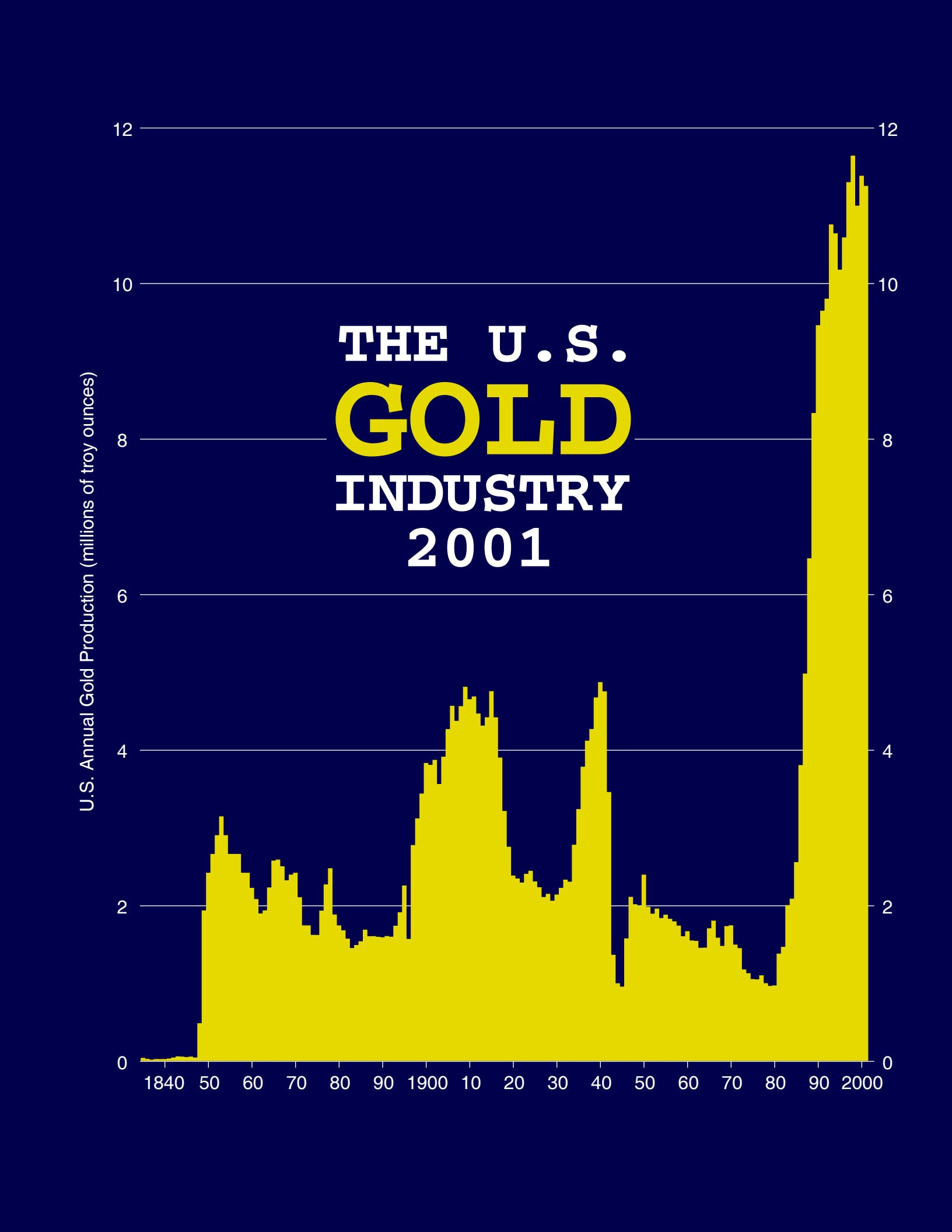
THE U.S.
GOLD
INDUSTRY
2001
U.S. Annual Gold Production (millions of troy ounces)
0
2
4
6
8
10
12
1840
50
60
70
80
90
1900
10
20
30
40
50
60
70
80
90
2000

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THE U.S. GOLD INDUSTRY 2001

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2002

MACKAY SCHOOL OF MINES
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RENO

CONTENTS

The views expressed in this publication are those of the author and are neither endorsed nor rejected by the Nevada Bureau of Mines and Geology, and the author acknowledges responsibility for any errors in fact or analysis.

