge. Chapter 2 identified three sets of specific problems sometimes faced by the mineral economies.

External Factors

The first set of problems is the result of external market forces: declining or unstable commodity prices. With regard to declining commodity prices, there is little governments can or should do in this area to influence prices directly. If a commodity is traded in internationally competitive markets, then market-determined prices are economically efficient and--at least to economists--the "correct" price; moreover, in competitive markets, no single participant (including a government) has control over prices. If a market is not competitive and producers in one or several nations have some influence over price, then these producers could consider collective action to restrict output to raise prices; however, most actions like these are successful only for relatively short periods of time, if at all. More fruitful approaches to dealing with declining commodity prices, if governments want to do anything at all, are to: (a) facilitate research and development aimed at reducing costs of

production so that profits are sustained even with declining prices (realize that an important reason why many commodity prices are falling is precisely that innovation has allowed production costs to fall), or (b) fund activities aimed at stimulating demand for a commodity (marketing, development of new products or markets for a commodity).

Turning to unstable commodity prices, that mineral prices are volatile and unstable over short periods of time (weeks, months, and from one year to the next) is well known. The biggest challenge for mineral economies here is how to deal with often-significant fluctuations in export earnings and government revenues from one year to the next over the commodity-price cycle. There is no simple solution or one that applies in all circumstances. But the elements of prudent policy seem to include (Daniel, 1992):

1. Use conservative forecasts of mineral revenues. It is easier increase spending when revenues are higher than anticipated than to make budget cutbacks when revenues fall short of predictions.
2. Strive for stable growth in government spending in the face of unstable commodity prices and government revenues.
3. Separate mineral revenues from other revenues and release them for spending at a steady rate.

A mechanism incorporating all three points above is a revenue stabilization fund (Auty and Mikesell, 1998; and Mitchell, Varangis, and Akiyama, 1996). As discussed by Auty and Mikesell (1998, p. 40), a stabilization fund can serve a number of purposes: stabilizing foreign exchange expenditures or government spending, serving as a mechanism to allocate mineral revenues between consumption and investment spending, and preventing appreciation or depreciation of real exchange rates. Stabilization funds accumulate funds during periods of high commodity prices and revenues and disburse funds when prices and revenues are low. To be sure, there are uncertainties about whether revenues are "high" or "low" at any point in time; but historical data should provide some insights. A stabilization fund should be managed "at a distance" from political pressures--independent in much the same way that many central banks are independent. A number of countries have established such stabilization funds, including Botswana, Chile, and Papua New Guinea.

At more of a microeconomic level, mineral producers have a number of ways to manage instability, including derivative-market hedges and commodity loans. If governments wish to be active here, they can consider policies that guarantee producers a minimum price. However, governments need to be careful that they do not distort the incentives facing private companies, by encouraging inefficient production. The strongest argument for a guaranteed minimum price is in small-scale and artisanel mining, much of which is carried out illegally or by people living in extreme poverty (or both); a guaranteed minimum price represents a form of protection for those most vulnerable in society and also would provide an incentive for illegal activities to come under the law. A guaranteed minimum price, however, is not a long-term solution to the problems of poverty and artisanel mining.

Diversification of the economy also can be considered a response to falling and unstable commodity prices. This issue is discussed later in this chapter as part of the Investment Challenge.

Internal Structural Change

The second set of problems is the result of what happens inside a national mineral economy, rather than coming from external market forces. Specifically, countries often have to adjust to and confront structural change associated with a large and booming (mineral) export sector--the Dutch disease effects noted in Chapter 2, including a contraction of export industries other than mining (often agriculture or manufacturing) and shifts in employment (toward the booming mineral sector and away from traditional employment sectors). These internal structural changes involve adjustment costs, and the issue for public policy is whether slow or nullify the changes that otherwise would occur. One approach is simply to accept structural change as part of the "cost" of benefiting from the expanding commodity sector. In any market economy, there is a continual ebb and flow of individual sectors as they expand and contract. If a government wants to ease the transition to the new economic structure, it can use some of the surplus (rent) from the booming or expanding mineral sector to compensate those forced to adjust to change.

There are three reasons, however, that government might consider actions to thwart the structural changes that otherwise would occur: the boom or expansion in mining is likely to be temporary, the costs of adjusting to booms and busts in mining are high, or there are significant external benefits associated with maintaining the shrinking, non-mining sectors, such as agriculture or manufacturing (for example, if manufacturing activity led to greater spillover benefits than mining, coming in the form of a more highly educated workforce). In this case, government could intervene actively in foreign-exchange or labor markets. In foreign-exchange markets the objective would be to limit the appreciation of the real exchange rate--in turn, reducing the contraction of other (non-mineral) export sectors of an economy. In labor markets, the policy objective would be to limit wage increases in the booming natural-resource sector as a way to limit the movement of labor to the mining sector.

This is dangerous ground. Government attempts to nullify the structural consequences of a booming or expanding mining sector distort the economy, making it less flexible to adjust to changing economic circumstances and less open to international trade. Over time, the result will be lower rates of economic growth.

Political Issues

The third set of problems is political in nature--dealing with the political challenges associated with mineral dependence, such as rent-seeking behavior and corruption. The primary response here is one of institution building--in government, private companies, and civil society. Ascher (1999) offers the following recommendations at the conclusion of sixteen case studies of natural resource production and associated public policies:

1. Rely on private (non-governmental) exploitation of natural resources, but with government regulation of this exploitation. Private companies, Ascher argues, are more likely to be open to public scrutiny than government agencies or state-owned companies, reducing the likelihood of secret backroom deals and corruption. Moreover, private exploitation combined with public regulation is more likely to deal appropriately with the negative spillover effects (e.g., environmental damage) of resource production than when government is both exploiter and regulator. Finally, private companies are intrinsically more likely to manage production with an eye toward long-term sustainability than government exploitation, as long as public policy does not force short-term thinking on the private company.
2. Restructure government institutions and their governing rules to: (a) simplify and clarify the mandates and jurisdictions of agencies and policies, (b) clarify priorities through the central budget, and (c) reform arrangements between government agencies and state enterprises. The first of these recommendations--simplifying and clarifying mandates and jurisdictions--aims to eliminate or reduce the ambiguities that often allow government leaders and agencies to avoid accountability, which in turn fosters rent-seeking behavior and corruption. Each agency, Ascher contends, should have one function, such as environmental protection. He thus argues against the current fashion of integrating many functions for a particular sector into one agency (e.g., a mining ministry responsible for all aspects of mining--such as land use, environmental compliance, worker health and safety, and regional development). By giving each agency clear authority in only one area, higher levels of government will be forced to set priorities necessary to make decisions when different agencies have different views on a particular activity (e.g., whether to proceed with mine development when the resulting regional economic development also would cause environmental damage). The second part of this recommendation--using the central budget to set priorities--aims to clarify how important various government objectives are relative to one another. How important, relative to one another, are objectives related to environmental protection, industrial expansion, poverty alleviation, and so on? The final part of this recommendation focuses only on state-owned enterprises and aims to make them more accountable and efficient. Ascher suggests improved accounting conventions (so that there is appropriate disclosure of company financial information), interministerial oversight (to ensure that top officials throughout government are aware of how the company is managing its natural resources), and fiscal arrangements (that reward company officials for good financial performance).
3. Use extra-governmental entities (i.e., civil society) to serve as ombudsmen or watchdogs, on the look out for--and thus reducing the likelihood of--government mis-management of natural resources ('government maneuvers that sacrifice sound resource policy' Ascher, 1999, p. 277). He identifies five ways extra-governmental entities can serve in this capacity. The first is by publicizing examples of mis-management and in so doing raising the political costs of mis-management. The second, for those organizations that have the ability to stall or impede a development project, is to make support of a project contingent on sound management. Third, groups outside of government can support individuals and groups within government who oppose mis-management and corruption. Fourth, experts from all realms can make their opinions known--engineers, scientists, economists from outside of government who have the ability to shape opinion and policy. Finally, as Ascher notes (p. 278-279),

there is great virtue in a skeptical public that is intolerant of special subsidies, suspicious government accounting, grandiose policy claims, ambiguous mandates, and rosy optimism.

5.5 The Investment Challenge

This challenge is one of investing for the future, ensuring that there is "life after mining". The fundamental challenge is to convert the depleting nonrenewable (mineral) resource into a sustainable or renewable resource. This conversion requires saving a portion of the revenues from mineral production and investing in sustainable assets or capital.

The challenge is analogous to the challenge facing individuals who want to preserve their personal wealth by investing in financial assets: invest in assets that earn income and then spend (or consume) no more than the income on these investments each period. For example, consume only the interest on an interest-bearing savings account, thereby leaving the principal intact. To preserve mineral wealth, holders of this wealth need to invest a large enough portion of the wealth in productive assets such that the value of the assets remains at least the same over time. For a nation or community, the goal is to sustain or even enhance economic well being over time, even as a mine or mining eventually declines. For a nation or community, meeting the Investment Challenge requires answering a number of questions.

How Much To Save and Invest?

The answer to this question depends, first and foremost, on, *what is the goal*? Is it--conservatively--to sustain the current level of economic well being or--more ambitiously--to sustain *growth* in the level of well being. The latter, growth, requires a higher saving rate than the former, simple sustainability.

For the moment, assume the more conservative goal of sustaining the level of well being. Economists often call this sustainable consumption, in which the goal is that a local or national mineral economy be able to consume the same amount of goods and services year after year, even after mining ceases. Let me quickly note that I define the term "goods and services" broadly so that it encompasses all goods and services that influence human well being, including clean air and other aspects of environmental quality, education, and human health, as well as purely economic goods and services (cars, household appliances, etc.).

Sustainable consumption is that level of consumption that leaves intact the overall stock of human, natural, social, and man-made physical capital (see Chapter 4). Consumption, or activities each period that create human well being, run down this stock of capital. For example, making a motor vehicle today reduces the ability to make a vehicle tomorrow because the automotive manufacturing equipment partially wears out. Similar, mining copper ore today reduces the ability to mine in the future because the mine is partially depleted. Without investment to offset this depreciation or depletion, the ability to generate income in the future--and in turn the ability to consume in the future--are reduced.

Preserving the overall capital stock as a mine or mining declines, therefore, requires that mineral wealth be converted into other forms of wealth. Mineral wealth, in this case,

represents the total economic rents--scarcity and differential--generated by mining (see Chapter 4). For a community or nation, what needs to be preserved is the portion of the total rent that is allocated to the community or nation in confronting the Distribution Challenge (see earlier section this chapter). The issue, then, is what portion of the rent generated each period over the life of a mine needs to be saved and invested? The answer to this question depends primarily on: *what is the rate of return on invested savings?* The higher the rate of return, the lower the necessary saving rate (and vice versa). If the rate of return were 5% per year, then essentially 5% of the principal could be consumed while leaving the stock of capital intact; the necessary saving rate, therefore, would be approximately 95%. If the rate of return on the invested savings were 10%, then essentially 10% of the principal could be consumed and the necessary saving rate would be approximately 90% of the principal. The more ambitious goal of increasing, rather than simply sustaining, the capital stock would require a higher saving rate.

So knowing how much to save depends on knowing what the rate of return on invested savings will be. Typically, this rate of return is not known with certainty *a priori*. For financial investments (stocks, bonds, other financial instruments), there is a large volume of historical evidence to guide our expectations about likely future returns. For other types of investment in commercial activities (e.g., a textile mill or semiconductor factory), we also can use information from financial markets to develop reasonable expectations about future returns. Many types of public investment, however, do not have rates of return that are easily observable--for instance, investments in roads, electric-power supplies, water, and other forms of infrastructure; and in a more highly educated and healthier workforce. Nevertheless, economists have developed methods to estimate social rates of return (see Boardman, Greenberg, Vining, and Weimer, 2001, chapter 10, and references cited therein).

By Whom?

Who should invest the rents? One possibility is the mining companies themselves. They are likely to invest the rents in profitable activities, including sustaining production at the existing mine through onsite exploration and development of additional mineral reserves. This is especially true for companies in competitive industries whose equity shares are traded publicly; competition and the stock exchanges place relentless pressure on firms to maximize profits, although to be sure these mechanisms do not ensure that some of the rents are used

for featherbedding the management and even ordinary workers and salarymen
(Hannesson, 2001, p. 37).

On a slightly different tack and thinking back to the Distribution Challenge, it is arguably appropriate to leave with the mining company the Hotelling rents and the portion of the differential rent due to managerial expertise, otherwise companies will face a disincentive to invest further in the region taxing away these rents. Mining companies also might appropriately make noncommercial investments on behalf of a local community or region if government is weak, incapable, or corrupt. Nevertheless it is unreasonable to expect mining companies to invest all the rents they retain on activities in the region of the mine or for the benefit of the local community; mining companies fundamentally are responsible to their owners.

