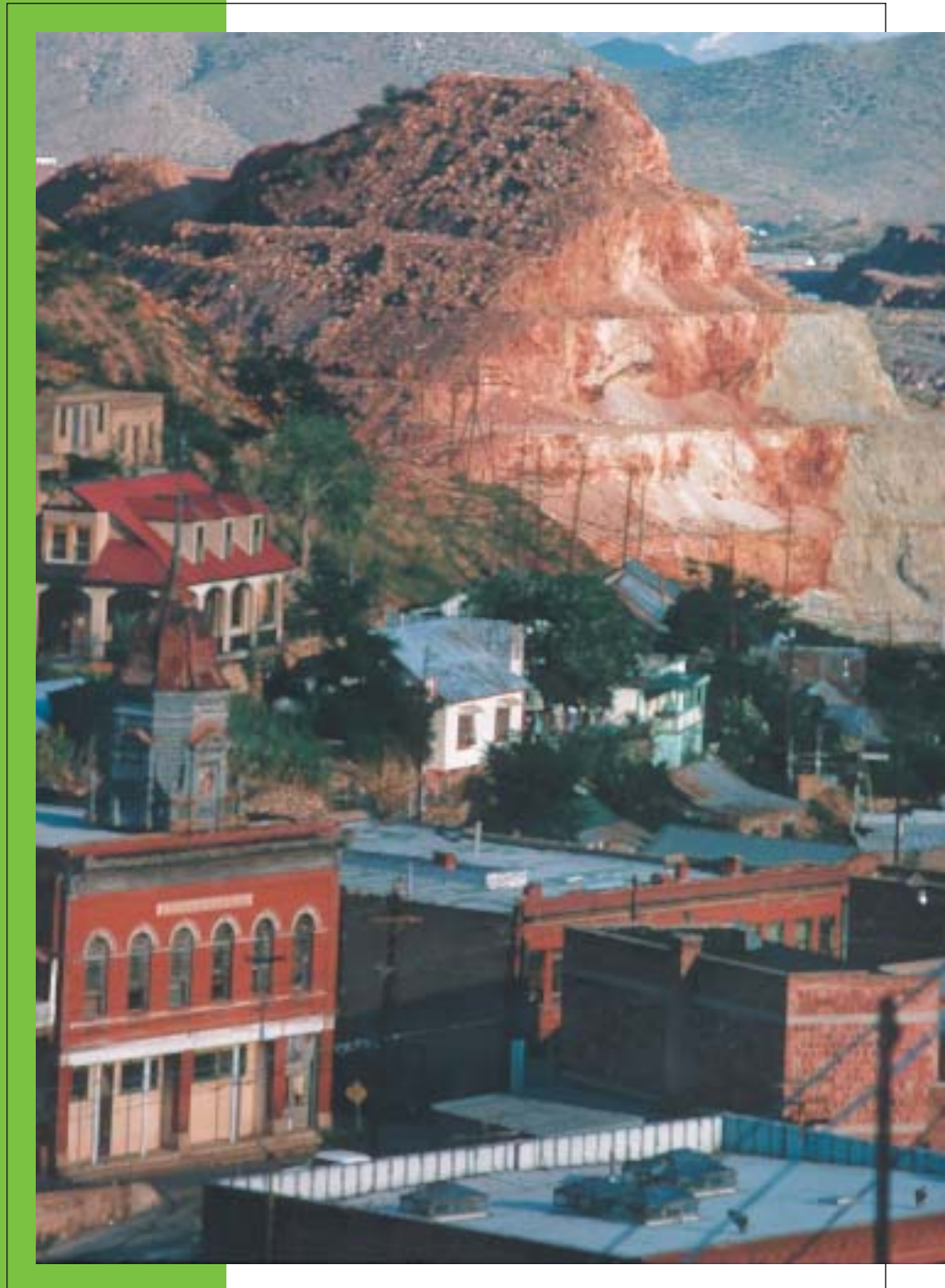


Digging to Development?

A Historical Look at Mining and
Economic Development

An Oxfam America Report



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Digging to Development?

A Historical Look at Mining and Economic Development

A report prepared for
Oxfam America

by

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September 2002



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Foreword

The export of minerals such as gold, silver, copper and zinc is the most important economic activity in many developing countries. Yet despite their mineral wealth, these countries often experience low economic growth and high poverty rates. Indeed, as political scientist Michael Ross demonstrated in an Oxfam America report published last year, “mineral dependent” developing countries appear to suffer from a variety of ills, including poor health care and high rates of child mortality and income inequality.

Despite the problems associated with mineral exports in poor countries, governments in the developing world and international financial institutions such as the World Bank continue to promote mining as a pathway out of poverty. One of the most frequently heard justifications for this is the apparent success the United States, Canada and Australia have had in converting their considerable mineral wealth into economic development. The analogy seems obvious: these countries are rich and they have sizeable mineral endowments; thus they must at some point have utilized this wealth for their development. Developing countries therefore can and should follow a similar path.

But is this really an appropriate analogy? How much did mining actually contribute to the development of these three rich countries? And can poor countries today develop in the same way the US, Canada and Australia did? Mining has had serious impacts on the environment and local communities, including some of those supported by Oxfam America’s programs in South America and other parts of the developing world. It is therefore vital to honestly assess these questions if mining is to continue to be promoted as a means to economic development and poverty reduction.

In this special report commissioned by Oxfam America, University of Montana economist

Thomas Power seeks to address these questions. Drawing on nearly 30 years’ experience studying the impacts of mining in the United States, Professor Power analyzes the role played by mining in the economic development of the US, Canada and Australia and the potential for the replication of this “success” in developing countries today. His conclusions present a strong challenge to the prevailing view that mining was an unalloyed success for the three countries in question and that this success can be easily replicated.

Oxfam America is not opposed to mining or other extractive activity in general. We believe that decisions on the appropriateness of these activities in developing countries must be made in open and fair consultation — and with full respect for the rights of — local communities who will be affected by extractive operations. We also believe in local communities’ right to have full information about the impacts and benefits of resource extraction, including access to an honest appraisal of the role these industries have played in the developed world. We hope Professor Power’s report will serve this end.

The global mining industry and the international financial institutions like the World Bank that support it are at a crossroads. They have recognized that in general mining has not made a strong contribution to sustainable development in poor countries. Both entities have committed themselves to reform. It is our hope that this report will contribute to additional reflection within the industry, the international financial institutions and global civil society about the proper role mining should play in promoting economic development and poverty reduction.

Keith Slack
Policy Advisor/Oxfam America
September 2002

Executive Summary

Mining played a very visible role in the early industrialization of the United States, Canada, and Australia. As a result, mineral development is often promoted as an obvious — even necessary — path for contemporary developing countries seeking sustained economic growth. Detailed data or analysis almost never supports this “reasoning by historical analogy.” It rarely succeeds as more than storytelling that has a folklore character to it.

Simplistic storytelling is a dangerous way to determine economic development policy. This report therefore critically examines this “reasoning by historical analogy” characterization of the U.S., Canadian, and Australian development experience with mining and finds it to be factually wrong. Mining alone was never a significant stimulant to the economic development of any of these nations. During these countries’ initial industrialization in the late 19th and early 20th centuries, mining contributed just a small percent of total economic output and did not dominate their exports. The degree of reliance on mining in these countries was never anywhere near the magnitude of dependence that occurs among many developing nations today.

Because the U.S., Canada, and Australia are continental in scale, they all had a broad geographic expanse over which mineral resources could be discovered and developed. This was important in smoothing out the otherwise disruptive impact that mining can have

on regional economies. As mineral development moved from one location to another, it often left ghost towns or depressed local economies. But as one local mining-dependent economy failed another was expanding, so the national experience was of ongoing expansion. The economic side effects of mineral development — locally low incomes, high unemployment, and poverty — continue to the present day in the United States. However, for developing nations without the same gigantic geographic scope, this local mining experience within developed nations urges caution in evaluating the exaggerated beneficial economic claims that often accompany proposed mining projects.

This does not imply that mining did not play a role in the development of the U.S., Canadian, and Australian economies. However, the role was far more sophisticated and complicated than that told in familiar folktales. Mining in these countries was linked to an overall transformation in business and financial organization, education, research and knowledge development, human capital accumulation, and infrastructure expansion. It was strengthened by well-developed and stable political institutions that respected the rule of law, markets, and private enterprise. Cultural values supported an entrepreneurial approach to economic opportunity. Public policies encouraged a broad distribution of land and resources, which reduced income inequality. During this industrialization, these three nations had large internal (or adjacent national) markets protected by high transportation costs and their own trade barriers. All three

Bingham Canyon copper mine near Salt Lake City, Utah. The largest open-pit mine in the US. (Mineral Policy Center)



countries were high-income nations as this industrialization process got underway. They were “labor poor” but “natural resource rich.” Almost none of these favorable conditions characterize contemporary developing countries, which makes “reasoning by historical analogy” particularly inappropriate when evaluating these countries.

In reality, mining has not supported sustained economic development in developing nations over the last several decades. The more reliance such nations place on natural resource exports, the lower their rate of growth of per capita GDP had been. Although this rule has a few exceptions, the statistical evidence clearly undermines the proposition that investments in mining can set a nation on the path of sustained development.

The “reasoning by historical analogy” with the folk-histories of the United States, Canada, and Australia encourages an overly simplistic, mechanical approach to economic development. These three nations’ economic histories, and the contemporary experience of developing countries, do not support this approach. Large investments in a particular industry (mining) to support a particular sector of the economy (exports) by itself will not stimulate sustained economic development.

Mining is not itself destructive or antithetical to economic development; however, high environmental and social costs come with natural resource exploitation. When mineral development occurs in a context of underdeveloped social, political, and economic institutions, the non-renewable resource wealth tends to be squandered, the level of social conflict increases and nearly irreparable damage is inflicted on the environment. This can leave a developing nation permanently poorer.

To ensure sustained development, investments must be supported by, and be supportive of, positive institutional changes within developing nations. Public international investments should focus on economic activities that promote the development of human and institutional capital. They should support the development of local entrepreneurial businesses, wide-ranging economic opportunity, civic institutions, a more equal distribution of income, and democratic decision-making. Such investments should encourage and strengthen the developing countries’ primary resources, workforce, and environments. It is unclear that the mineral development investments that many transnational corporations want to make in developing nations meet these criteria.

1. Introduction

Although some nations have experienced dramatic economic improvements over the last half-century, many of the poorer nations of the world have not. In Sub-Saharan Africa, Latin America and the Caribbean, and Central Asia, economic development has been spasmodic; brief periods of growth are interspersed with long periods of stagnation and, in some cases, significant deterioration.

This has led to a renewed search for ways to put the world's developing nations on a path of sustained development. These countries have sought strategic infusions of investment capital in order to raise productivity and boost local incomes. The histories of the world's advanced economies have been studied for lessons as to what strategic investments might be effective. One such "lesson" from countries like the United States, Canada, and Australia, has been their historical and continuing reliance on natural resource industries such as mining.

Mining¹ appears to have played an important role in the developmental history of these three advanced industrial nations as they established century-long patterns of sustained economic growth. Their histories suggest that mining tends to draw large investments, generate substantial surpluses (rents) that can finance additional investments, stimulate the development of basic transportation infrastructure, pay relatively high wages, and support the development of local manufacturing that processes the minerals. This historical reasoning suggests that an emphasis on mining can potentially be just the sort of "big push" that might enable developing countries to escape from the "low-income trap" that has mired many of them in poverty.

If mining were "just another industry" with positive and negative characteristics similar to most other economic activities, proposals to focus international development assistance on mining projects in developing countries would not be controversial. But mining has characteristics that raise concerns about its social costs. Mining intensively uses land and environmental resources, often leading to significant and enduring environmental degradation. Because mineral commodity prices tend to be volatile, income and employment in mining can also be unstable. Mining projects necessarily deplete the mineral deposits they extract, assuring a limited and often relatively short lifespan for any given project. Mining tends to be capital intensive, making heavy use of labor saving technologies, and rapid technological change has steadily reduced the labor requirements per unit of output. This tends to reduce the local employment opportunities mining provides. Mining can generate huge surpluses or rents over costs. In poor countries, the struggle over control and use of these rents can be unproductive, even violent. The high wages and rents associated with mining can also exacerbate income inequality within a country, increasing social conflict and political instability.

Because of these potential social costs, mining development proposals present a mix of potentially high benefits and high costs. These issues need to be carefully weighed before a conclusion can be drawn about the size of the expected net benefits or net costs. This report focuses on the potential economic development benefits associated with mining development proposals because these are often either taken for granted or derived from very informal analysis. Such a clear analysis of the economic development benefits of mining lays the



foundation for a more careful weighing of the social benefits and costs of mining.