INTRODUCTION

In this sixth edition of this report on the U.S. gold industry the focus is shifted slightly from that of previous editions. While this edition still looks at industry developments, economic impacts, trends in production costs and public policies affecting the industry like previous editions, it is the latter issue that is most prominent in this edition. The low price environment that began in 1996 continues to pressure the industry and communities dependent upon it. The industry and these communities could reasonably be described as having been in a recession since 1997 while the rest of the U.S. economy has boomed. This regional recession, primarily affecting the rural western U.S., has seen job losses, mine closures, reduced state and local tax revenues, and the general economic uncertainty that is usually associated with hard times.

In spite of these problems, through rationalization of operations, the synergy of mergers, and other measures, the industry has improved its financial performance in 1999 and 2000. Results in 2001 are only partially available at the time of this writing, but early indications are that the remaining major producers continued to benefit from streamlined operations as well as an improvement in gold prices in the last quarter of the year. The industry appears prepared to ride out the recession in the near term without significant reductions in overall production and only moderate reductions in economic impacts relative to changes in prices. In short, discussions of the demise of the U.S. gold industry are premature.

Longer-term prospects are more problematic. The European Central Bank agreement may well be renewed, but sales under the current agreement are limited to historically unprecedented high levels. Continued low gold prices after the expiration of the European Central Bank agreement limiting gold sales in 2004 would pose significant problems, for example. However, it is changes in the regulatory environment that occurred during the Clinton administration that most seriously threaten the industry's long-run sustainability in the U.S.

This shift in focus to public policy and regulatory issues is necessitated, in the author's view, because changes in the industry regulatory environment likely foreshadow significant changes in the structure, conduct and performance of the industry in the U.S. More specifically, we are referring to proposed changes in federal Surface Management regulations contained in 43 C.F.R. § 3809 ("3809 regulations") and the U.S. Department of the Interior Solicitor's "millsite" opinion issued in November 1997.

These regulatory changes have coincided with increases in industry concentration in terms of the percentage of output produced by the largest producers and increased consolidation of producers through mergers, acquisitions and bankruptcies, and have led to a virtual cessation of grassroots exploration in the U.S. Workforce reductions, mine closures, and reduced exploration quite naturally reflect depressed gold and silver markets. However, changes in the regulatory environment adopted in the final years of the Clinton administration, if they were to remain in effect, would make it unlikely that the industry could regain the vitality it had in the 1980s even if the price were to return to 1980s levels. Hence, at the crux of these developments is the fundamental sustainability of the industry in the U.S.

In many ways industry developments in the post-1996 period provide a textbook example of the dynamics of what economists refer to a "perfectly competitive industry." This is an industry characterized by relatively few barriers to industry entry or exit by producers and consumers, little or no ability on the part of producers to influence price, and product homogeneity. Although the analogy is by no means perfect, what we have observed over the past two decades has been:

1) Exogenous factors, in this case inflation-driven demand for gold, pushed market prices well over industry production costs. In the late 1970s and early 1980s this demand was almost entirely met from world mine supply, which was considerably smaller than current levels, rather than from above-ground stocks which still played a significant monetary role for many, especially European, central banks.

2) The price increases led to rapid entry of new producers and expansion of existing producers in the 1980s. This entry and expansion was fueled by tens of billions of dollars in capital expenditures. In Nevada alone, the nation's largest producer with approximately 75 percent of current production, an estimated $13 billion has been invested. The figure for the U.S. is conservatively estimated at twice that level. (The disproportionate relationship between current production and total investment stems from the fact that relatively more mines outside of Nevada have ceased production and were generally less successful.)

3) Rapid expansion of industry output in the U.S. as indicated by the graph on the cover of this publication coincided with expansion of world mine supply. World mine supply increased from 31 million ounces (962 tonnes) in 1980, (Murray and others, 1990) to 82.6 million ounces (2,568 tonnes) in 2000 and U.S. production increased from 1.4 million ounces (44 tonnes) in 1980 to 10.9 million ounces (340 tonnes) in 2000.

4) Increases in supply from underground and above-ground sources led to a significant decline in prices at the time of this writing, approximately $270/troy ounce that leaves gold at the lowest real price since the early 1970s, shortly after the collapse of Bretton Woods agreement when it was fixed at $35 per ounce.