Many investments have benefits that are diffuse or far in the future and thus difficult for a private investor to appropriate or obtain. Private investors will under-invest in these activities from the perspective of society as a whole. Examples include investments in physical infrastructure--such as roads, public sanitation, and electric power systems--and in education and human health. For these investments it is appropriate for government to be involved. In an ideal world, governments at all levels (local, regional, national) would act on behalf of society as a whole. They would focus their investment of mineral rents on these public investments that facilitate commercial or for-profit activities that are best left in the hands of private entities.

Finally, there is an appropriate role for partnerships involving not just mining companies and governments, but also civil society. Representatives from all three sectors or entities--mining companies, government, civil society--would be charged with investing a portion of the rents for the benefit of society as a whole. Civil-society organizations play a critical role in ensuring that the views and preferences of society at large are represented and considered in investment decisions.

In What?

In what should mineral rents be invested? As Hannesson (2001, p. 40-41) notes, the fundamental choice is between assets yielding a visible and measurable financial return or, alternatively, in assets with less-visible or less-measurable returns. The former category includes financial assets (stocks, bonds, other financial instruments), real estate, and commercial enterprises. The latter includes expenditures on education, health care, and physical infrastructure (roads, airports, etc.).
Private mining companies primarily will focus on profit-making investments.

For governments and civil society, the choice is not simple. Their challenge is to construct the optimal portfolio of investments from the perspective of their constituents. One possibility is a strategy of investing only in financial assets--stocks, bonds, other securities--that generate income. The income then is available for spending or re-investing. As long as the principal remains intact, the mineral wealth has been preserved. It is relatively simple and straightforward, in this case, to monitor the performance of the investments. For small communities with limited opportunities for local investment, investing most mineral rents in financial assets usually yields greater returns with less risk than requiring local investment in commercial enterprises.

Nevertheless, the well being of a community or nation also depends on its physical infrastructure--roads, electric power supplies, airports, sanitation facilities, and other things that facilitate commercial activity and more generally a well-functioning society. As worthy as these public investments are in principle, it is notoriously difficult to evaluate the attractiveness of specific investment opportunities precisely because the returns are diffuse, difficult to measure, and often far in the future. Thus these types of public investments often get made on the basis of special-interest lobbying, cronyism, nepotism, and so on, rather than on a sound economic basis. The result is, for example, roads leading to no where, grand offices for public officials, airports with few flights, and convention halls with

few conventions. Nevertheless, it makes little sense to say that these investments should be made by the private sector, because it will have exactly the same evaluation problems as governments do. Moreover, as noted above, the private sector is likely to under-invest in these public investments because it is difficult for private entities to fully obtain the benefits of these investments. Thus the challenge is to develop mechanisms in government to ensure systematic and objective evaluation of possible investments in education, human health, and infrastructure. Ideally these mechanisms would reside in government acting on behalf of society as a whole, with an appropriate amount of public participation. In a second-best world, partnerships involving mining companies, governments, and civil society may be necessary. Daniel (1992, p. 115) notes that, under normal circumstances, the need for physical infrastructure tends to be identified as a result of--or coincident with--opportunities for commercial investment, rather than in advance of these opportunities. The lesson is that communities and nations should avoid the temptation to build infrastructure in the hope that something good will happen as a result; rather specific types of infrastructure need to be linked with specific commercial activities.

An often more fruitful avenue for public investment is in education and human health. To be sure, such investments are prone to the same problems as physical infrastructure--it is difficult to evaluate how worthy they are, and the private sector likely to under-invest in these activities from society's. Nevertheless, investments in education give people the skills and ability to create their own sustainable well being. Investments in education and human health are less likely to result in infrastructural "white elephants", properties needing much care and attention but yielding few benefits to society.

What about public (government) investment in directly productive activities? There often are opportunities for commercial enterprises that supply inputs to a mine or that process the output of the mine; but these activities should be commercially viable in their own right. It also should be noted that these activities depend on the mine and may not be commercially viable after mining ends. Governments often subsidize or in some other way encourage investment in *non-mineral* activities, with the arguably laudable goal of diversification and reducing a community's or nation's dependence on mineral production. As Daniel (1992, p. 114) notes, the danger here is that government encourages activities that are not commercially viable and that thus require a permanent subsidy. In addition, government usually has little expertise in making commercial decisions and thus little ability to identify which specific sectors are worthy of investment. Diversification of a mineral dependent economy, again, is a laudable goal. But governments do best when they use mineral rents to facilitate, rather than fund, other economic activities--through investments in education, human health, and appropriate physical infrastructure. As Auty and Mikesell (1998, p. 104) note:

> The historical evidence suggests that directly productive investment to diversify the economy is best achieved by the private sector (with subsidies, if any, being minimal) rather than, as was fashionable in the 1970s, by the public sector. Only if there are strong externalities, as with education and infrastructure, can a clear case be made for public investment…Government intervention to force the pace of industrialization via an active industrial policy is even less likely to be efficient…The rents conferred on infant industries invariably lead to 'policy capture' by which groups (workers, executives, and nationalistic technocrats) that benefit from state intervention build a coalition which blocks withdrawal of the rents [or subsidies].

Where to Invest?

Where should mineral rents be invested? In the mining community itself? Somewhere in the national economy? Abroad? In principle, the issue is straightforward: invest in that portfolio of activities yielding the highest return. In practice, however, the issue is more complicated. Hannesson (2001, p. 43) suggests three considerations influencing the location of investment. The first is the size of the economy. The larger the economy, the more likely it is that there will be productive investments within the economy (and vice versa). The second factor is an economy's level of development. The lower the level of development, the more urgent the needs for (and returns to) internal investment in education, human health, and (probably) infrastructure. At the same time, the lower the level of development, the less developed an economy's financial institutions are likely to be and in turn the fewer the opportunities for internal investment in financial assets. And the lower the level of development, the lower the capacity of an economy to absorb investment flows. The third factor is urgency of the need to diversify an economy. The larger a community's or nation's dependence on mineral production, the larger the need for internal investment of one form or another.

Investment Funds: In Trust or for Development and Other Purposes?[12]

One mechanism for meeting the Investment Challenge is a fund invested in assets that earn income or in some other way increase an economy's capital stock. The objective of the fund is to "make permanent" the wealth created by mining. The fund in effect becomes a permanent renewable resource created out of the nonrenewable mineral resource. Reviewing the experience of two such funds--one in the U.S. state of Alaska, the other in the Canadian province of Alberta--illustrate the fundamental investment issues introduced above: how much to save and invest, by whom, in what, and where?

Alaska and Alberta both derive much revenue from crude oil and natural gas production. In 1976, both created investment funds, each with a broadly similar purpose--"to save for a time when natural resource revenue would begin to decline" (Warrack and Keddie, 2001). The Alaska Permanent Fund and the Alberta Heritage Savings Fund, although broadly similar in purpose, have been substantially different in implementation.