The report is organized as follows. First, we examine the historical analogies that are often used to “document” the power of mining to energize sustained economic development: the historical role of mining in the economic development of the United States, Australia, and Canada. Then we look more closely and quantitatively at these three countries’ developmental histories. We also closely examine the local (regional) — as opposed to national — economic impacts of mining within these three advanced countries. Then we analyze whether the patterns of mineral development found historically in the U.S., Canada, and Australia are potentially transferable to developing countries today, given the dramatic changes in transportation costs, the character of business organ-

ization, technology, and the extent of global trade. We outline the distinct initial conditions and developmental paths taken by these three advanced nations and how they differ from those faced by contemporary developing nations. Next, we analyze the actual economic development experiences of developing countries that have relied on mining over the last several decades to see whether the expectations that investments in mining can provide nations with a “big push” into sustained development have been borne out. Finally, we draw some conclusions about the efficacy of building economic development strategies around mining in developing nations.

*Golden Sunlight
gold mine in Mon-
tana (Mineral
Policy Center)*

2. Arguing by Analogy from the U.S., Canadian, and Australian Experiences

Mining and other natural resource industries played a very visible role throughout the economic histories of some of the world's most successful economies. Thus, many commentators consider it "intuitively obvious" that mining has the power to trigger sustained economic growth that can lift countries out of poverty. A recent World Bank report makes this familiar case.²

... natural resources-based activities can lead growth for long periods of time. This is patently evident in the development history of natural resource-rich developed countries, such as Australia, Finland, Sweden, and the United States. Mining was the main driver of growth and industrialization in Australia and the United States over more than a century ... (p.4)

The most convincing evidence is offered by history: It is impossible to argue that Australia, Canada, Finland, Sweden, and the United States did not base their development on their natural resources. In fact, even today they are net exporters of natural resource-based products. p. 6

However, many of the world's most developed countries — Australia, Canada, Scandinavia, and the United States — have successfully developed on the basis of, and not in spite of, their resource base. In fact, ...their net exports are heavily resource intensive. p. 49

Our focus is on mining, rather than on forestry and forest products that are often claimed to have energized the sustained developments of Sweden, Finland, and the other

Scandinavian countries. Consequently, we will focus on the economic histories of the U.S., Canada, and Australia.

In a recent critique of an Oxfam America paper on the link between poverty and dependence on mining, mining industry spokespersons made the same assertions:

The experiences of the U.S., Canada, and Australia in becoming among the richest nations in the world while continuing to rely on mining clearly proves that mining is an economic foundation that can reliably help nations escape from poverty.³

This type of reasoning by historical analogy is remarkable for how little actual empirical analysis is carried out. The style is almost that of "free association," and has a folklore character to it. Thus, in a recent World Bank defense of the use of mining as a springboard to sustained economic development, U.S. industrial development is characterized as follows:⁴

The United States was the richest country in terms of natural resources, and its transformation into the global manufacturing leader, while somewhat technology driven, was sparked by the discovery of iron ore reserves in Minnesota that reduced the cost of iron-intensive manufactures below those of the competition. Even today, [the U.S.] remains first and foremost a net exporter of foodstuffs. p. 49

One would gather from this that if not for the Mesabi range ores in Minnesota, the U.S. would never have become an industrial leader and that the U.S. strength in the world economy is tied to its food exports. As this report shows, serious economic historians paint a much more complex picture with quite different implications for contemporary developing countries.⁵

The World Bank's description of Canada's reliance on natural resource industries for its historical economic development uses the same "free association" technique:⁶

It was Canada's developmental experience that suggested the "staples theory" of economic development. Primary goods exports, beginning with fur and fisheries and then progressing to forestry and wheat — through either demand or supply linkages — drove subsequent industries in wood, pulp, and metal refineries. Canada remains principally a net exporter of forest products.

Again, it has been suggested that particular natural resource exports, such as furs and fish, brought the contemporary Canadian economy into existence and adequately describes its current economic base.

The following is the Australian version of this type of broad-brush folkloric characterization of economic development history:⁷

Although wool is Australia's most famous staple, extraordinary and continuing success in mining and the derivative industries of both made the country one of the richest economies in the world in the early 20th century, and discoveries of new deposits might put it near the top of the list again.

This World Bank review of these countries' economic histories concluded: "The bottom line is that it is impossible to argue that these economies did not base their development on their natural resources. . . ."⁸

Natural resource industries, including mining, clearly **were** important at various stages of U.S., Canadian, and Australian economic development; however, it is not obvious whether

mining development was either necessary or sufficient for economic development to occur. These folks stories also tell us nothing about the reliability of the link between mining and economic development either in the past or in the present. After all, as Europeans took control of North America and Australia from a dramatically depleted indigenous population, they had little to work with initially besides their own labor skills and the natural landscape. It is not surprising that in this frontier settlement they drew on the natural resources that the land provided. How could it have been otherwise? Whether this initial pattern of settlement activities was central to the ultimate rise of a successful modern advanced economy is another question. Simply because one event precedes another does not imply that the first **caused** the second.

Economic history does not tell just one story either. Economic historians have not primarily emphasized the success of a few natural resource-rich nations. More challenging to economic historians has been the fact that many of the world's most prosperous nations are not resource-rich but the opposite. Resource-poor Japan, Switzerland, Ireland, Hong Kong, and Singapore are obvious examples. In the 2002 World Bank ranking of countries by national income per person, at least half of the richest 25 nations are considered natural resource poor. Similarly, many of the poorest nations are considered resource-rich.⁹ Clearly, natural resource development is not necessary for, nor does it assure, successful development. The lessons to be learned from close examination of many countries are varied and quite complex. Overall, they tend to contradict the conclusions of those who have used historical analogy to make the case for emphasizing mining in contemporary developing countries.

3. A Closer Look at the Role That Mining Played in the Development of the U.S., Canadian, and Australian National Economies

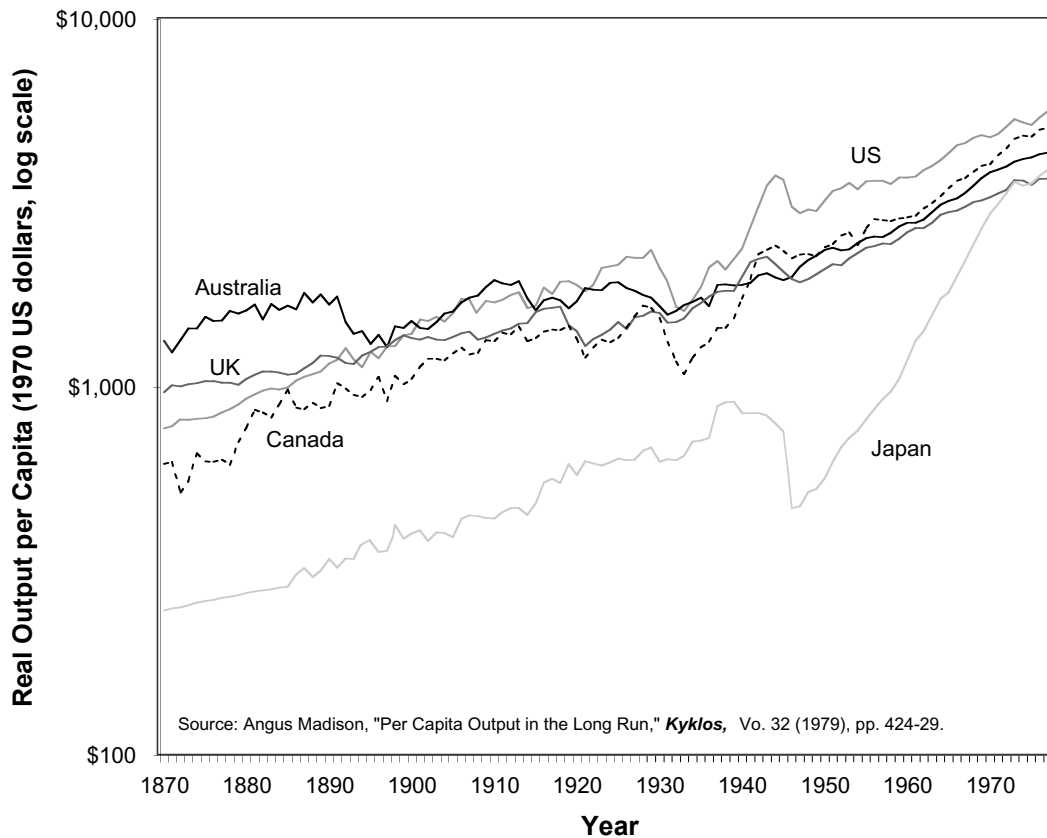
Historical review of the U.S., Canadian, and Australian experiences with mining usually just points out that mining was significant at various points in these countries' historical development and remains so today. Such factual statements about the components of a nation's economy at various points in its past are then converted into causal statements that mining was the engine driving the nation's development. No theoretical analysis or factual data is typically provided to support this move from being just a sector of the economy to being the energizing force behind the sustained economic growth. As emphasized previously, precedence does not imply causality. Slavery in the United States, the bi-lingual character of Canada, and penal transportation to Australia did not "cause" those nations' later sustained development. "Before" does not imply causality.

The problem with labeling the early reliance on natural resources in these nations the cause of their later development is fairly obvious. The population had to be engaged in some type of economic activity at every point in the past. However, that does not mean that each of those past economic activities was the source of the changes that led to ongoing economic development. Some of them may have been irrelevant from a developmental perspective; they either faded out of existence as the economy developed or passively developed alongside the evolving economy. The existence of a sector in an

earlier period of history does not prove its causal importance. In both the U.S. and Canada, fur trapping was the "vanguard" activity through which Europeans originally "settled" the frontier. While it lasted, it was also big business. But it seems highly implausible to argue that if it were not for those fur trappers, European settlement would never have extended beyond the eastern seaboard and its river systems. Other economic opportunities would have drawn the new settlers inland, and those economic opportunities themselves would have given way to others as the economy evolved. Simply looking at the makeup of the economy at a given point in time does not identify the dynamic forces driving economic evolution and development.

More careful analysis is required to understand the dynamics of a nation's economic development. We now briefly discuss the role played by mining in the early economic development of the U.S., Canada, and Australia. We focus on the late 19th and early 20th centuries because by the end of World War One all three countries were affluent, sophisticated economies experiencing sustained economic development. Figure 1 shows the level and growth of GDP per capita in these three countries compared to the United Kingdom and Japan. Note that by 1911 the U.S., Canada, and Australia had already attained or exceeded the per capita productivity level found in the United Kingdom, the world's early industrial leader. Japan, in contrast, lagged significantly behind. We focus here on the **quantitative** importance of mining in each country during this period of industrialization. In a later section,

Figure 1: Real Output per Capita in Five Industrial Countries, 1861–1981



as we consider the relevance of the U.S., Canadian, and Australian experience to contemporary developing countries, we will also discuss some of the important qualitative characteristics of these three countries' experiences with mining. It turns out that **how** mining occurred and was linked to the national and international economies was even more important than the relative size of the mining sectors.