5) A "shake-out" of less competitive, generally higher-cost producers but also firms with unsuccessful exploration records. At this time fully half of world mine supply is unprofitable on a full cost basis. (Klapwijk and others, 2000) Barring a rebound in prices, this trend is expected to continue as high cost producers drop out, producing orebodies are exhausted, and fewer new orebodies can be brought into production because of low prices, regulatory barriers, and a lack of exploration efforts.

We note that the description of the industry as a "perfectly competitive industry" is flawed for a number of reasons. First, and foremost, this process, once set in motion by exogenous factors, was not directed purely by its own internal dynamics like the textbook description of a "perfectly competitive industry." Overlaying these traditional economic foci are regulatory and political changes, both domestic and international, that have influenced the process. For example, were it simply a matter of mine production affecting precious metals markets conditions, it is likely that the boom would still be in progress. Over the past decade 30 to 40 percent of world physical demand for gold has been met from sources other than mine supply, i.e., central banks and producer hedging. But, the exogenous macroeconomic conditions that increased demand and raised the price in the early 1980s, i.e., inflation, subsided. In the 1990s bond and equity markets and the U.S. dollar replaced gold as a safe haven for wealth, resulting in a significant decline in investment demand in the developed world. In addition, new exogenous macroeconomic and political developments led to the formation of the European Central Bank out of the most gold heavy central banks in the world, and have made much of the gold held in European Monetary Union (EMU) members' central banks unnecessary for foreign exchange purposes. The majority of foreign trade of EMU members is among themselves. Hence, once a common currency is introduced, the demand for foreign exchange holdings is diminished. As a result, EMU members' central banks have mobilized their gold holdings and increased supply.

Second, because of the industry's own unique internal dynamics and perhaps its corporate culture, the industry's expansion in the late 1980s and early 1990s prompted a reaction from environmental interest groups. For a wide variety of reasons, the internal dynamics of interest group politics has seen a coalescence of environmental interests around mining law reform and regulatory issues. These developments, as much or more than the traditional subject matter of mineral economics, threaten the industry's survival. To put it more succinctly, while the industry is capable of surviving $250 gold and sub $5 silver—although not generally profitably—it is not likely to survive the regulatory climate created in the last years of the Clinton administration. All of these actions, which are discussed in detail below, bring into question both the short-term survival and long-term sustainability of the industry.

Although the "perfectly competitive industry" comparison may not seem to portend well for the industry, a more positive outlook is warranted, particularly for the U.S. industry. On the crucial regulatory front, the reforms pushed through in the last days of the Clinton administration have been reopened for public comment and review and some significant provisions were dropped at the end of 2001. Hence, there is at least a prospect of seeing less radical reform. A window of opportunity, however, is not a reprieve, and there are reasons to doubt that the new administration will be willing to risk much for such a small industry with a small political constituency. Indicative of this small political base is the fact that approximately three-quarters of U.S. gold production occurs in a single congressional district. In addition, it is a solidly Republican district and, hence, not "in play" politically, and not likely to attract significant political favors from either party.

In addition, while the "shake-out" phase of the cycle implies diminished employment, lower taxes paid in communities affected by mining, bankruptcies, reorganizations, mergers, and takeovers, it must be recalled that the history of the cycle is simply that it is a cycle, not a secular trend. While some have argued that the demonetization of gold in Europe and North America may signal the start of a secular trend, strong gold demand has absorbed the substantial increases in mine and aboveground supply of the past two decades. Hence, gold still performs its traditional role as a store of value for much of the world's population that lacks the relatively sound monetary and banking systems of developed economies. As the partial recovery of gold prices to over $300 after the events of September 11, 2001, the ensuing war on terrorism, and events in the Middle East suggest, gold may be a "barbarous relic," as Keynes described it, but world events still routinely remind us that it's a barbarous world and that is not likely to change soon.

INDUSTRY STRUCTURE

The structure of the U.S. gold industry can be viewed from several perspectives. First, as a result of geology, primary gold production is centered in the mountainous western third of the U.S. and particularly in the Great Basin (see Fig. 1). Primary and identifiable by-product gold and silver production is summarized by state in 1999 by Table 1 and in 2000 by Table 2. The tables show that production is highly concentrated with the top three producing states, Nevada, with 70.9 percent of the value of total U.S. output in 1999 and 72 percent in 2000, Alaska (4.7 percent), Utah (4.5 percent) combined for 80.1 percent of the total value of production. Expanding the list to the top five producing states would add California with 3.6 percent and Idaho with 3.2 percent, to account for 86.9 percent of the total value of U.S. production in 1999.