The Alaska Permanent Fund originated, to a large extent, out of frustration and disappointment with what seemed to be often excessive and wasteful government expenditures financed by government hydrocarbon revenues in the late 1960s and early 1970s--on infrastructure (roads, water systems, and airports) and subsidies to enterprises that were supposed to diversify the economic base of the Alaskan economy (e.g., agriculture). The Fund required a constitutional amendment, approved by the voters by almost a two-to-one majority. The philosophy behind the Fund is that it is held "in trust" on behalf of the citizens of Alaska. It holds financial assets and real estate for the purpose of earning income and benefiting from capital gains. Investments are not made for social or

[12] The discussion in this section of investment funds in Alaska and Alberta is based on Hannesson (2001), Warrack and Keddie (2001), and the website of the Alaska Permanent Fund (www.apfc.org).

political reasons. The Fund does not seek to foster diversification or economic development of the Alaskan economy; there are other government agencies and mechanisms to pursue these objectives. The Fund seeks to earn a consistent real rate of return of 4% per year with investments of below-average risk. Alaska receives oil and gas revenues from several sources: licensing fees, royalties on production on State of Alaska lands, some revenue sharing with the U.S. federal government on oil produced on federal lands, and a severance tax. How much is saved and invested in the Permanent Fund? Fifty percent of royalty revenues (25% prior to 1980), as well as periodic additional appropriations from the state legislature. Since the construction of the trans-Alaska pipeline in the 1970s, 18% of State of Alaska oil revenues have been saved in the Fund. The remaining hydrocarbon revenues are deposited into the state's General Fund, to finance normal expenditures of the state.

The Permanent Fund consists of two parts: principal and income. Between 1976 and 2001, the principal grew in value to about US$25 billion. Cumulative net income exceeded US$ 20 billion. The principal cannot be spent unless a majority of all voters approve such spending in a statewide referendum. The principal is invested in a variety of assets. In 2001, the asset allocation of the principal was: domestic U.S. equities, 37%; international equities, 16%; domestic U.S. bonds, 35%; non-U.S. dollar bonds, 2%; and real estate, 10%. Only about 1% of the principal is invested in Alaskan assets.

How Fund income is used each year is determined by the state legislature. To date, the income has been used in three ways. First, to make dividend payments to individuals; in 2000, each Alaskan received a dividend check for US$1964. Second, income is used to inflation-proof the Fund by re-inserting income into the principal if inflation would otherwise reduce the real value of the principal. Third, income is used to increase the size of the principal. Since 1976, 42% of the principal has been paid out to individuals as dividends, with the remaining 58% being re-inserted in the principal in the form of inflation proofing or re-investment. As Hannesson (2001, p. 60) notes, there are other possible uses for Fund income. Income could be used to finance public services or to reduce household or corporate taxes. A dividend payment, however, is arguably a fairer use of oil income if we believe oil revenues should be used to benefit all citizens. Not everyone benefits from public services, and not everyone pays taxes, thus reducing the equality of using Fund income to provide public services or reduce taxes.

Particularly noteworthy is how the Alaska Permanent Fund is managed and governed. It is managed at arm's length from the government by the Alaska Permanent Fund Corporation. The Corporation in turn is overseen by a board of trustees consisting of four public members, the Alaska Commissioner of Revenue, and a cabinet minister chosen by the Alaska governor. Thus the Fund is managed at a distance from government and the pressing political issues of the day. Given that Alaska citizens receive an annual dividend, and that they had to approve a constitutional amendment to create the Fund, citizens have developed and retained a strong interest in the Fund, its management, and its financial performance. The Fund has strong support of the Alaska voters.

The Alberta Heritage Savings Trust Fund, from its outset in 1976, had a broader mandate than the Alaska Permanent Fund. Not only was it to serve as a savings account for the province for a day when oil revenues declined, it was "to act as a future source of revenue, either through income from the fund or *from the fund itself* [emphasis added]. . . [and to]

strengthen and diversify the economy of the province" (Hannesson, 2001, p. 72, quoting from Peter Lougheed, premier of Alberta when the fund was created). So the principal of the fund could be a source of revenue; thus it was less clear that preserving wealth was a high priority. In addition, broader economic development of the provincial economy was a stated goal. The Heritage Fund did not require a provincial referendum, as was the case in Alaska; rather it was created by an act of the provincial parliament. Thus from its outset the Heritage Fund did not figure prominently in the minds of Albertans. Between 1976 and 1983, the Heritage Fund received 30% of provincial revenues from non-renewable resources (primarily oil and gas). Following the decline of oil prices in the early 1980s, the Fund received 15% of these revenues between 1984 and 1987. The Fund stopped receiving funds after 1987. The cessation of contributions to the Heritage corresponds to a period in which the provincial government's budget went into deficit; so oil revenues were redirected to the general provincial budget. With regard to income, the Heritage Fund retained all its income until 1982. After 1987, all income went to the Alberta general fund to finance ongoing government activities. There was no inflation proofing as in Alaska. The Heritage Fund underwent a major restructuring in 1997, discussed in greater detail later in this section.

Between 1976 and 1997, the Heritage Fund operated much more like an economic-development fund than as trust fund or an endowment. It had a number of different divisions, each with different objectives. The Alberta Investment Division made debt and equity investments in the Alberta economy, primary provincial Crown corporations and other government investments. These investments were to earn a return, but not necessarily a commercial return. In the late 1980s, this division held more than half of the Fund's assets. But the middle 1990s, this percentage fell to about 20%. The Canadian Investments Division made loans to other provincial governments at below-market interest rates. The Capital Projects Division made investments in projects providing long-term benefits to Alberta, especially medical research facilities, education, agriculture, transportation, and telecommunications. No financial return was expected or considered. Finally, the Commercial Investment Division invested in Canadian stocks and money market securities. It was a very small part of the overall Fund, but it was supposed to earn commercial returns.

As for organization and governance, between 1976 and 1997, the Heritage Fund was managed and operated within the Alberta Treasury, and it was overseen by the provincial parliament--in contrast to the arm's length relationship between government and fund with the Alaska Permanent Fund.

Given the non-commercial nature of much of the Heritage Fund's investments, it is difficult to evaluate its performance. The Fund's net asset value peaked at somewhat more than $12 billion in 1987. Its value since 1997 has been approximately $12 billion. The Fund's cumulative income as about $15 billion. Hannesson (2001, p. 75) concludes:

> In financial terms the fund was thus a mixed success. The lack of financial success in areas where that criterion is not applicable (the Capital Projects Division) is not the issue here, but the lack of success of the Crown corporations is, since these were commercial undertakings which should have earned a commercial return. The history of the fund casts an unfavorable light on having governments run development banks financed from tax money. In such arrangements political expediency tends to overshadow financial

> objectives, and even if the latter may at times be insufficient as criteria for success in economic development, political criteria are not likely to be any better.