United States

The centrality of mining to U.S. growth is generally illustrated by the character of U.S. exports: The products the U.S. sold to the rest of the world were natural-resource intensive. This does not mean that the U.S. was exporting large quantities of raw minerals, but that these exported manufactured goods were produced

using high levels of indigenous raw materials, particularly non-renewable resources. U.S. agricultural exports were also part of this pattern of land and raw material intensive exports. This evidence suggests that U.S. exports continued to be natural resource intensive well into the second half of the 20th century.¹⁰

This evidence clearly indicates that the United States had a comparative advantage in natural resources that it exploited in its exports. But exports played a rather limited role in the U.S. economy for most of its history. Thus, this characteristic of U.S. exports does not necessarily tell us what was driving the development of the U.S. economy. In the period of U.S. industrialization, 1880-1929, exports represented about 6.5 percent of national income.¹¹ The mining and unfinished metal product portion

Figure 2: Total Exports, Crude Material Exports, and Mine Product Exports as a Percentage of US National Income



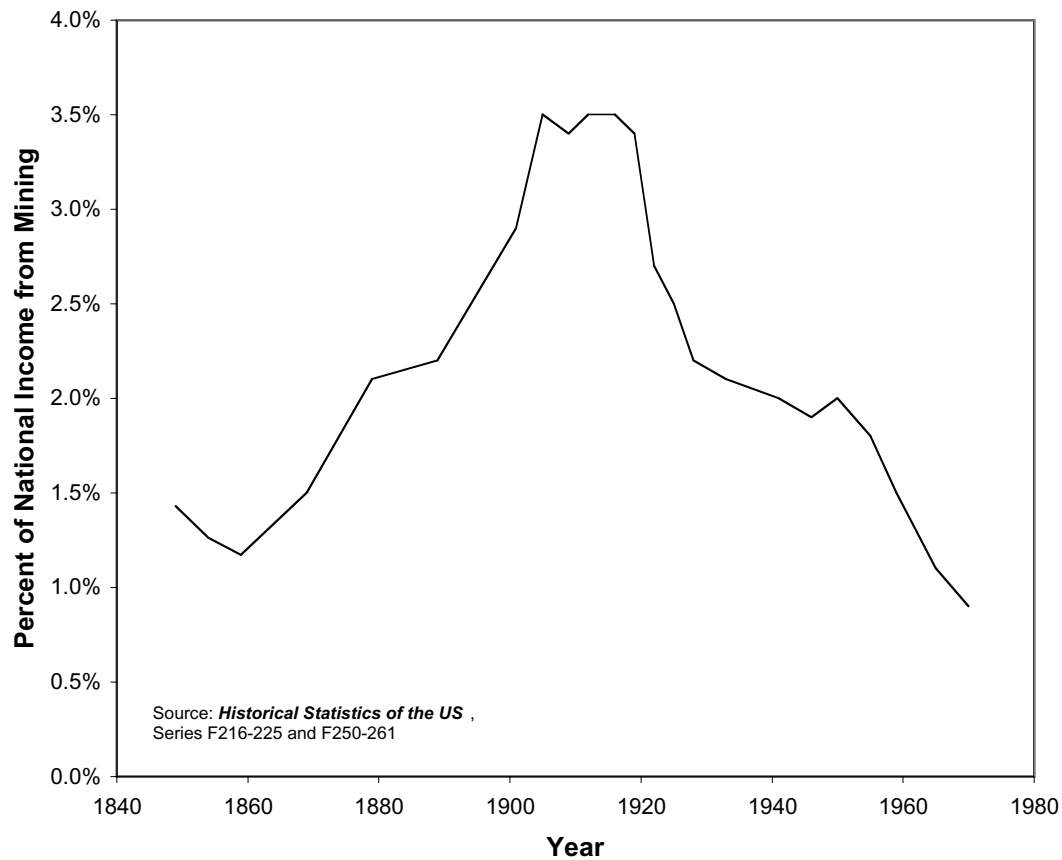
was only a little over one percent of national income.¹² Between 1929 and 1970 exports represented only about 4 percent of national income.¹³ (See Figure 2.)

By the late 19th century, the United States had a huge internal market that was protected by two oceans and tariffs. The U.S. economy was one of the most self-sufficient modern economies, producing most of what it consumed, although relying on foreign capital and, for a period, foreign technology. Trying to describe the development of the U.S. economy by focusing on the character of its exports risks confusing the tail with the dog. Mining output (including that exported) rose from about 1 percent of national income in 1860 to about 3.5 percent between 1900 and 1920 before

beginning a long decline back to about one percent of national income. (See Figure 3.) Mining employment as a percentage of total employment followed a similar trajectory.

Standard economic histories of the United States do not emphasize mining as a driving force behind the United States' economic development. For instance, Douglas North's *Growth & Welfare in the American Past: A New Economic History* does not list mining, minerals, or natural resources in its index.¹⁴ North's answer to the question of why per capita output rose so fast in the U.S. focuses on technological progress, investments in human capital, and improvements in the efficiency of economic organization. These are now familiar themes in explaining why some nations are so

**Figure 3: US Mining as a Source of National Income
(Oil and Gas Included)**



much more productive than others and why economic growth rates differ. Technological development in all sectors of the U.S. economy — agriculture, manufacturing, transportation, services, as well as mining — stimulated that ongoing growth. Improvements in the U.S. transportation infrastructure, rising incomes, immigration, the development of national corporations and their marketing strategies, and so on, enabled the size of the U.S. internal market to expand tremendously, allowing the exploitation of economies of scale in manufacturing. As will be discussed, this does not imply that mining developments in the U.S. were irrelevant or not a significant part of all of these changes. Rather, it is to emphasize that it was not the mineral extrac-

tion per se that was the dynamic force. It was how the mineral sector developed that was important to U.S. economic growth.

U.S. mining development was also widely dispersed over a huge geographical area, rising and falling in waves over time and shifting geographically. Gold discoveries lurched almost randomly across the western U.S. and Alaska. Booms were followed quickly by busts. Coal production moved from the Appalachian Mountains to the southern portions of the Great Lakes states and back to Appalachia before, in the late 20th century, shifting to the northern Great Plains and Rocky Mountain states. Petroleum production began in Pennsylvania, shifted to California then to Texas and Oklahoma, to Louisiana and the Gulf Coast, to the northern

Great Plains, and so on. Copper production began in Michigan's Upper Peninsula but then shifted to Montana, Utah, Arizona, and New Mexico. These mining developments often had very dramatic local impacts both positive and negative, but, as this report discusses, it is difficult to link local mining development to regional patterns of ongoing economic development in the U.S. Such sustained development, when it did come, came as previously mining-dependent regions successfully diversified away from that sector. Regions that did not diversify suffered long periods of decline and depression.

Canada

Canada, like the U.S. and Australia, currently has a sophisticated and diverse mining sector and provides world leadership in exploration and development. However, this development is relatively recent, primarily the result of a major expansion in exploration, development, and processing following World War Two. Iron, uranium, cobalt, magnesium, and molybdenum production primarily expanded after 1945. Copper, zinc, lead, nickel and platinum expanded after 1920 but experienced much larger booms after 1945. Silver production and exports boomed between 1905 and 1915 but then collapsed and began to recover only after 1945. Gold production was the only Canadian metal that boomed in the early 20th century, reaching a peak between 1900 and 1940.¹⁵

As a percentage of total Canadian GDP, mining rose from about 1 percent in 1880 to about 3 percent in 1900 during the Canadian gold boom. It fluctuated between 2.5 and 3.5 percent of the GDP between 1900 and 1932 when it began a pre-war climb to 7 percent of the GDP in the late 1930s. It then declined to about 4 percent between 1940 and 1975. See Figure 4. In 1951, mining's share of total Canadian employment was the same as it was in

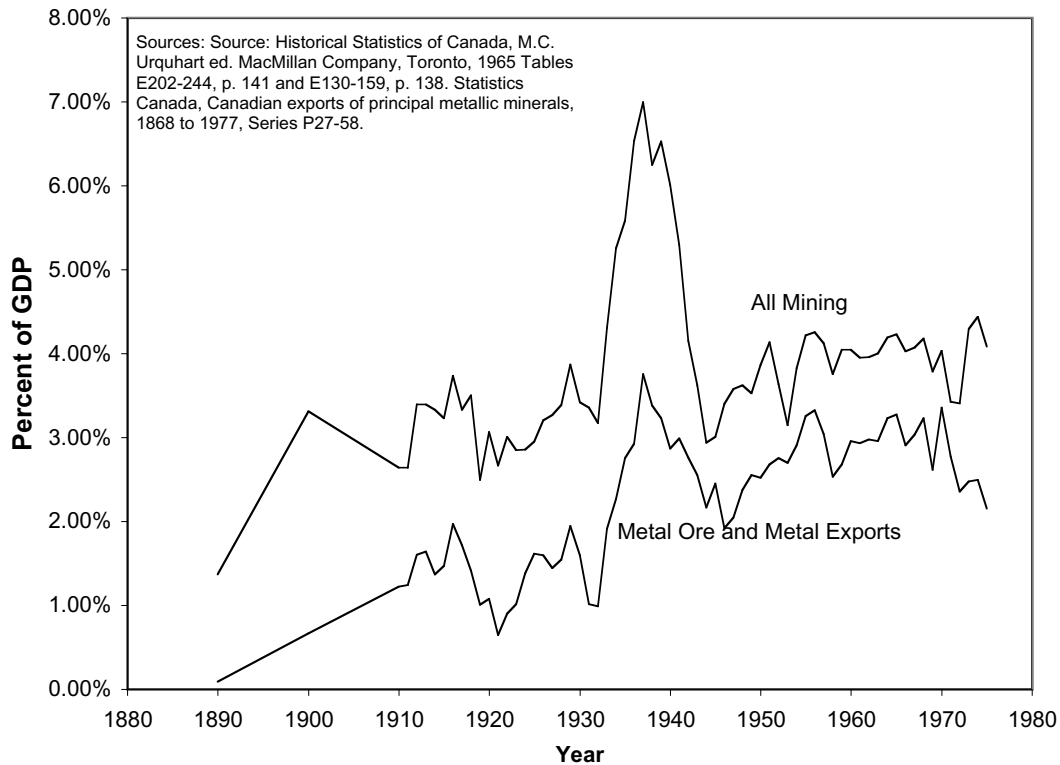
1901, 1.6 percent.¹⁶ Nor did mining dominate Canadian exports. Between 1890 and 1914 metal and metal ore exports averaged 5 percent of Canadian domestic exports or about 1 percent of the GDP. This rose to about 9 percent between 1918 and 1940, but that was only about 3 percent of the GDP. It was only in the post-war metal industry expansion, 1950-1970, that metal exports rose to about 17 percent of Canadian exports.¹⁷ Clearly, mining was not the Canadian economy's dominant sector in the late 19th and early 20th centuries when Canada was industrializing and establishing its pattern of sustained growth. The dynamic role mining played in the contemporary Canadian economy should not be taken as an indication of mining's role in the development of the Canadian economy during this earlier time.

Before the second half of the 20th century, Canada had no extensive or systematic exploration and development of mineral resources similar to that which had occurred in the U.S. between 1880 and 1920.¹⁸ As Canada developed its modern economy, mining played only a modest role. It was agriculture, especially wheat, and manufacturing focused on both domestic and U.S. markets, that led Canadian growth in the early 20th century. As one economic historian put it:

Canada rose to prominence in these prosperous years [1896-1913] as "the last best west." Increasing demands for her exports, particularly of grains, created a favorable atmosphere for domestic and outside capital. The demand for labor and for farmer settlers rose along with the demand for capital. Population and incomes expanded. Industrialization and urbanization further stimulated investment activity.¹⁹

Between 1896 and 1914, the expansion in Canadian exports was led by wheat, which

Figure 4: Canadian Mining Output and Metal Exports as a Percent of GDP



comprised about a third of the growth. Gold, other mining, and the processing associated with it represented only 14.5 percent.²⁰ Even while agricultural settlement and production were expanding rapidly during the early 20th century “wheat boom,” manufacturing production tripled and the percentage of the population living in urban areas rose from 32 to 45 percent.²¹ The sustained development of the Canadian economy was underway. But mining was not leading that expansion.

The “gold rushes” that occurred in Canada’s Yukon and British Columbia at the turn of the century did not significantly contribute to Canadian economic development. That type of mining development and the rest of the economy were not strongly linked. Because of gold’s very high value per unit weight, a significant expansion in the national transportation infrastructure was not required to support the expansion of gold mining. Pro-

duction at any particular location was short-lived, quickly moving from one region to another. This reduced the economic logic of investing in significant permanent facilities. The early gold mining did not require the manufacturing of specialized capital goods. The inputs required for gold mining were primarily subsistence goods for the miners since this early mining was very labor intensive. Because mining centers were constantly shifting, these subsistence goods tended to be produced externally and shipped in rather than being produced locally. The product, gold nuggets and dust, required little additional processing. One economic study of Canada’s economy explained the limited economic development impact of this early Canadian gold mining in the following terms: “Thus,...[gold mining] left [little] residue in the form of permanent settlement and a nucleus for a self-sustained economy.”²²

World War One gave a temporary stimulus to Canadian mining. Between 1913 and 1918, high prices stimulated significant expansions in copper (54 percent), nickel (84 percent), lead (36 percent), and the initiation of zinc production. The wartime prices collapsed with the end of the war, as did much of that production. In 1926, copper was the only mineral among Canada's ten leading export commodities. In 1956, five of the top ten exports were minerals, aluminum, nickel, copper, iron ore, and asbestos.²³ By 1956, of course, Canada was already a prosperous, advanced economy.