In terms of the concentration of gold production as opposed to the value of gold and silver production, 1999 gold production was slightly more concentrated than the value of all production because primary silver production is included in the precious metals production value. The top three gold-producing states in 1999 produced 84.2 percent of U.S. production. These included Nevada with 75.2 percent, Alaska with 4.7 percent, and Utah with 4.2 percent. The top five producers would include California with 4.0 percent and Colorado, where the Cripple Creek/Victor Mine alone accounts for 2.1 percent. Hence, the top five producing states accounted for 90.2 percent of production. Furthermore, it should be noted that since Utah's gold and silver production is a by-product of copper mining at Kennecott's Bingham Canyon Mine outside of Salt Lake City, these figures understate the geographic concentration of primary gold production.

As a result of mine closures in Montana, Idaho, South Dakota, and other states in 2000, production figures show slightly increased concentration in the top producing states. In 2000 the top three states again accounted for 88.7 percent of gold production, while the top five accounted for 94.9 percent. This trend is likely to continue under present market and regulatory conditions. Low prices will both hasten mine closures and provide little incentive for exploration, and the barriers to new mines created by new federal surface management (3809) regulations as well as some state regulations will accelerate these trends in the future.

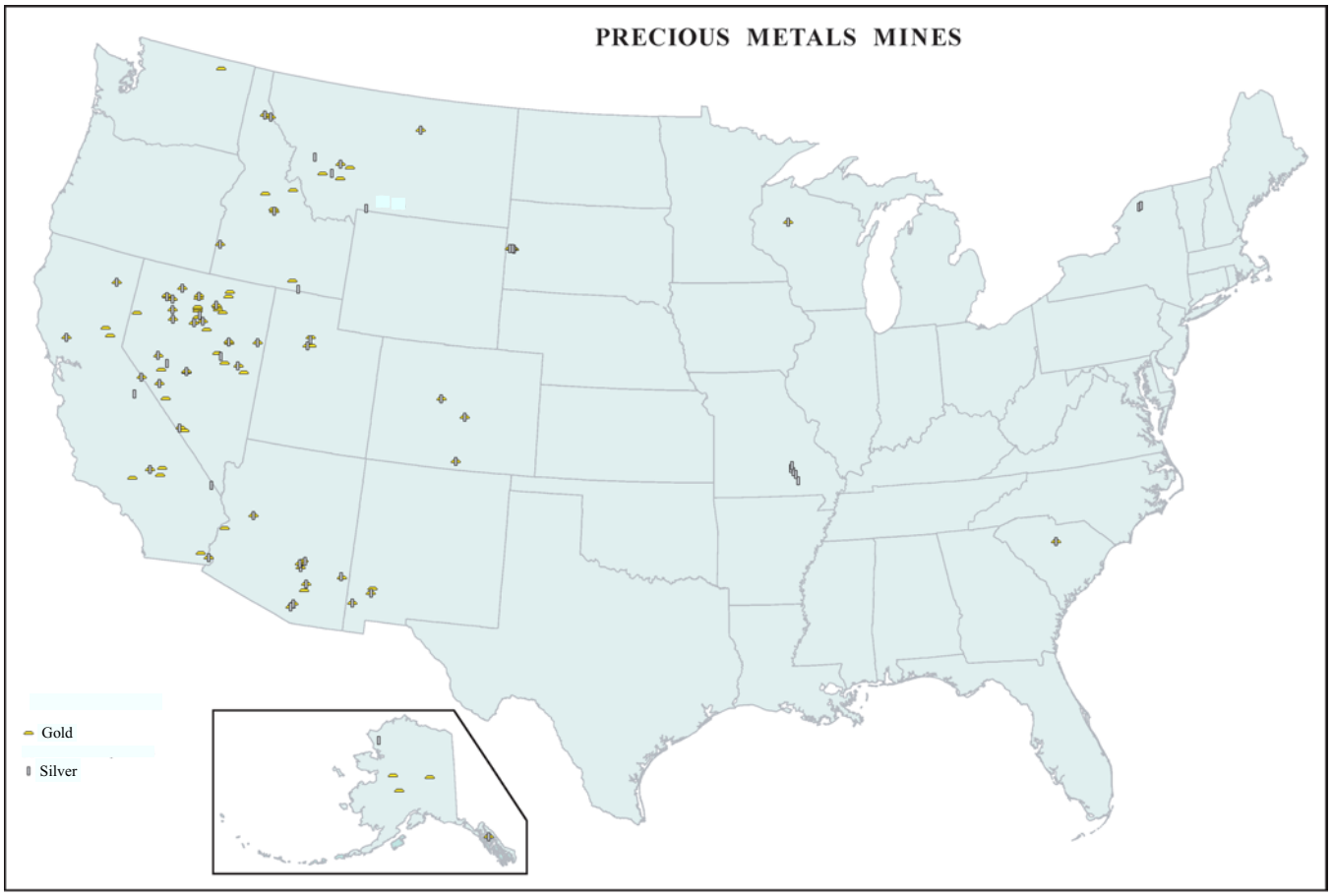

Figure 1. Map of gold and silver mining locations (from USGS web page http://minerals.usgs.gov/minerals/pubs/mapdata/precious.pdf)

Table 1. Gold and silver production in 1999 by state

State	Gold (1,000 oz)	Percent of Total	Value ($1,000s)	Silver (1,000 oz)	Percent of Total	Value ($1,000s)	Total Value ($1,000s)	Percent of Total Value
Alaska	517.9	4.71%	144,494	3,100	4.94%	16,182	160,676	4.7%
Arizona	na	na	na	5,884	9.39%	30,714	30,714	0.9%
California	441	4.01%	123,011	24	0.04%	125	123,136	3.6%
Colorado	231	2.10%	64,449	na	na	na	64,449	1.9%
Idaho	133	1.21%	37,107	13,407	21.38%	69,985	107,092	3.2%
Montana	145	1.32%	40,399	na	0.00%	na	40,399	1.2%
Nevada	8,260	75.16%	2,304,540	19,500	31.10%	101,790	2,406,330	70.9%
S. Dakota	213	1.94%	59,343	na	na	na	59,343	1.7%
Utah	470	4.28%	131,130	4,000	6.38%	20,880	152,010	4.5%
Washington	104	0.95%	29,016	na	na	na	29,016	0.9%
Other	475	4.32%	132,525	16,780	26.76%	87,592	220,117	6.5%