Warrack and Keddie (2001, p. 4) are less judgmental:

> In addition to financial impacts, there are important externalities that have resulted from the Alberta Heritage Fund [AHF]. They are both positive and negative. Positive ones for Alberta include lower taxes than fellow Canadians, generally lower utility prices, and jobs that were created by AHF funding of projects that otherwise would not have been affordable. Negative externalities include misallocations from underpricing of Crown Corporations' outputs (e.g., telephone services), natural gas price subsidization, funding of uneconomic projects, and lending from the Heritage Fund at interest rates below market rates of return. To determine a social rate of return on funds used by AHF, the private rate of return would need to be taken and adjusted with both positive and negative externalities. No attempt has been made here to measure externalities, but it is important to enumerate and understand them.

In 1997, the Heritage Fund was restructured. Over a period of ten years, it will be made to look more like the Alaska Permanent Fund. Over this period, the old assets will be transferred into a new endowment, which is invested in financial assets, primarily fixed-income securities and equities. Income will be used to inflation proof the endowment. Governance of the fund has changed such that individuals from the private sector have a greater role oversight. But income beyond those required to inflation proof the endowment will go into the provincial general fund.

Thus, the experiences of Alaska and Alberta represent strikingly different approaches to using investment funds to address the challenge of making mineral wealth permanent. The Alaska Permanent Fund is truly a trust fund, invested in financial assets and real estate for the purpose of generating income at low risk. The principal has been preserved and grown. A significant portion of the income has been distributed to Alaska resident, who then make their own decisions about consuming or investing these gains. The Alberta Heritage Fund, in contrast, has functioned much more like a development fund--serving as a source of financing for a large range of projects aimed at developing and diversifying the Alberta economy.

Summing up, managing mineral wealth requires meeting the creation, distribution, macroeconomic and political, and investment challenges. Governments, mining companies, and civil society all have important roles to play. Government at all levels plays perhaps the decisive role--facilitating the creation of mineral wealth, overseeing its distribution, dealing with macroeconomic and political issues, and coordinating the investing mineral wealth in sustainable capital. Mining companies are the principal vehicle through which mineral wealth is created. Unresolved is exactly what roles and responsibilities mining companies should assume with regard to environmental and social issues affecting mining communities and national mineral economies. Civil society contributes to and participates in the process of decision making in meeting all four challenges. Finally, there are many situations in which government institutions are weak, ineffective, or corrupt. Over the longer term, the objective should be to strengthen these government institutions. In the meantime, however, it is up to mining companies and civil society to assume more active roles in meeting the four challenges of managing mineral wealth.

6 Summary and Conclusions

This study set out to answer two questions: What are the economic effects of mining and mineral processing? Can we manage mineral wealth so that the economic benefits are enhanced in the short term and sustained over the long term, even as individual mines inevitably decline? It studied these questions from two perspectives, those of national economies and local communities. It now is time to summarize the findings in the context of these two questions.

What are the economic effects of mining? It is too easy and simple to take an extreme position--either that minerals are a curse to be avoided because of their negative economic, environmental, or social effects on local communities or national economies, or--alternatively--that minerals are a blessing that hold a key to economic development in mineral-rich regions.

The reality is more complicated. Minerals in the ground are potential wealth. They have the potential to contribute significantly to the economic development of communities and nations. Mining can create significant economic benefits--the direct benefits that come in the form of income and employment, as well as the indirect benefits that come in the form of local or national purchase of mining inputs, local or national processing of mineral ores and concentrates, and the additional spending by mining households that stimulates local economic activity generally. Mining can persist in communities and regions even as the physical quality of mineral deposits declines because of the advantages to a community that come in the form of infrastructure and agglomeration economies.

But these benefits often come at a cost. At the local level, mining affects the natural environment (some of which, to be sure, is avoidable at a cost) and often creates significant social disruptions. At the national level, mining requires that governments and other entities learn how to: live with market instability, deal with structural changes in the economy due an expanding or booming resource sector, and minimize rent-seeking and other political problems caused by the presence of mineral rents. The national economies dependent on mining are diverse--geographically and in terms of per capita income, life expectancy, and adult literacy. The include some of the poorest nations on earth and a number that have performed very poorly over the last several decades.

Whether the benefits of mining outweigh the costs is specific to a community or nation. How mining and mineral wealth are managed--by governments, mining companies, and civil society--is critical to whether the potential embodied in minerals in the ground is realized.

Can we manage mineral wealth so that the economic benefits are enhanced in the short term and sustained over the long term? Yes, but to do so we must address four challenges.

The first is the Creation Challenge--that mineral wealth be created in the first place, efficiently and in a manner consistent with social preferences for environmental quality and other social and cultural values. Governments play a critical facilitating role in meeting this challenge, through the legal and political framework in which actual mineral exploration and mine development occur. The policy framework generally should be nondistortionary in

the sense that it does not steer or guide investment toward particular sectors but rather facilitates investment in those sectors with the greatest commercial attractiveness; the major exception to this generalization is when there are spillover benefits to the economy as a whole that are not considered by private decision makers. Although not a panacea, the economic method of benefit-cost analysis provides a useful framework for organizing discussions and making decisions about mineral development. The relevant benefits and costs here include the full social benefits and costs of mineral development. Social costs include the value of environmental damage and social disruptions caused by mining; these costs need to be paid (i.e., those bearing these costs need to be compensated) or else the policy environment of mineral development will not be truly nondistortionary.

Three additional issues are important in addressing the Creation Challenge. First, governments influence perceptions of geologic potential upon which mining companies base investment decisions in mineral exploration and mine development. The availability of basic geologic information is critical in this regard, either through government-funded geological surveys or some other form of public investment or subsidy to the private sector. Second, tax and fiscal systems influence where mineral investment occurs. Third, and perhaps most important, social preferences for environmental quality and other social and cultural values need to be incorporated into decision making about whether a mineral deposit is developed. Ideally, a process through which these preferences are elicited would be part of public policy toward the mineral sector. But in some cases, government institutions are sufficiently weak or ineffective that mining companies and civil society need to assume responsibility for incorporating these preferences into decision making.