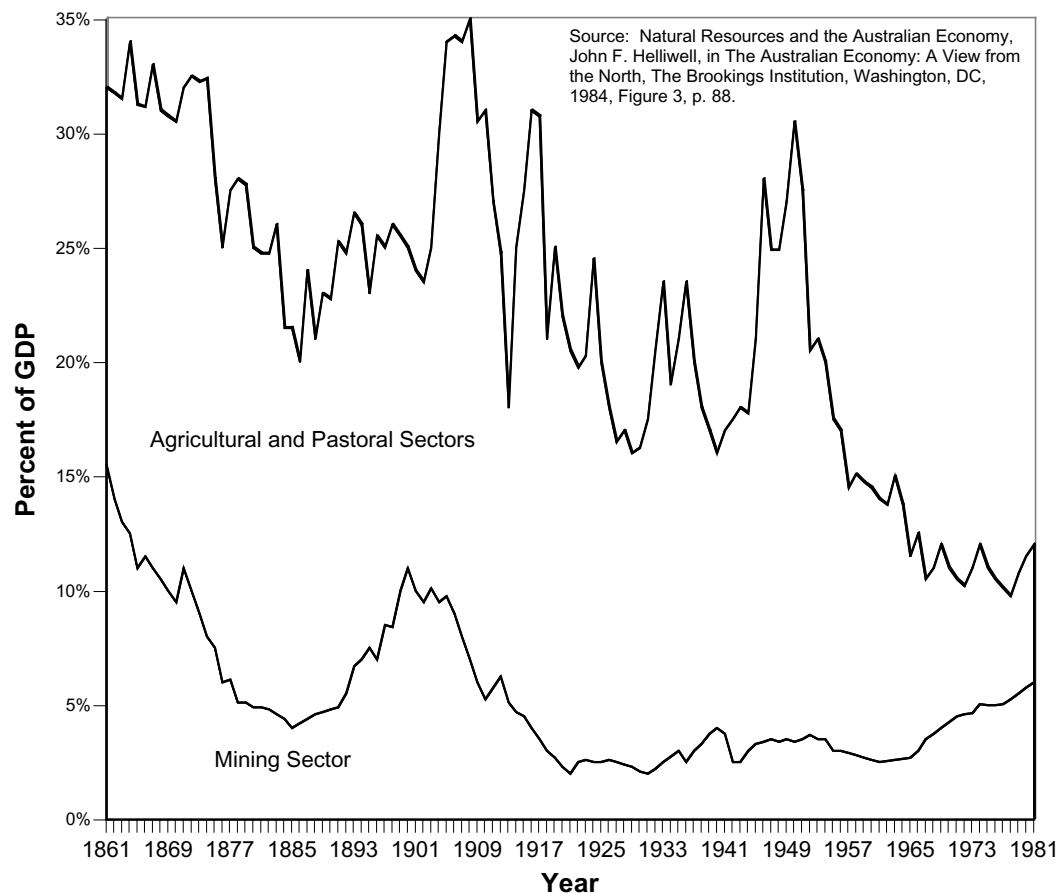
Even the current extensive mining activities in Canada should not be exaggerated in relative importance. At the end of the 20th century, metal and metal ore exports comprised only 1.4

percent of Canadian exports. Agricultural exports were five times as large and automotive exports almost twenty times as large.²⁴ Throughout the first three-quarters of the 20th century, metal ore and metal exports represented only about one-sixth or one-seventh of total exports.²⁵ Mine and oil production represented about 4.5 percent of the GDP between 1926 and 1945 and 3.9 percent between 1945 and 1975.²⁶ Clearly, mining did not dominate the Canadian economy either in its early or later industrialization.

Australia

Historically, mining has made a very irregular contribution to the Australian economy. Australia had two gold booms between their 1860 and 1905 peaks. Gold was the source of 16 per-

Figure 5: Mining and Agriculture as Percentages of Australian GD



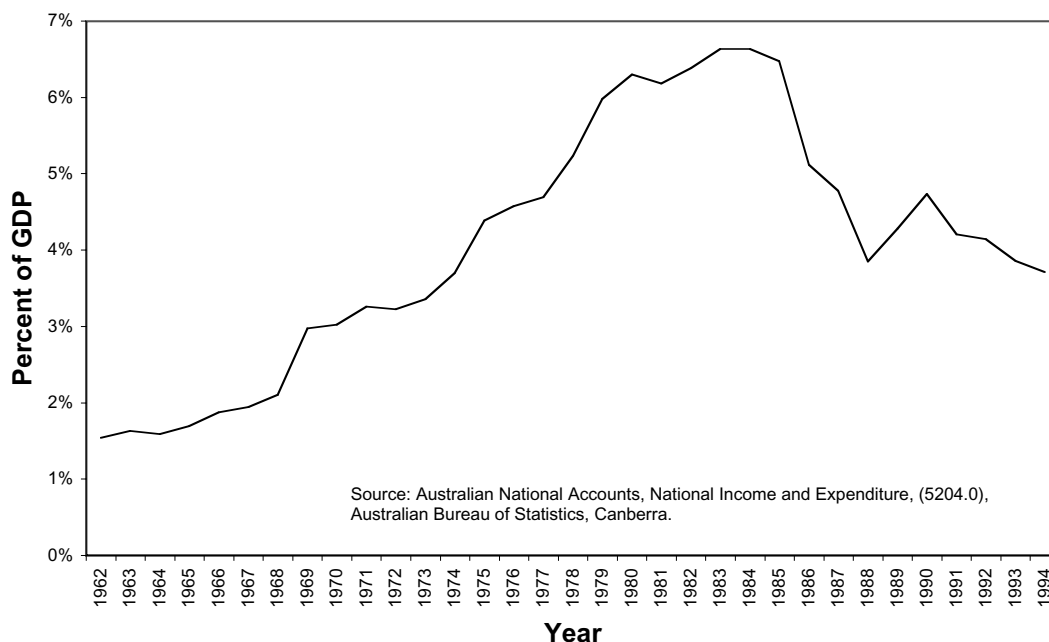
cent of GDP in 1861, but that contribution fell to less than 3 percent by 1890. At its peak, the second gold boom contributed only 8 percent to GDP. By 1930 gold was the source of less than 1 percent of GDP. Mining was the source of 4 percent or less of GDP between 1920 and 1960. (See Figure 5.) Beginning in the 1960s, petroleum, natural gas, iron, coal, and bauxite production expanded, starting Australia's third mining boom.²⁷ At the beginning of this period, mining's share of GDP was only 1.8 percent. With the new boom, mining peaked at 6.6 percent of GDP in 1984 but by the mid-1990s it had dropped back to less than 4 percent.²⁸ (See Figure 6.) But even at its earlier peak, mining was the source of just over one percent of employment.

Australia transformed into an affluent, developed nation able to sustain long-term economic growth primarily during the late 19th and first half of the 20th centuries. During this period, Australia's agricultural and pastoral sectors completely dominated the mining sectors in terms

of their contribution both to the GDP and to exports. (See Figure 5.) In addition, mining investment represented only a tiny part of total business investment (including agricultural investment) in almost all the years between 1861 and 1980.²⁹ As one Australian economic historian stated, after the second gold boom at the turn of the 20th century, "natural resource activities faded into insignificance for a half-century."³⁰ Despite mining's "faded" role, the Australian economy continued to develop, with GDP per capita rising at about the same rate and to the same levels as found in the United Kingdom and Canada through the first half of the 20th century. (See Figure 1.) Except for the two brief gold booms, mining was not a dominant part of Australia's economy during this developmental period. Australia's agricultural production and protected manufacturing were the core of its developing economy.³¹

The similarity of the development paths and growth in the GDP per capita in Australia and New Zealand during the last half of the 19th

Figure 6: Australian Mining Sector as Percentage of Total GDP



century and first half of the 20th century confirms the limited role that mining played in Australian development. New Zealand, after some early but modest gold discoveries between 1860 and 1880, developed its economy around wool and, with the advent of refrigerated shipping, meat and dairy products. Like Australia, it also developed a locally oriented manufacturing base that was protected by both high transportation costs and tariffs. Mining never played a major role in the New Zealand economy, yet for a century it developed parallel to the Australian economy.³²

In the second half of the 20th century, Australia's mineral sector did blossom into a diverse and dynamic set of industries. Its reach is now worldwide, providing leadership in mineral exploration, development and processing, as well as environmental control and remediation. But by the time this broad mining expansion occurred, Australia had long been on a path of sustained development and was one of the most affluent countries in the world.

Conclusion

Between the late 19th and early 20th centuries when the economies of the U.S., Canada, and Australia industrialized and set out on a path of sustained economic growth, mining and mining exports did not represent a dominant part of their overall economies. At most, mining represented a few percent of these nation's total production. This contrasts dramatically with the situation found in many contemporary developing nations where the natural resource component of exports represents 10 to 85 percent of the GDP.³³ In these three countries mining itself was not a primary engine driving their

economic development. However, as will be discussed in a later section, a complex set of business, governmental, educational, and research developments occurred around mining and mineral processing that did contribute to these countries' economic development. As with agriculture, manufacturing, and services, it was not so much **what** was produced as **how** it was produced that mattered from the perspective of stimulating sustained growth.

4. The Regional Impact of Mining within the United States

In considering what might be learned from the experiences of the U.S., Canada, and Australia, it is important to examine not just each country's national experience. Their local or regional experiences may be more important. These three nations, whose economic histories are often used to show the importance of mining to the establishment of a pattern of sustained economic growth, are continental-scale nations. Their huge geographic expanses increased the likelihood of diverse natural resources being available at numerous sites. When the nation as a whole is discussed, it is easy to ignore the regional character of mining development and the role of geographic scale in facilitating ongoing mineral development. For instance, the iron ores discovered in Minnesota did not lead to the development of an iron or steel industry near those deposits. The ore was carried hundreds of miles via a sophisticated water and land transportation system to Pennsylvania. Coal was also brought to these industrial iron and steel facilities. In smaller nations, this type of integrated development spread over a vast geographic area would not have been possible. Instead, iron ore extraction would have occurred in one country, coal extraction in another, and steel production in a third. Integrated industrial development around the iron mine would not have occurred within the country where the mine was located.

Copper mining, which expanded rapidly to support the electrification of the U.S. economy in the late 19th and early 20th centuries, had a similar complex geographic pattern. As production costs and limited capacity in the original copper fields in Michigan's Upper Peninsula became a problem, copper mining shifted to the continental divide in Montana, the copper towns in southern Arizona, the Silver City area

in the Gila River region of New Mexico, and the Wasatch Front in Utah. Similarly, precious metal mining hopped across the Western United States from one discovery to another. In discussing the economic development of the U.S. economy, one can skip over these geographic patterns and talk in the aggregate about **national** copper or gold production as if it proceeded in a smooth, regular manner. But within countries that lack a continental scale, the **regional** experiences of these very large countries would likely be a smaller country's national experience. Thus, it is important to examine more closely how mining affected the regional economies in the U.S., Canada, and Australia.

Local economic impacts of mining

The concept of the "ghost town" entered American parlance because of the short-term character of much of the mining development. A mineral discovery would trigger the influx of thousands of workers; a bustling town would develop around the mining activities; and then, as the deposit was depleted, the miners would leave for more promising deposits in another area. In a matter of a few years, towns of tens of thousands would shrink to a few hundred or be abandoned altogether.³⁴ This pattern of massive short-term regional impacts and then abandonment was common in Canada and Australia as well. In fact, this pattern **still** exists for many metal mining operations. Beginning in the 1980s, this is what led mining companies operating in Australia, for instance, to turn to "fly in, fly out" operations that seek to minimize the urban infrastructure that must be installed to support the mine site's workforce. In the early 1990s Australia had 40 such mining operations.³⁵ Similar mining operations occur in Alaska and have been proposed in Montana.



Even when mineral deposits are large enough to support mining operations for many decades, local economic impacts often are not entirely positive. Technological change has been more rapid in mining than in almost any other major industry. Many of these technological changes have systematically reduced the labor needs of mining operations.³⁶ As a result, even when mines have been able to maintain output levels or even increase production, employment levels have declined dramatically, leading to high unemployment rates and depressed local economies. In addition, the volatility of international commodity prices has often led to periodic shutdowns of mine operations when commodity prices are not high enough to cover the variable costs of operation. This instability in mining employment and income stresses the local economy. Finally, because of the high rents (profits) often associated with mining, ongoing struggles tend to occur between miners and mining companies over the sharing of those rents. This has led to often bitter and extended strikes and lockouts that also have taken their toll on local communities.

These patterns associated with mining operations help explain what otherwise appears to be an anomaly: Despite the wealth generated by mining and the relatively high wages paid to miners, many mining communities are anything but prosperous. In fact, in the United States, the historic mining regions have become synonymous with persistent poverty, not prosperity: Appalachia (coal), the Ozarks (lead), and the Four Corners (coal) areas are the most prominent.³⁷ Federal efforts have focused considerable

resources at overcoming the poverty and unemployment found in these historic mining districts. In addition, the Iron Range in Minnesota; the copper towns of Michigan, Montana, and Arizona; the Silver Valley of Idaho; the gold mining towns of Lead and Deadwood, South Dakota; and so on, are also not prosperous, vital communities. Over the last several decades some of these areas have begun to recover as a result of the in-migration of new, relatively footloose residents and economic activities, but that recovery is entirely non-mining based.