The second challenge is the Distribution Challenge--that mineral wealth, once created, be distributed fairly or equitably among private mining companies, government at all levels, and other organizations and entities. To make a long story short, there are no simple rules here, and we should not expect any. There is no single "correct" allocation of the rents. This is a particularly thorny or vexing issue precisely because there are no universally accepted definitions of what is equitable or fair. An important part of this challenge, therefore, is philosophical, defining what is fair. One possibility is to distribute the rents from mineral production in proportion to a party's contribution to mineral development. Even if one agrees with this principle, it often is difficult to specify exactly what each party's contribution is. Another possibility is to distribute mineral rents such that they create the greatest good for the greatest number, or in other words to maximize the total welfare of all interested parties. But again, quantifying where the greatest good will occur is not simple or straightforward. Finally, mineral rents could be distributed such that the least well-off group in society is made as well off as possible. At a practical level, distributions that are considered to be fair or equitable are the result mechanisms and institutional arrangements that facilitate discussion of the following six questions among all interested parties to mineral development (after Young, 1994): (1) what form should the allocation take, (2) what are the eligibility criteria, (3) what counts in the distribution and what are the relevant principles, (4) what are the relent precedents, (5) how should competing principles and criteria be reconciled, and (6) what incentives does a rule create?

The third challenge is the Macroeconomic and Political Challenge--to understand and manage the broader economic and political effects of mineral development. Governments

have the primary responsibility for meeting this challenge, much of which is simply sound macroeconomic management. Meeting this challenge involves a number of issues:

- Responding to at times declining and unstable mineral prices: There is little government can or should do to influence prices. Perhaps the biggest challenge here is how to respond to significant annual fluctuations in export earnings and government revenues. The evidence suggests that a prudent course of action involves: using conservative forecasts of mineral revenues, striving for stable growth in government spending in the face of unstable mineral prices, and separating mineral revenues from other revenues and releasing them for spending at a steady rate (Daniel, 1992).
- Responding to internal changes in the structure of a national economy as the mineral sector expands: Generally speaking, governments should accept the structural change as part of the cost of benefiting from increased mineral revenues. If government wants to ease the transition, then it can use some of the mineral rents to compensate those affected by structural change. Although there are a few situations in which government might want to nullify the structural consequences of an expanding mineral sector, in most cases actions to nullify the structural adjustment make an economy less flexible to changing economic circumstances and less open to international trade, which over the longer term impede economic growth.
- Responding to the political problems often associated with mineral dependence, such as rent-seeking behavior and corruption: Ascher (1999) has three recommendations. First, that societies rely on private (non-governmental) development of mineral resources, but within a framework established by government. Private companies usually are more open to public scrutiny than government agencies, reducing the likelihood of secret arrangements, lack of accountability, and corruption. Second, that government institutions and their governing rules be restructured: to simplify and clarify mandates and jurisdictions of agencies and policies; to use the central budget to clarify priorities; and to reform arrangements between government agencies and state enterprises. Third, that societies rely on extra-governmental entities (i.e., civil society) to serve as ombudsmen or watchdogs to ferret out government mis-management of natural resources.

The final challenge is the Investment Challenge--to ensure that the economic benefits of mining are sustained, even as a mine is inevitably depleted, by saving a portion of the revenues from mining and investing them in other forms of capital. This challenge, in other words, is one of making the mineral wealth permanent. The critical issues here involve deciding:

- How much to save and invest? The answer to this question depends primarily on the goal to be pursued and that rate of return on specific investments. The goal of simply sustaining the current level of well being requires a lower saving rate than the more ambitious goal of increasing this level. The higher the rate of return, the lower the necessary saving rate. "Return" here represents the full social return to investments that influence the level of human well being (including expenditures on environmental quality, education, and human health), and not just the private return on commercial investments.

- Who should invest the rents from mineral production? Private mining companies are likely to be efficient in investing in the sustaining of mineral exploration and development; in fact, if the Hotelling or scarcity rents from mineral production do not accrue to mining companies, these companies are not likely to invest in mineral production in the first place. Other investments, however, have benefits that are diffuse or far in the future, implying that private companies are likely to under-invest in these activities from the perspective of society as a whole. Government has a central role in ensuring that these investments in public goods take place--in basic geological information, physical infrastructure, education, and human health. Civil society needs to be active in ensuring that governments in fact make these investments.
- In what should the mineral rents be invested? The basic choice here is between assets that yield a visible financial return (e.g., stock, bonds, real estate, directly productive enterprises) and assets with less-visible returns (e.g., education, health care, physical infrastructure). Most analysts believe investments in directly productive enterprises are best left to the private sector. Although diversifying a mineral economy is a laudable goal, governments do best when they use rents to facilitate, rather than directly fund, investment in directly productive activities outside of mining. Governments do this by investing in those assets with less-visible returns, such as education. An important caution is that investments of this type are hard to evaluate, precisely because their returns are less visible or measurable.
- Where should the mineral rents be invested? In the mining community itself? Somewhere else in the national economy? Abroad? Hannesson (2001) suggests three considerations here. First, the larger the economy, the more likely it is that there will be productive investments within the economy (and vice versa). Second, the lower the level of an economy's development, the more urgent the needs for and returns to investments in education and human health; however, the lower level of development, the lower the capacity of the economy to absorb investment flows. Finally, the larger an economy's dependence on mineral production, the larger the need for internal investment of one form or another.

Thus, through appropriate responses to the challenges of mining and economic development, the benefits of mining can be sustained, even when a mine or a mining community inevitably declines as the ore runs out. Mineral wealth lives on, but in other forms--in educated and healthy people, efficient and fair social institutions, and man-made physical capital. To be sure, mining and minerals can be a curse if the challenges are not met. But if we choose not to address the challenges and instead leave minerals in the ground, we forego the opportunity to take advantage of this gift of nature.

References

Armstrong, Harvey, and Jim Taylor, 2000. ***Regional Economics and Policy***, 3rd edition (Oxford, Blackwell Publishers).

Aroca, Patricio, 2000. "Diversification and Development in Local Economies Based on the Mining Sector: The Case of Chilean II Region," paper presented at the UNCTAD regional workshop for mineral economies in Africa, Cape Town, South Africa, 7-9 November 2000. Available on the Internet at http://www.natural-resources.org/society/.

Ascher, William, 1999. ***Why Governments Waste Natural Resources: Policy Failures in Developing Countries*** (Baltimore, The Johns Hopkins University Press).

Auty, Richard M., 1999. "The Transition from Rent-driven Growth to Skill-driven Growth: Recent Experience of Five Mineral Economies," pp. 55-77 in Jörg Mayer, Brian Chambers, and Ayisha Farooq, editors, ***Development Policies in Natural Resource Economies*** (Cheltenham, UK, Edward Elgar in association with UNCTAD).

Auty, R. M., and D. Evans, 1994. ***Trade and Industrial Policy for Sustainable Resource-based Development: Policy Issues, Achievements and Prospects***, Report GE94-50979 prepared for UNCTAD, Geneva, Switzerland.

Auty, Richard M., and Raymond F. Mikesell, 1998. ***Sustainable Development in the Mineral Economies*** (Oxford, Clarendon Press).

Baldwin, R. E., 1966. ***Economic Development and Export Growth: A Study of Northern Rhodesia, 1920-1960*** (Berkeley, University of California Press).

Barry, Norman, 2000. ***Business Ethics*** (West Lafayette, Indiana, Purdue University Press).

Boardman, Anthony, and David Greenberg, 1998. Discounting and the Social Discount Rate, pp. 269-318 in Fred Thompson and Mark T. Green, editors, ***Handbook of Public Finance*** (New York, Marcel Dekker).

Boardman, David H. Greenberg, Aidan R. Vining, and David L. Weimer, 2001. ***Cost-Benefit Analysis: Concepts and Practice***, 2nd edition (Upper Saddle River, New Jersey, Prentice Hall).

Bouton, Lawrence, 1999. "Bolivia: Mining Gold, Empresa Inti Raymi S.A.," [note: get complete reference from IFC website; it appears to have been published in paper somewhere]

Caves, Richard E., Jeffery A. Frankel, and Ronald W. Jones, 1996. ***World Trade and Payments: An Introduction***, seventh edition (New York, Harper Collins).

Corden, W. Max Corden, 1984. "Booming Sector and Dutch Disease Economics: A Survey," ***Oxford Economic Papers***, vol. 36, pp. 359-380.

Corden, W. M., and J. Peter Neary, 1982. "Booming Sector and De-Industrialization in a Small Open Economy," ***Economic Journal***, December issue, pp. 825-848.

Daniel, Philip, 1992. "Economic Policy in Mineral-Exporting Countries: What Have We Learned?" pp. 81-121 in John E. Tilton, editor, ***Mineral Wealth and Economic Development*** (Washington, D.C., Resources for the Future).

Davis, Graham A., 1995. "Learning to Love the Dutch Disease: Evidence from the Mineral Economies," ***World Development***, vol. 23, no. 10, pp. 1765-1779.

Davis, Graham A., 1998. "The minerals sector, sectoral analysis, and economic development," ***Resources Policy***, vol. 24, no. 4, pp. 217-228.

Deaton, Angus, 1999. "Commodity Prices and Growth in Africa," ***Journal of Economic Perspectives***, vol. 13, no. 3, pp. 23-40.

Dehn, Jan, and Christopher L. Gilbert, 1999. "Commodity Price Uncertainty and Economic Growth and Poverty," unpublished study cited in World Bank, ***Global Economic Prospects and the Developing Countries, 2000*** (Washington, D.C., World Bank, 2000).

Doran, C. R., 1984. "An Historical Perspective on Mining and Economic Change," pp. 37-84 in L. H. Cook and M. G. Porter, editors, ***The Minerals Sector and the Australian Economy*** (Sydney, George Allen & Unwin, in association with Centre for Policy Studies, Monash University).

Eggert, Roderick G., 1999. "Mining Taxation and Economic Rents: A U.S. (Economist's) Perspective," pp. 167-188 in E. Figueroa, editor, ***Economic Rents and Environmental Management in Mining and Natural Resource Sectors*** (Santiago, University of Chile, and Edmonton, University of Alberta).

Friends of the Earth International, 2000. "Phasing Out Public Financing for Fossil Fuel and Mining Projects," Position Paper, September (http://www.foe.org/international/, accessed October 30, 2001).

Garnaut, Ross, and Anthony Clunies Ross, 1983. ***Taxation of Mineral Rents*** (Oxford, Clarendon Press).

Hamilton, Kirk, 2000. ***Genuine Saving as a Sustainability Indicator***, Environmental Economics Series Paper no. 77 (Washington, D.C., World Bank).

Hanneson, Rögnvaldur, 2001. ***Investing for Sustainability: The Management of Mineral Wealth*** (Boston, Kluwer Academic Publishers).

Hirschman, A. O., 1958. ***The Strategy of Economic Development*** (New Haven, Yale University Press).

Humphreys, David, 2000. "A Business Perspective on Community Relations in Mining," ***Resources Policy***, vol. 25, no. 3, pp. 127-132.

Isard, Walter, Iwan J. Azis, Matthew P. Drennan, Ronald E. Miller, Sidney Saltzman, and Erik Thorbecke, 1998. ***Methods of Interregional and Regional Analysis*** (Aldershot, UK, Ashgate).

Karl, Terry Lynn, 1997. The ***Paradox of Plenty: Oil Booms and Petro-States*** (Berkeley, University of California Press).

Kremers, Jeroen J. M., 1986. "The Dutch Disease in the Netherlands," pp. 96-136 in J. Peter Neary and Sweder Van Wijnbergen, editors, ***Natural Resources and the Macroeconomy*** (Cambridge, Massachusetts, MIT Press).

Krugman, Paul, 1991, ***Geography and Trade*** (Leuven, Belgium, Leuven University Press, and Cambridge, Massachusetts, MIT Press).

Kunte, Arundhati, Kirk Hamilton, John Dixon, and Michael Clemens, 1998. ***Estimating National Wealth: Methodology and Results***, Environmental Economic Series (Washington, D.C., World Bank).

Lewis, Stephen R., Jr., 1989. "Primary Exporting Countries," pp. 1541-1600 in H. Chenery and T. N. Srinivasan, ***Handbook of Development Economics***, volume II (Amsterdam, Elsevier).

Lind, Robert, Kenneth Arrow, and others, 1982. ***Discounting for Time and Risk in Energy Policy*** (Washington, D.C., Resources for the Future).

Lundgren, Nils-Gustav, 1996. "Bulk Trade and Maritime Transport Costs: The Evolution of Global Markets," ***Resources Policy***, vol. 22, no.1/2, pp. 5-32.

Lysy, Frank J., 1999. "Assessing Development Impact," unpublished manuscript.

Mahon, James E., Jr., 1992. "Was Latin America Too Rich to Prosper? Structural and Political Obstacles to Export-Led Growth," ***Journal of Development Studies***, vol. 28, no. 2, January, pp. 241-263.

Mainardi, Stefano, 1995. "Mineral resources and growth: towards a long-term convergence?" ***Resources Policy***, vol. 21, no. 3, pp. 155-168.