U.S. Mining-Dependent Counties

In order to explore the contemporary local impact of the reliance on mining in the United States, we studied the economic performance of all U.S. counties where mining (excluding oil and gas extraction) was the source of 20 percent or more of labor earnings between 1970 and 2000. About 100 such counties could be identified out of the 3,100 counties in the U.S.³⁸ Data disclosure problems prevented the identification of some mining-dependent counties.³⁹

The U.S. mining-dependent counties are spread out over 25, or half, of the U.S. states but are geographically clustered in the Appalachian (Pennsylvania, West Virginia, Tennessee, Kentucky, and Virginia) and Mountain West states. The century-old copper mines of Upper Michigan, Montana, Utah, Arizona, and New Mexico are included as are the new gold mines in Nevada. The older coal mines in southern regions of the Great Lakes states (Illinois, Indiana, and Ohio) are included as are the new open pit coal mines of Wyoming, Montana, Utah, Colorado, and New Mexico. The lead mines of the Ozarks in Missouri, the precious metal mines in the Black Hills of South Dakota and the Silver Valley of Idaho, and the iron fields of Minnesota are also included. In addition, other mining operations located in Florida, Alabama, Georgia, Maryland, and Oklahoma were the source of at least one county's dependence on mining.

**Table 1: Growth in Labor Earnings and Per Capita Income
Mining-Dependent and Other US Counties**

	Growth in Mining-Dependent Counties Relative to All Other Counties					
	Labor Earnings by Place of Residence			Per Capita Income		
	80-90	90-00	80-00	80-90	90-00	80-00
Mining- Dependent Counties in 1970s	0.41	0.75	0.49	0.71	0.97	0.77
Mining- Dependent Counties in 1980s	0.41	0.69	0.46	0.72	0.95	0.76

Source: REIS CD-ROM; author's calculations

The question we sought to answer was whether this degree of reliance on mining enabled these counties to outperform counties that did not rely heavily on mining. For counties that were dependent on mining in the 1970s, we looked at their economic performance in the following decades: 1980-1990, 1990-2000, and 1980-2000. For counties that were dependent on mining in the 1980s, we looked at their economic performance between 1990 and 2000. Economic performance was measured in terms of the growth in the aggregate labor earnings of county residents, per capita income, and population. The level of per capita income at the beginning and end of the periods was also analyzed.

The 1980s were not a good decade for mining-dependent counties. Aggregate labor earnings grew much more slowly than in other counties, almost 60 percent slower. During the 1990s, earnings were still growing 25 to 30 percent slower in mining-dependent counties. For the whole period 1980-2000, aggregate earnings in mining-dependent counties grew at only half the rate of other U.S. counties.

Per capita income also grew about 30 percent less during the 1980s in mining-dependent

counties. During the 1990s, per capita income grew at about the same rate as the rest of the nation, but for the whole period, 1980-2000, per capita income grew about 25 percent slower. The **level** of per capita income was also lower in the mining-dependent counties and, given that slower growth, the gap increased relative to the rest of the nation. In 2000, the income available to support each person in a mining-dependent county was about \$9,500 per year below what was available, on average, in other counties.⁴⁰

Given this poor economic performance in U.S. mining-dependent counties, it is not surprising to find that population growth in these counties was negative during the 1980s and significantly slower than the rest of the nation in the 1990s. Between 1980 and 2000, population growth in mining-dependent counties was only one-fourth to one-eighth of the average in the other U.S. counties.

Clearly, over the last several decades, dependence on mining did not enable U.S. communities to perform better than other U.S. communities. In fact, mining-dependent communities lagged significantly behind the average for the rest of the nation. See Tables 1 and 2.

**Table 2: Population Growth and Level of Per Capita Income
Mining-Dependent and Other US Counties**

	Population Growth			Level of Per Capita Income		
	80-90	90-00	80-00	1980	1990	2000
Non-Mine-Dependent Counties	4.5%	11.2%	18.1%	\$10,201	\$19,622	\$29,548
1970s Mine-Dependent	-3.0%	6.8%	4.6%	\$8,362	\$13,595	\$19,893
1980s Mine-Dependent	-3.8%	5.5%	2.2%	\$8,390	\$13,754	\$20,099
Difference: 1970 Mine-Dependent and Other Counties	-7.6%	-4.4%	-13.5%	\$(1,839)	\$(6,027)	\$(9,655)
Difference: 1980 Mine-Dependent and Other Counties	-8.3%	-5.6%	-15.8%	\$(1,813)	\$(5,874)	\$(9,457)

Source: REIS CD-ROM; author's calculations

These are not new results. U.S. Department of Agriculture analyses of mining-dependent counties have also indicated the slower economic growth and lower per capita incomes.⁴¹

Unemployment is also higher in mining-dependent counties in the U.S. For instance, unemployment rates in coal mining counties⁴² are significantly above the state's average unemployment rate. Averaged over 1990-2000 and across all coal-mining counties, the unemployment rate in those counties was 55 percent above the state average. For some states, such as Arizona and Virginia, the coal county unemployment rates are two to three times higher than the state unemployment rates. (See the following table.) Given the ongoing job losses in most coal mining counties due largely to labor-displacing technological changes, these high unemployment rates might be expected. During the 1980s, for instance, the layoff rate in the mining industry was the highest of all the major industrial groups in the U.S., and the rate of job displacement in coal mining was much higher than in mining as a whole.⁴³

It is not, however, just the job losses in coal mining that explain these high unemployment rates. Equally important in a quantitative sense is simply the relative importance of coal mining as a source of employment in these counties.⁴⁴ Even when large recent layoffs of coal miners have not occurred, the unemployment rate in coal mining counties is higher than elsewhere. Economists have studied this phenomenon for many years including analyses of the coal mining regions in West Virginia.⁴⁵

The primary explanation for high unemployment being associated with U.S. mining counties — even when there have not been

layoffs — is that the high wages paid in mining draw workers who hope to obtain one of these very high-paying jobs. In addition, miners who are laid off do not leave the area in search of other employment, because it is unlikely that they will be able to find a job that pays as well. As a result, they too remain in the area hoping to be rehired. The outcome is a local labor supply that is persistently in excess of the local labor demand. Workers are willing to accept lengthy periods of unemployment in order to increase the likelihood that they will be able to obtain one of these premium jobs. The normal adjustment to job loss and high unemployment rates, accepting alternative jobs and/or out-migration to regions where labor supply and demand are more in balance, is thus delayed and dampened. In this setting, high unemployment rates continue indefinitely even when there are no additional layoffs.⁴⁶

The important point from an economic development perspective is that whatever impact mining has on national economic development, in the U.S. these mining activities have not triggered sustained growth and development in the local regions where the mining occurred. Closure of the mines often led to ghost towns and abandonment of the region. Where mining persisted over longer periods, it did not trigger a diversification of the economy. Instead, as labor-saving technologies reduced employment opportunities, the region around the mines became distressed with high unemployment and poverty rates. This was not just a historical problem associated with 19th century mineral developments on the U.S. frontier. Contemporary U.S. counties that depend on mining continue to lag behind the national economy.

Table 3: Ratio of the Unemployment Rates in Coal Counties to the Statewide Average Unemployment Rate, 1990-2000

AL	AZ	CO	IL	IN	KY	MT	NM	ND	OH	PA	TX	UT	VA	WV	WY	All Coal Ctny
1.05	2.64	1.31	1.50	1.38	1.64	1.76	1.38	1.82	1.75	1.44	1.23	1.73	2.95	1.27	1.02	1.55

Source: US Department of Labor; coal counties identified by the author. Source: Author's calculations. See footnote.

A recent review of the literature dealing with the economic characteristics of mining-dependent rural communities in the U.S. reinforces these results.⁴⁷ Of the 301 quantitative economic findings in scholarly studies about how mining-dependent communities fared relative to other communities, almost two negative impacts were reported for every positive finding (1.87:1). The economic measure in which mining-dependent communities were most likely to have an advantage over other communities was average income. Still, less than half of the income results were positive for mining-dependent communities, while 34 percent were negative, and that difference was not statistically significant. When unemployment and poverty rates were used to judge the economic performance of mining-dependent communities, the results were overwhelmingly negative. The unemployment rate was higher in 59 percent of the findings and lower in only 16 percent, a four-to-one ratio of negative to positive results. In terms of poverty rates, the negative results were twice as common at the positive results. Both the unemployment and poverty differences between mining and other communities were statistically significant. The long-term results are actually even more negative than this. The short-term experience associated with energy development in the Western United States in the 1970s biases the results towards the positive side, even though after 1982 those Western mining-dependent communities also experienced negative impacts. If these relatively brief positive results associated with the 1970s Western energy boom are excluded, the negative impacts of mining outweigh the positive results by almost three to one: 60 percent negative, 20 percent positive; the other results were neutral or inconclusive. Clearly, the claim that dependence on mining has had a reliable positive impact on contemporary U.S. non-metropolitan communities can be rejected. For unemployment and poverty rates, the negative

“mining curse” hypothesis appears to be supported within the United States.

This contemporary regional experience with mining within one of the world’s most advanced nations provides an important warning to developing nations that mining brings with it serious economic problems. In larger developing nations it can lead to increased regional inequality, unemployment, and poverty. In smaller nations, the impact nationwide of dependence on mining may be the same.

5. The Relevance of the U.S., Canadian, and Australian Historical Mining Experience to Contemporary Developing Nations

Mining **did** play a role in the economic development of the U.S., Canada, and Australia. However, the relationship between mining and economic development differs significantly from that claimed in the folklore-like “reasoning by historical analogy.” Just as important, it is not clear that the **historical** experience of these countries is applicable to **contemporary developing** nations because of changes in the character of the world economy.

Contemporary economic historians have documented the close relationship between mineral industry development in the United States and the nation’s rise to industrial pre-eminence. But mineral abundance in the U.S. — that is, the presence of an unusual abundance of rich, cheaply accessible mineral deposits — did not lead to its industrial development. Rather, the early development of the U.S. economy gave the U.S. the institutions, organization, and markets that enabled it to **create** mineral wealth despite the fact that its geological endowments were not particularly superior to what was available elsewhere in the world. That is, the U.S.’s early successes at social, political, and economic development allowed it to transform relatively low grade and inaccessible ores into economically viable mines in a way that supported its ongoing economic development.⁴⁸ Very particular initial conditions impacted the

way in which mineral development proceeded in the U.S., Canada, and Australia. The economic development that occurred was very much “path dependent.” Because of that, we must be very cautious about drawing lessons from these historical experiences for contemporary developing countries. The next sections discuss a variety of these relatively unique initial conditions that created the potential for mineral development to contribute significantly to national economic development in the U.S., Canada, and Australia.

High Levels of Institutional Capital

All three countries had a stable tradition of the rule of law. Legal institutions were well developed and stable. Democratic institutions provided a means of politically adjusting to changed circumstances. Stable financial institutions were in place that enabled capital to be accumulated and used productively. The cultural values shared by the population supported trust, entrepreneurial attitudes, acquisitiveness, and respect for private property and markets. Incentive systems encouraged the development of economic opportunities and new technologies. Mechanisms were developed to provide the general citizenry access to land and natural resources. This encouraged a more equalitarian distribution of income and lower levels of social and political conflict.⁴⁹ These institutional arrangements assured that the potentially large economic rents associated with mineral development did not lead primarily to conflict, corruption, and waste.⁵⁰



The Zortman and Lundusky goldmines in Montana. The mine, whose owner Pegas Gold went bankrupt in 1998, has destroyed Spirit Mountain, a cite sacred to local Native American groups. (Mineral Policy Center)

Large, Continental Nations with Diverse Natural Resources

As mentioned earlier, all three nations were continental in breadth with an incredible geographical, climatic, and geological diversity. In each case, it was not a single important mineral development that occurred, but a whole string of mineral developments that stretched across the continent and a century or more through time.⁵¹ Where there was only one major find in a local area, it usually lead to a boom and bust that had little lasting impact on the local economy. Mineral deposits tended to be over-exploited at particular sites as mining companies sought to exploit the resource before others did.⁵² While this was destabilizing and ultimately led to economic depression at the site of the mine, the ability of the mineral industry to shift its operations within these very large nations allowed mining to continue to contribute to **national** development despite the negative **local** impacts. The variety of resources and sites assured long-run sources of supply from an aggregate national perspective despite the depletion of particular local sources of supply.