Manners, Gerald, 1971. ***The Changing World Market for Iron Ore, 1950-1980*** (Baltimore, Johns Hopkins University Press for Resources for the Future).

Marshall, Alfred, 1920. ***Principles of Economics***, 8th edition (London, Macmillan and Company).

Mayer, Jörg, 1999a. "Introduction," pp. 1-10 in Jörg Mayer, Brian Chambers, and Ayisha Farooq, editors, ***Development Policies in Natural Resource Economies*** (Cheltenham, UK, Edward Elgar in association with UNCTAD).

Mayer, Jörg, 199b. "Conclusions," pp. 189-205 in Jörg Mayer, Brian Chambers, and Ayisha Farooq, editors, ***Development Policies in Natural Resource Economies*** (Cheltenham, UK, Edward Elgar in association with UNCTAD).

Mayer, Jörg, Brian Chambers, and Ayisha Farooq, 1999. ***Development Policies in Natural Resource Economies*** (Cheltanham, UK, Edward Elgar in association with UNCTAD).

Meier, G. M., and R. E. Baldwin, 1957. ***Economic Development*** (Chichester, Sussex, UK, Wiley).

Mitchell, D., P. Varangis, and T. Akiyama, 1996. Managing Commodity Booms and Busts (Washington, D.C., World Bank).

Moore, Garrick, undated. ***Atlas: Mining Towns of Western Australia*** (Perth, Curtin University of Technology, The Chamber of Minerals and Energy of Western Australia, and the Department of Minerals and Energy, Western Australia).

Myrdal, G., 1956. ***An International Economy*** (New York, Harper & Row). Chapters 8 and 13.

Neary, J. Peter and Sweder Van Wijnbergen, editors, 1986. ***Natural Resources and the Macroeconomy*** (Cambridge, Massachusetts, MIT Press).

The New Palgrave: A Dictionary of Economics, 1987 (London, Macmillan Press).

Nordhaus, William D. and Edward C. Kokklenberg, editors, 1999. ***Nature's Numbers: Expanding the National Economic Accounts to Include the Environment*** (Washington, D.C., National Academy Press).

Otto, James, editor, 1995. ***Taxation of Mineral Enterprises*** (Dordrecht, Graham and Trotman/Kluwer Academic Publishers).

Porter, M. G., 1984. "Mining and the Economy--Some Key Issues," pp. 1-35 in L. H. Cook and M. G. Porter, editors, ***The Minerals Sector and the Australian Economy*** (Sydney, George Allen & Unwin, in association with Centre for Policy Studies, Monash University, Special Study no. 6).

Portney, Paul R., and John P. Weyant, editors, 1999. ***Discounting and Intergenerational Equity*** (Washingon, D.C., Resources for the Future).

Prebisch, R., 1950. ***The Economic Development of Latin America*** (New York, United Nations).

Radetzki, Marian, 1982. "Regional Development Benefits of Mineral Projects," ***Resources Policy***, vol. 8, no. 3, pp. 193-200.

Ross, Michael, 2001. ***Extractive Sectors and the Poor***, an Oxfam America Report (http://www.oxfamamerica.org/, accessed October 29, 2001).

Sachs, J. D., and A. M. Warner, 1995. "Natural Resource Abundance and Economic Growth," Working Paper 5398 (Cambridge, Massachusetts, National Bureau of Economic Research).

Sachs, Jeffrey D., and Andrew M. Warner, 1999. "Natural Resource Intensity and Economic Growth," pp. 13-38 in Jörg Mayer, Brian Chambers, and Ayisha Farooq, editors, ***Development Policies in Natural Resource Economies*** (Cheltenham, UK, Edward Elgar in association with UNCTAD).

Sala-I-Martin, X. X., 1997. "I Just Ran Two Million Regressions," ***American Economic Review***, vol. 87, pp. 178-183.

Seers, D., 1959. "An Approach to the Short Period Analysis of Primary Producing Economies," ***Oxford Economic Papers***, February issue.

Singer, H. W., 1950. "The Distribution of Gains Between Investing and Borrowing Countries," ***American Economic Review***, Papers and Proceedings, vol. 40, pp. 473-485.

Snider, L. W., 1996. ***Growth, Debt, and Politics: Economic Adjustment and the Political Performance of Developing Countries*** (Boulder, Colorado, Westview Press).

Squire, Lyn, 1989. "Project Evaluation in Theory and Practice," pp. 1093-1137 in Hollis Chenery and T. N. Srinivasan, editors, ***Handbook of Development Economics***, volume 2 (Amsterdam, North Holland).

Stilwell, L. C., R. C. A. Minnitt, T. D. Monson, and G. Kuhn, 2000. "An input-output analysis of the impact of mining on the South African economy," ***Resources Policy***, vol. 26, pp. 17-30.

Strongman, John, 1998. "Mining and the Community--From Enclave to Sustainable Development," in ***Mining and the Community for Asian and Pacific Nations Conference***, proceedings of a conference organized by the World Bank, Metal Mining Agency of Japan, Papua New Guinea Department of Mineral Resources, and PNG Chamber of Mines and Petroleum, July 26-28, 1998, Madang, Papua New Guinea.

United Nations, 2000. ***Human Development Report 2000, Statistical Annex*** (New York, United Nations).

U.S. Geological Survey, 2001. ***Mineral Commodity Summaries 2001*** (Washington, D.C., U.S. Geological Survey, www.minerals.usgs.gov/minerals).

Warrack, Allan A., and Russell R. Keddie, 2001. "Alberta Heritage Fund vs. Alaska Permanent Fund: A Comparative Analysis," unpublished paper submitted to the ***American Review for Canadian Studies***. Downloaded from www.apfc.org, June 19, 2001.

Wheeler, David, 1984. "Sources of Stagnation in Sub-Saharan Africa," ***World Development***, vol. 12, no. 1, pp. 1-23.

World Bank, 1997. ***World Development Report 1997: The State in a Changing World*** (New York, Oxford University Press).

World Bank, 2000a. "Managing the Recent Commodity Price Cycle," pp. 103-132 in ***Global Economic Prospects and the Developing Countries, 2000*** (Washington, D.C., World Bank).

World Bank, 2000b. ***World Development Indicators 2000***, CD-ROM (Washington, D.C., World Bank).

World Bank, 2001. ***World Development Report 2000/2001: Attacking Poverty*** (New York, Oxford University Press).

World Bank and Metal Mining Agency of Japan, 2001. ***Review of Legal and Fiscal Frameworks for Exploration and Mining*** (London, Mining Journal Books).

Young, H. Peyton, 1994. ***Equity: In Theory and Practice*** (Princeton, New Jersey, Princeton University Press).