The Development of Knowledge, Technology, and Business Organization

The continental scope of the mining opportunities, and the potential for ongoing development at multiple sites over a long period of time, also provided the rationale for a substantial investment in infrastructure, knowledge, and technology. Contemporary economic historians emphasize the role played by technological developments in turning what were relatively low-grade ores located at difficult sites into profitable deposits. The national governments of the U.S., Australia, and Canada assisted mineral development through national geological surveys that provided public information on mineral potential. Cooperative arrangements between mining companies and these nations' leading universities led to the development of mining engineering, mineral processing, and geology programs that enhanced exploration, development, and processing. From the very beginning of the U.S. industrial period, and at later periods in Australia and Canada, mining was a "knowledge" industry that was at the forefront of developing science and engineering. In

addition, because of the need to mobilize large quantities of capital and integrate mining, concentrating, refining, and other manufacturing operations, mining provided impetus for the development of new, complex forms of business organization.⁵³ Because these nations were already high-income, developed nations they were able to follow this early “high tech” path rather than rely on other nation’s technology and expertise to develop their resources.

Protected National Markets

Until the middle of the 20th century, high transportation costs provided an economic rationale and natural protection to manufacturing complexes that developed around mineral deposits. Because transporting mineral ores was often prohibitively expensive, ores were not just mined but also concentrated and refined at the mining site. In addition, the metal product was often processed into various manufactured goods such as wire or rolled metal products. National tariffs often also added to the protection provided to these mineral-related manufacturing activities. Consequently, mineral development was linked to a variety of manufacturing activities, extending its impact to the overall economy. Rather than displacing local manufacturing because of competition for resources (“Dutch Disease”), mining stimulated manufacturing expansion in these three countries. This was facilitated by the influx of both capital resources and labor resources through relatively open foreign investment and immigration policies for those of European heritage.⁵⁴

Large Internal National Markets

The role of mining in national economic development often focuses on mining’s contribution to exports. But in the United States and, to a lesser extent, in both Canada and Australia, a large national market (and for Canada, a large

neighboring foreign market) was even more important. The development of a national transportation infrastructure, combined with the natural geographic isolation associated with being continental nations, created large national markets to which indigenous mineral companies had privileged access. Earlier periods of economic development and technological advance in agriculture and urban manufacturing had given all three nations very high incomes, further enhancing the size of their internal markets. This enabled mining and related manufacturing to exploit economies of scale, raising productivity still further.⁵⁵

Labor-Scarce, Land- and Resource-Rich Nations

The initial interaction between Europeans and indigenous peoples in these three countries led to catastrophic declines in the indigenous populations. The much reduced indigenous populations were then dispossessed of their homelands and the resources associated with those lands. The new settlers thus took control of a huge landmass but had a very small population to develop it. The U.S., Canada, and Australia historically were labor-scarce, land- and resource-rich nations. The development path that was followed, as economic logic would suggest, emphasized high resource-intensity and high capital-intensity production methods that focused on labor-saving techniques. This resulted in high labor productivity and high wages, and represented a relatively unusual national endowment of resources tied to the particular histories of these three nations. U.S. production techniques and products continue to be energy, capital, and natural resource intensive.⁵⁶

Given the initial conditions under which the U.S., Canada, and Australia developed their mineral resources, and the development paths that these initial conditions guided them to, can

contemporary developing nations follow the same paths with the same results? Those who “reason by historical analogy” make this assumption. But many contemporary economic historians who believe that mining played a central role in the development of the U.S., Canadian, and Australian economies doubt that these three nations’ experiences can be easily replicated in today’s developing nations.⁵⁷

Contemporary developing countries trying to replicate the U.S., Canadian, and Australian developmental experiences with mining, are likely to be frustrated because their contemporary circumstances do not closely match the relatively unique attributes of these three nations’ histories. Among the key differences are the following:

- a. In many ways, the U.S., Canada, and Australia were high-income, advanced nations with stable political and economic institutions when they started to develop their mineral resources. It was **because** of this economic and institutional status **before** the broad development of mining that mining could contribute to their economic development the way it did. Contemporary developing countries by definition are not high-income nations. They are also still struggling to establish the political, economic, and social institutions that would support any sort of sustained economic development. Finally, they are unlikely to be the centers of mineral knowledge and technology development as were the U.S., Canada, and Australia.⁵⁸
- b. Since the middle of the 20th century, dramatic reductions in transportation costs have eliminated the protection that manufacturing development tied to mining had at the turn of the 20th century. Copper ores mined in Montana can and are shipped to Europe to be smelted. Japan and Korea have developed world-class steel industries built around importing both the iron ore and the fuel to process it into steel. These low transportation costs have undermined the type of economic links that existed in the U.S., Canada, and Australia between mining and related manufacturing early in their mineral development. Low transportation costs have enabled manufacturing itself to “disintegrate” in the sense of being broken into various steps that occur at different locations around the world.⁵⁹ The high skill and high wage aspects can thus remain centered in developed nations while the low wage aspects are located in developing nations.
- c. The same low transportation costs, and disintegration of the mineral and mineral processing industries, have put all mines worldwide in direct competition with each other. This has put downward pressure on mineral prices and assured ongoing price instability, which reduces the likelihood that mining can provide a stable basis for economic development. It also exposes developing countries that rely on mining to external price shocks that can be disruptive and debilitating.⁶⁰
- d. Partially because of the reduction in transportation costs, business activity has become increasingly “globalized” in the sense that large transnational companies operate worldwide. This is especially true in mining. Ongoing consolidation has occurred through mergers of mining and mineral processing companies into ever-larger transnational corporations. For instance, Chile’s largest copper mine, La Escondida, was discovered and is run by BHP, the Australian mining conglomerate. Canadian and U.S. companies (when they can be identi-

fied as such) play similar roles around the world. These transnational companies provide the exploration, development, and processing knowledge and technology to exploit developing countries' minerals. This knowledge and technology is no longer developed indigenously. This too removes a whole set of crucial economic linkages that were important in the historical developmental role that mining played in the U.S., Canada, and Australia. The "knowledge industry" aspect of mining can now remain an export from the world's developed nations. There is little "learning by doing" for citizens and businesses of developing nations as transnational corporations develop these nation's mineral resources.⁶¹

- e. Many developing countries are small geographically compared to the continental nations that are held up to them as models for how mining can support sustained economic development. A much smaller geographic area likely has a more restricted set of mineral potentials and mineral sites. The smaller developing countries thus likely have to depend on far fewer mineral opportunities. Rather than having the "smoothed out" aggregate experience of a large nation like the U.S., small developing nations will instead experience the disruptive and ultimately impoverishing local booms and busts that were part of the historical, and are still a part of the contemporary U.S., Canadian, and Australian, experience. It is difficult, as the local experiences of communities in these countries prove, to build sustained development in the face of such ongoing economic shocks.
- f. Unlike the U.S., Canadian, and Australian economies in the late 19th century, most developing countries are **not** labor-poor and

land- and resource-rich with ready access to international capital flows. They tend to be the opposite: They have large and growing populations that put considerable pressure on their land bases; their political and economic instability often confronts foreign investors with unacceptable levels of risk. Given these dramatically different relative resource endowments, basic economics would suggest that trying to mimic the experience of nations that began with fundamentally different initial resource conditions would be a mistake. In particular, modern mining and mineral processing is very capital and energy intensive, and uses very little labor. These sectors will thus offer very little employment to the primary resource that most developing nations have in abundance, their workforce. Mining is also likely to exacerbate the degree of inequality in the distribution of income, adding to the likelihood of social conflict and potentially retarding more broad-based economic development.⁶²

For these reasons, the U.S., Canadian, and Australian developmental experiences with mining do **not** provide relevant models that support contemporary developing countries' reliance on mineral development for their own economic development.

6. The Actual Experience of Contemporary Developing Countries with Mining

The reliability of mining as a basis for sustained economic growth in contemporary developing countries needs no speculation. One can simply study the actual experiences of these countries to see whether specialization in mineral development has supported sustained economic development over the last 30 or 40 years. Many empirical researchers have done exactly that. Their results confirm the concerns expressed previously: Over the last several decades, the more a developing country depends on mineral development, the slower its rate of growth in per capita income. In general, reliance on mineral development has **not** been consistent with sustained economic development.

Harvard economists Jeffrey Sachs and Andrew Warner documented the relatively poor performance of developing nations that had a high ratio of natural resources in their exports relative to the total GDP. Studying 95 countries between 1970 and 1990, they found that the higher the dependence on natural resource exports, the slower the growth rate in GDP per capita. Considerable econometric testing for different definitions and measures of dependence on natural resource exports, and the inclusion of various variables to account for the level of development, the character of institutions, regional location, and so on, showed these negative results to be highly robust.⁶³ In a 1999 study, they also looked closely at Latin American countries to see whether natural resource booms there had provided a “big push” to sustained development. None of the countries that

had experienced such a natural resource boom had a growth rate after the boom greater than before it; for some, the growth rate was negative after the boom.⁶⁴ More recently, Sachs and Warner tested the possibility that this negative relationship between dependence on mining exports and national economic growth was due to some unmeasured characteristic other than mining dependence that had retarded economic development and kept countries with that characteristic from “naturally” diversifying away from mining dependence as they developed. They again showed that even allowing for that possibility, “the curse of natural resources” remains: The heavier the reliance on natural resources in exports, the slower the rate of growth in GDP per capita.⁶⁵

Economic geographer Richard M. Auty of Britain’s Lancaster University analyzed 85 countries between 1960 and 1993 to see whether natural resource abundance contributed to economic development. As part of his analysis he separated the smaller nations that he assumed would be less economically diversified and, among these, the nations that relied on solid minerals as opposed to oil and gas. He found that the small, solid mineral countries actually had negative growth between 1970-1993 (-0.2 percent per year). As a result, they went from having a per capita GDP that was well above those in small, non-mineral countries to well below them. He found that the mineral-driven resource-rich countries were among the poorest economic performers.⁶⁶

World Bank economist and research director Alan Gelb also compared hard-mineral exporters, oil exporters, and other middle

income and poor countries for two periods, 1960-1971 and 1971-1983. He found that the solid mineral countries did the worst in terms of growth and return on investment after the terms of trade deteriorated in the second period. Even in the first period, the solid mineral countries fared no better in terms of growth than the middle-income countries that had not specialized in natural resources.⁶⁷

University of California at Berkeley economist Jean-Philippe Stijns confirmed Sachs' and Warner's results that nations that depended on natural resource exports performed more poorly over the last several decades than other nations. He also showed that if instead of focusing on natural resource **exports** but on natural resource **production** or natural resource endowment within the nation, the negative relationship disappears. Stijns did not, however, find a positive relationship between dependence on natural resource production and economic growth. He concluded that natural resources and natural resource production have no significant relationship to national growth rates. However, if nations primarily export their natural resources, rather than use them internally to support their citizens and manufacturing, there is a significant negative impact on growth.⁶⁸

A World Bank and International Finance Corporation analysis of 51 solid mineral-dependent countries produced mixed results for economic growth in the 1990s. When India and China, which do not engage in significant international trade in solid minerals but have high levels of solid mineral production for internal use, were included, this study found that countries relying on solid mineral production performed better than other countries in their region. However, when compared to all other developing countries rather than just those in their region, the solid mineral countries had

slower growth. When India and China were not included in the sample, mineral activity was not linked to superior economic performance. When the measure of dependence was on the percentage of solid minerals in exports, there was a negative impact on the growth in real GDP per person. In fact, the solid mineral countries had negative growth rates. This report concluded that mineral activity was neither necessary nor sufficient for sustained economic growth.⁶⁹

Others have tried to explain this poor performance of natural resource-rich nations in recent decades. Auty focused on the poor investments in human capital and poor development of appropriate and stable institutions in natural resource-rich countries. He also pointed to the environmental damage caused by mining.⁷⁰ Birdsall *et al.* have shown that resource-abundant nations tend to invest less in education.⁷¹ Gylfason and Zoega found that a strong focus on the development of a nation's natural resources (natural capital) tended to "crowd out" investments in physical and human capital.⁷² The World Bank analysis summarized previously also found that the worst performing solid mineral countries were plagued by poorly developed political and social institutions, poor economic management, and under-investment in human capital and public infrastructure.⁷³

Some have criticized these empirical studies for focusing on the last several decades rather than the entire 20th century. However, as discussed previously, the world economy and the economic context in which developing countries' mining ventures have to operate have changed dramatically in the second half of the 20th century. It is not at all clear that going back 50 or 100 years in order to find success stories provides reliable information for developing countries in the early 21st century.

It is certainly true that a few developing countries that emphasized mineral development managed to enjoy extended periods of economic growth. The statistical analysis demonstrates the rule, but there are always exceptions to that rule. Chile and South Africa have relied on mineral development for over a century and have had significant periods of economic growth.

Chile began its economic development by focusing on nitrate production between 1880 and 1919. It enjoyed a near monopoly in nitrate production and was able to use the revenues from that sector to finance both infrastructure and manufacturing. Chile's copper industry also boomed in the late 19th century but then lagged as ore quality deteriorated. The transfer of U.S. technology, expertise, and corporate organization through investments by Guggenheim and Anaconda revitalized Chile's copper industry and set it on the road to being a world leader after 1920.⁷⁴ Chile's economic development slowed and then stalled in the middle of the 20th century. More recently, especially in the 1990s, it has revived, continuing with a significant emphasis on mineral development. During the 1990s, Chile led all other Latin American economies in its rate of economic growth. The explanation for this growth, however, is not its mining sector. As one World Bank publication stated,

While over the past decade revenues generated from mining have helped strengthen economic growth, the overall economic performance cannot be understood other than in the light of the overall quality of institutions and economic management.⁷⁵

Whether this growth will be sustained is certainly open to some doubt given the fits and starts in Chile's past economic performance and its long periods of very slow growth.

South Africa began producing gold in 1867 and diamonds in 1886. These mineral developments drew massive flows of capital and labor from abroad and led to rapid expansions in production and exports. A "European" economy was constructed primarily around those resource flows and the confiscation of the lands and resources of the indigenous population. This economy sought to consciously exclude the indigenous population from most of the benefits of economic development so that, for instance, wages for blacks in gold mining were no higher in 1971 than in 1911.⁷⁶ South Africa's experience is relatively unique given the domination of the majority of the population by the minority of European immigrants and their apartheid policies for most of the 20th century. Two neighboring countries, Botswana and Namibia, however, in the late 20th century managed significant economic growth despite heavy reliance on mining. This contrasts with the dismal performance of most African mineral economies. Commenting on this unusually positive performance in Sub-Saharan Africa, a World Bank review of developing countries' experience with mining commented:

....[D]epending on the quality of a country's economic management and the competence of its institutions, mineral-rich countries can either fare spectacularly well or fail in similarly spectacular ways.⁷⁷

For most mining-dependent developing countries, it has been primarily a spectacular failure. What is clear is that mining by itself cannot trigger and sustain economic development.

7. Conclusions

From this study, we draw the following conclusions about the relevance of the historical experience of the U.S., Canada, and Australia for contemporary developing nations:

- A. Mining advocates have seriously exaggerated the role of mining in these three countries' economic development. Mining played a very modest role as they industrialized and established a sustained pattern of economic development. Only a small percentage of national economic output was associated with mining. In a developmental context, mining was just part of a complex pattern of institutional, technological, and corporate development that characterized not only mining but also agriculture, manufacturing, retail trade, and services.
- B. "Reasoning by historical analogy" with developed nations seriously exaggerates the claimed positive economic benefits of mining for several reasons:
 - i. The non-economic prerequisites for sustained economic growth tend to get ignored in favor of a crude mechanistic model of economic development.
 - ii. The role of a single economic activity (mining) in a particular sector (exports) tends to get exaggerated in size and importance.
 - iii. The particular initial conditions, and the character of the historic path actually followed by a particular country, tend to get ignored.
 - iv. Changes in the world economy, and in the character of technology and business organization since those earlier historical periods, tend to be ignored.
- C. The process of economic development is very complex and extends far beyond commercial market exchange and financial and business relationships. It includes the development of political and social institutions, cultural values, public infrastructure, and human capital, as well as the effective protection of the environment. Large investments in a single project (*e.g.* a mine) in a particular sector of the economy (*e.g.* exports), by themselves, will rarely have major sustained developmental impacts.
- D. The U.S., Canada, and Australia were already high-income advanced economies when they began the industrial development of their mineral resources in the late 19th and early 20th centuries. Mineral development was thus knowledge, technology, and business organization intensive. Contemporary developing nations lack these conditions.
- E. The decline in transportation costs since the middle of the 20th century has dramatically changed the likelihood that mining can be the basis for sustained economic development in developing countries. This is true for several reasons:
 - i. Distance and isolation no longer protect the manufacturing that might otherwise develop around mining projects. Local manufacturing will not be linked to mining.
 - ii. Low transportation costs have led to the "dis-integration" of the mineral industry and other manufacturing. Ores, fuels, and unfinished manufactured goods can be shipped around the world cost-effectively for processing and finishing. This has destroyed the links between mining and other sectors of the local economy that often existed historically and supported extensive economic development.

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- iii. Isolation no longer provides local protection for high mineral prices. Worldwide competition among producers now puts downward pressure on mineral prices and contributes to considerable volatility in mineral prices. This can lead to price shocks that disrupt economic development.
- F. The development of large transnational mineral companies has globalized mining knowledge, technology, and management. Indigenous learning-by-doing, the development of local mineral expertise, and technological and knowledge spillovers into the rest of the economy are no longer a necessary outcome of particular mining developments.
- G. The U.S., Canada, and Australia are continental nations with vast geographic expanses. This enabled them to have a more stable aggregate national experience with mining than most developing nations can now expect for several reasons:
- i. These large nations had many diverse mineral sites that enabled mineral development to shift geographically and continue over time even as individual deposits became uneconomic and were abandoned.
 - ii. The boom and bust and/or secular decline that was experienced at any particular local mining site was offset in the national aggregate by the development of new mining sites at different locations. The local economic damage was digested and offset within the larger national economy.
 - iii. A very diverse set of mineral activities was able to develop. These large nations did not become dependent upon just one or a few minerals.
- H. The **local** economic impacts of mining development within the U.S., Canada, and Australia were not usually positive. Persistent poverty or ghost towns often followed the local decline in mining. Local sustained economic development built around mining, in general, did **not** result from the mining. Over the last several decades, local communities dependent on mining in these developed countries continue to lag their national and other regional economies.
- I. Within contemporary developing nations, reliance on mining has not had a positive impact on growth in per capita GDP over the last several decades. Mining has not helped them escape from poverty. The more heavily a developing nation has relied on mining, the poorer its economic performance has been.
- J. Mining investments in developing countries cannot by themselves stimulate sustained economic development. Instead it can increase social conflict, expand governmental and business corruption, and displace investments in human capital.
- K. Mining itself is not destructive or antithetical to economic development. But when mineral development occurs in a context of under-developed social, political, and economic institutions, the high rents associated with it lead the non-renewable resource wealth to be squandered while increasing social conflict and causing nearly permanent environmental damage. This can leave a developing nation permanently poorer.

8. Recommendations

The actual mining experiences of the U.S., Canada, and Australia teach very different lessons than the informal folk histories that uncritically present mining as a powerful and reliable engine for sustained economic development. An accurate interpretation of these three countries' mining experience suggests a number of conditions that should be met before International Financial Institutions (IFIs) support mining projects in developing countries.

- A. IFIs should support mining only in countries with effective democratic institutions. Although this is no guarantee of effective management of mining for poverty elimination, countries with democratic governments are more likely to use their mineral wealth for productive purposes.
- B. IFIs should only support mining projects in which host countries have agreed to independent monitoring of social and environmental impacts. Existing safeguard policies have often been ignored in IFI-supported projects and independent professional monitoring has often been non-existent. Without social and environmental guarantees, the health and development potential of local communities are likely to be undermined.
- C. Support for mining should be offered only in countries that have a clearly defined plan for the use of the resulting revenues for the elimination of poverty, including promotion of education, public health, and infrastructure investments that will benefit the

poor. IFIs should require mining companies to disclose complete information about payments made to host country governments. Host country governments should transparently account for all expenditures of mineral revenues.

- D. IFIs should require firms to provide benefits to local workers, including education and training, that will allow them to fill positions within the mining operation at all levels of skill and managerial responsibility. A mining project plan should involve skill, knowledge, and technology transfer to the developing country so that there is a significant “learning by doing” component across the spectrum of skills.

The recommendations above speak to **new** IFI support for mining. However, many developing countries are already highly dependent on mining and have suffered significantly in terms of retarded economic development. IFI support needs to be modified to assist these countries in breaking the “natural resource curse” that has thus far contributed to their underdevelopment. To accomplish this, diversification of their economies away from primary reliance on the export of unprocessed minerals is required. The following policies that are also supported by the actual historical experiences with mining of the US, Canada, and Australia could assist this process.

- A. IFI investments in mining-dependent countries should be focused on economic activities that assist in the development of human and institutional capital. Those investments



Aerial of the slurry pumping station at the Peabody Coal Mine at Black Mesa in Arizona.

should be consistent with the development of local entrepreneurial businesses, broad ranging economic opportunity, civic institutions, a more equal distribution of income, and democratic decision-making. Those investments should assist in fully developing and using the developing countries primary resource, their workforce, and the protection of the nation's environment.

- B. Current debt repayment policies by IFIs often contribute to developing countries' single-minded focus on mineral exports. IFIs have often conditioned their loans to mining-dependent developing countries on the expansion of mineral exports. This has proved to be a self-defeating strategy that has slowed growth and development. The IFIs must modify both the size and structure of the debt and encourage the diversification of these economies away from mining dependence.
- C. The actual experience of the US, Canada, and Australia involved significant links between mining and mineral processing

and related manufacturing. The IFIs should support sustainable value added mineral-based manufacturing in mining-dependent countries.

- D. Diversification is likely to be viable in developing countries only if developed economies reduce or eliminate the tariff and non-tariff barriers that discriminate against developing countries manufactured goods. IFIs can play a role in moving the OECD nations in this direction.

Endnotes

- ¹ In this paper, “mining” refers to the extraction of solid minerals from the earth, e.g. coal, metal ores, and other solid minerals. In the industrial classifications of some nations, oil and gas extraction are also treated as part of “mining.” In this paper, oil and gas extraction are **not** included in “mining.”
- ² **From Natural Resources to the Knowledge Economy.** 2002. David de Ferranti, Guillermo E. Perry, Daniel Lederman, and William F. Maloney. The World Bank, Washington, D.C. p. 4.
- ³ MiningWeb (theminingweb.com), posted 2002/04/03, Tom Butler, Gary Mead, and Matthew Turner. They were responding to “Extractive Sectors and the Poor,” by Michael Ross, an Oxfam America report (October 2001).
- ⁴ Op. Cit. Ferranti et al. p. 49
- ⁵ Actually, as will also be discussed, Ferranti *et al.* also tell a much more complex story that emphasizes not so much the existence of mineral deposits but the manner in which they are developed.
- ⁶ Op. Cit. Ferranti et al. pp. 49-50
- ⁷ Ibid. p. 50.
- ⁸ Ibid. p. 52.
- ⁹ World Development Indicators database, World Bank, April 2002
- ¹⁰ “The Origins of American Industrial Success, 1879-1940,” Gavin Wright, *American Economic Review* 80(4);651-668, September 1990.
- ¹¹ Historical Statistics of the United States, Series U201-206, U.S. Bureau of the Census, 1975.
- ¹² The crude materials and semi-finished manufactured exports represented 2.3 percent of the GDP during this time period. Merchandise exports included fiber such as cotton and unfinished products made from it. We have approximated the mining and metals portion of this as one-half or 1.3 percent. Ibid.
- ¹³ In the late 20th century, the American reliance on exports grew. Between 1970 and 1990 exports represented 6.8 percent of the GDP; in 1990-1999 they represented 10.4 percent. Bureau of Economic Analysis, U.S. Department of Commerce. The official government statistics on national income go back only to 1929.
- ¹⁴ Douglas C. North, 2nd edition, 1974, Prentice-Hall, Englewood Cliffs, New Jersey.
- ¹⁵ Statistics Canada, Historical Statistics, Series P1-58.
- ¹⁶ *The Canadian Economy: Prospect and Retrospect*, Richard E. Caves and Richard H. Holton, 1959, Harvard University Press, Cambridge, MA., Table 2. If one focuses only on mining, one can see significant growth in mining in the first half of the 20th century. But the Canadian economy was expanding significantly at the same time so that the relative importance of mining was not increasing dramatically. For a focus only on the growth of mining, see Alexander Dow, 1985, *Prometheus in Canada: The Expansion of Metal Mining, 1900-1950*, Explorations in Canadian Economic History, Duncan Cameron editor, Ottawa: University of Ottawa Press.
- ¹⁷ Statistics Canada, Series P27-58, and Domestic Exports, Series 381.
- ¹⁸ “Resource-Based Economic Growth, Past and Present,” Gavin Wright and Jesse Czelusta, Stanford University Working Paper, June 2002.
- ¹⁹ *Canada in the World Economy*, John A. Stovel, 1959, Harvard University Press, Cambridge, MA. p. 212.

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- ²⁰ *Ibid.* pp. 109 and 113 and Table 7.
- ²¹ *Ibid.* p. 210.
- ²² *Ibid.* p. 42.
- ²³ ***The Canadian Economy: Prospect and Retrospect***, Richard E. Caves and Richard H. Holton, 1959, Harvard University Press, Cambridge, MA. pp. 37 and 467.
- ²⁴ Statistics Canada.
- ²⁵ Between 1890 and 1920 metal exports were 15% of total domestic exports; between 1920 and 1945 they were 17%; from 1945 to 1975 they were 18%. Statistics Canada. Some of the metal exports were not associated with Canadian mining. Metal ore was regularly imported into Canada for processing. Canadian aluminum, for instance, is produced entirely from imported bauxite ore. Other ores that are mined in Canada are also imported into Canada.
- ²⁶ Statistics Canada. GDP historical data only goes back only to 1926.
- ²⁷ **John F. Helliwell, “Natural Resources and the Australian Economy,”** in *The Australian Economy: A View from the North*, Richard Caves and Lawrence Krause, eds., The Brookings Institution, Washington, DC, 1984, p. 96, Figure 7.
- ²⁸ Glyn Wittwer and Melissa Bright, 1997, “The Effects of Mining Expansion on Regional Economies in Australia,” *Australasian Journal of Regional Studies* 3(1):71-84, p. 74.
- ²⁹ *Op. cit.* Helliwell, Figure 5, p. 92, and Figure 4, p. 90.
- ³⁰ **Australian Growth: A California Perspective**, Ian W. McLean and Alan M. Taylor, National Bureau of Economic Research Working Paper W8408. August 2001. <http://www.econ.ucdavis.edu/faculty/amtaylor/papers/w8408.pdf>: The revival of a diversified mining sector beginning in the 1960s has led some to see a continuity in Australia’s mining history that while real was spasmodic and for long periods of time not of much economic significance. For the development of this mining continuity view, see G. Blainey’s ***The Rush That Never Ended: A History of Australian Mining*** (1993, Melbourne University Press: Melbourne), which has gone through four editions.
- ³¹ *Ibid.*
- ³² In the last half of the 20th century, New Zealand also saw an expansion of mineral development as iron-sands, oil, natural gas, and other resources were discovered and developed. ***The Making of New Zealand: An Economic History: An Economic History***, G.R. Hawke, Cambridge University Press: Cambridge, UK, 1985.
- ³³ Treasure or Trouble? Mining in Developing Countries, 2002, World Bank and International Finance Corporation, Appendix C, p. 18. Also, “The Curse of Natural Resources,” 2001, Jeffrey D. Sachs and Andrew M. Warner, ***European Economic Review***, 45(2001): 827-838, Figure 1 and pp. 832-33 and 837.
- ³⁴ The territorial capital of Montana shifted from one mining town to another as gold mining booms busted. The original capital was in Bannock; it then shifted to Virginia City; then to Helena. As the Helena boom faded, it was proposed to shift the capital to Butte. Bannock and Virginia City are now ghost towns maintained only as historical monuments.
- ³⁵ The Australian Mining Industry: From Settlement to 2000, Australian Bureau of Statistics, October 2000, ABS Catalogue No. 8414.0, <http://www.abs.gov.au/ausstats/abs@.nsf/Lookup/NT00017CF2>.
- ³⁶ U.S. Dept. of Labor, Bureau of Labor Statistics, Productivity Measures for Selected Industries, Bulletin 2421, 1993.

³⁷Outside of the rural U.S. Deep South where a long history of racial inequality has led to persistent poverty, mining and other natural resource counties are prominent among the persistently poor non-metropolitan counties. "Mining the Data: Analyzing the Economic Implications of Mining for Non-metropolitan Regions," William R. Freudenburg and Lisa J. Wilson, *Sociological Inquiry* (forthcoming). Also, The Revised ERS County Typology: An Overview, 1994, Peggy J. Cook and Karen L. Mizer, Economic Research Service, Rural Development Research Report Number 89, U.S. Department of Agriculture. Compares the mining counties with the persistent poverty counties, pp. 8 and 24.

³⁸The Regional Economic Information System 1969-2000 CD-ROM (Bureau of Economic Analysis, U.S. Department of Commerce) was the source of the data. A county was included as "mining dependent" if the data indicated that for at least one year in the between 1970-1979 or 1980-1989 period "mining" less "oil and gas" earnings were 20 percent or more of total earnings by place of work.

³⁹If a few firms dominated local mining, federal regulations prevent the release of the mining data for that county. This is often a problem in any given year, but is less of a problem when looking at 20 years of data because mining data is often available for at least one of those years. The number of counties that would have been labeled mining dependent if it were not for these data disclosure restrictions is unknown. However, our analysis identified about the same number of mining-dependent counties as other studies, about 100 counties dependent on solid minerals and another 100 dependent on oil and gas extraction. Kenneth Deavers and David Brown in a 1985 study identified a total of 199 counties in these two categories (Natural Resource Dependence, Rural Development, and Rural Poverty, Economic Research Service, U.S. Department of Agriculture. Rural Development Research Report No. 48). A 1994 study identified only 146 mining-dependent counties (including oil and gas counties) (Peggy Cook and Karen Mizer, The Revised ERS County Typology, Economic Research Service, Rural Development Research Report Number 89, U.S. Department of Agriculture).

⁴⁰Most mining operations are located in non-metropolitan areas where average incomes, in general, are lower. If the mining-dependent counties are compared only to other non-metropolitan areas, it is still true that the mining-dependent counties have lower per capita incomes and that they have lost ground relative to other non-metropolitan counties over the last three decades. This is also true for most mining regions even if the mining-dependent counties are compared only with the other non-metropolitan counties in the same state. Of the 25 states with mining-dependent counties, only 4 (MT, MN, MI, GA) had per capita incomes above the state's non-metropolitan average and those incomes were only 3 to 11 percent higher. Of those 25 states with mining-dependent counties, 19 saw per capita income in the mining-dependent counties deteriorate relative to the state non-metropolitan average between 1980 and 2000.

⁴¹See the studies cited in footnote 37 above.

⁴²A U.S. county was categorized as being a "coal mining county" if it had 200 or more coal miners in its work force. There were 99 such counties out of the U.S.'s 3,100 counties. The Regional Economic Information System (U.S. Bureau of Economic Analysis) was the source of the employment data, U.S. Department of Labor the source of the unemployment data for the years 1990-2000.

⁴³"The Industrial structure of job displacement, 1979-88, *Monthly Labor Review*, September 1992, pp. 17-25.

⁴⁴A regression of the unemployment rate relative to the state average on the percent of county employment in coal mining, and the coal mining jobs losses between 1989 and 1998 expressed as a percentage of total employment, shows that each of these variables have about the same impact on the relative unemployment rate. Both variables are statistically significant; Multiple R = 0.37, adjusted R² = 0.117.

⁴⁵Stephan Weiler, "Industrial Structure and Unemployment in Regional Labor Markets," *Industrial Relations* 39(2):336-359, April, 2000.

⁴⁶*Ibid.*

⁴⁷"Mining the Data: Analyzing the Economic Implications of Mining for Non-metropolitan Regions," William R. Freudenburg and Lisa J. Wilson, *Sociological Inquiry* (forthcoming). "Rural" is used loosely here to refer to non-metropolitan areas that can have urban areas with populations of up to 50,000.

- ⁴⁸Gavin Wright, 1990, “**The Origins of American Industrial Success 1870-1940,**” *American Economic Review*, 80(4):651-68. **Increasing Returns and the Genesis of American Resource Abundance**, Paul A. David and Gavin Wright, *Industrial and Corporate Change*, 6(2):203-245, 1997.
- ⁴⁹In all three countries, however, the indigenous population did not share in access to that land and natural resources. Indigenous populations often were forcibly removed from lands that had mineral potential. Loss of this land contributed to the poverty from which these populations continue to suffer. Indigenous populations have also suffered from environmental damages caused by mining on or near traditional lands.
- ⁵⁰**Resource Abundance and Economic Development: Improving the Performance of Resource-Rich Countries**, Richard M. Auty, UNU/WIDNER, Research for Action 44, 1998.
- ⁵¹“**Australian Growth: A California Perspective,**” Ian W. McLean and Alan M. Taylor, National Bureau of Economic Research Working Paper W8408. August 2001. <http://www.econ.ucdavis.edu/faculty/amtaylor/papers/w8408.pdf>.
- ⁵²Gavin Wright and Jesse Czelusta, 2002, Resource-Based Economic Growth, Past and Present, Stanford University Working Paper, <http://www-econ.stanford.edu/faculty/workp/swp02008.html>, Paper presented at the 2002 World Congress of Environmental and Resource Economists.
- ⁵³Gavin Wright and Jesse Czelusta, 2002, Resource-Based Economic Growth, Past and Present, Stanford University Working Paper. “The Rise and Fall of American Technological Leadership: The Post-war Era in Historical Perspective,” Richard R. Nelson and Gavin Wright, 1992, *J. of Economic Literature* 30:1931-1964. “Resource-Based Economic Growth, Past and Present,” June 2002, Gavin Wright and Jesse Czelusta, Stanford University.
- ⁵⁴Australia pursued an explicit “whites only” immigration policy. The United States’ policy varied over time but explicitly favored immigration from certain European countries although both African slaves and Asian laborers were used extensively. Canada, at least in recent decades, has had the most liberal immigration policy.
- ⁵⁵Auty, *op. cit.*
- ⁵⁶Gavin Wright 1990, *op. cit.*
- ⁵⁷See the World Bank report by Ferranti *et al. op. cit.* pp. 70-73 for a discussion of the problems of replicating these countries’ historical experience.
- ⁵⁸Wright and Czelusta, *op. cit.*
- ⁵⁹**Resource-Led Growth—A Long-Term Perspective The Relevance of the 1870-1914 Experience for Today’s Developing Economies, Ronald Findlay and Mats Lundahl**, Working Papers No. 162, July 1999, United Nations University, World Institute for Development Economics Research (UNU/WIDER), Helsinki, Finland. Sachs, Jeffrey D. and Andrew M. Warner. 1995. Natural Resource Abundance and Economic Growth. NBER Working Paper Series, Working Paper 5398. Cambridge, MA: National Bureau of Economic Research.
- ⁶⁰Wright, *op. cit.*
- ⁶¹Ferranti *et al. op. cit.* Norway, a developed nation, negotiated with the transnational corporations that initially developed their North Sea oil to assure that knowledge and technology got transferred to Norwegian citizens and firms. Norway was able to shift its considerable skills and experience with ship building and other advanced manufacturing to oil-related projects such as the construction of deep water drilling platforms. Wright and Czelusta, *op. cit.*
- ⁶²Findlay and Lundahl, *op. cit.* Auty, *op. cit.* Wright, *op. cit.* **Oil Windfalls: Blessing or Curse?** Alan Gelb and Associates, published for the World Bank by Oxford University Press, New York, 1988.
- ⁶³Sachs, Jeffrey D. and Andrew M. Warner. 1997. “Natural Resource Abundance and Economic Growth.” Updated and extended version of NBER working paper 5398 (October 1995). Harvard University. Harvard Institute for International Development, Cambridge, MA.

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- ⁶⁴The big push, natural resource booms and growth, Jeffrey D. Sachs and Andrew M. Warner, *J. of Development Economics* 59(1999):43-76, 1999.
- ⁶⁵“The Curse of Natural Resources,” 2001, Jeffrey D. Sachs and Andrew M. Warner, *European Economic Review*, 45(2001):827-838.
- ⁶⁶**Resource Abundance and Economic Development: Improving the Performance of Resource-Rich Countries**, Richard M. Auty, UNU/WIDNER, Research for Action 44, 1998.
- ⁶⁷**Oil Windfalls: Blessing or Curse?** Alan Gelb and Associates, published for the World Bank by Oxford University Press, New York, 1988
- ⁶⁸Natural Resource Abundance and Economic Growth Revisited, Jean-Philippe C. Stijns, University of California at Berkeley, First draft: May 1999; Current draft: March 2001.
- ⁶⁹Treasure or Trouble? Mining in Developing Countries, 2002, Mining Department, World Bank Group, World Bank and International Finance Corporation, Washington, DC.
- ⁷⁰Auty, *op. cit.*
- ⁷¹Birdsall, Nancy, Thomas Pinckney and Richard Sabot. 2000. “Natural Resources, Human Capital, and Growth.” Carnegie Endowment Working Papers, Global Policy Program No. 9, Carnegie Endowment for International Peace, Washington, D.C.
- ⁷²Gylfason, Thorvaldur, and Gylfi Zoega. 2001. “Natural Resources and Economic Growth: The Role of Investment.” University of Iceland, Reykjavik, Iceland. Unpublished Manuscript.
- ⁷³World Bank and International Finance Corporation, *op. cit.*
- ⁷⁴Wright and Czelusta, *op. cit.* pp. 10-11.
- ⁷⁵World Bank and International Finance Corporation, *op. cit.* p. 11.
- ⁷⁶Merle Lipton, 1985, *Capitalism and Apartheid: South Africa, 1910-84*, Aldershot: Gower, p. 388.
- ⁷⁷World Bank and International Finance Corporation, *op. cit.* p. 10



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