Total	10,989	100.00%	3,066,015	62,695	100.00%	327,268	3,393,283	100.0%

Sources: Gold Fields Mineral Services, U.S. Geological Survey, state agencies, and company reports.
"Other" includes the states for which data are not available (shown as "na").

Another view of industry concentration is the percentage of output produced by individual mines and mining complexes and mining companies. While gold is produced in hundreds of locations in the U.S. and as a by-product of other metal mining, both primary production and total production are highly concentrated in a few large producing mines and mine complexes. As indicated in Table 3, in both 1999 and 2000 the top three producing mines and mining complexes were in Nevada and accounted for 48.3 percent and 52.2 percent of total U.S. production in each respective year. The largest producer in each year was Newmont Mining's Carlin trend and Valmy trend operations accounting for 24.3 percent of 1999 production and 27.9 percent of 2000 production or 2.5 million and 3.05 million ounces in the respective years. Second in 1999 was Placer Dome (60%) and Kennecott's (40%) Cortez operation with 1.33 million ounces. Third in 1999 was Barrick Gold's Betze-Post Mine with 1.13 million ounces. In 2000 Betze-Post and Cortez traded places producing 1.65 and 1.01 million ounces, respectively.

In spite of Newmont's Carlin and Valmy trends' top position in each year, that ranking is problematic. The Carlin trend actually consists of a number of distinct extractive locations located approximately 20 miles west of Elko, Nevada on Interstate 80 along a northwest to southeast band extending 20 miles north and several miles south of the Interstate. The Valmy trend represents another group of extractive locations about 60 miles west of the Carlin trend, which also extends approximately 20 miles north and south of Interstate 80. In total, the Carlin and Valmy trend operations consist of 10 extractive locations. Hence, describing these locations as a single mine is misleading. In addition, with the merger of Newmont and Franco-Nevada in 2001, the Ken Snyder Mine will likely be integrated into these operations.

However, it is difficult and probably meaningless to some extent to try to differentiate the output of these different points of ore extraction because they constitute a single operating unit. Ores from each extractive location are shipped to centralized processing locations based on the most efficient type of process for each type of ore. Hence, sulfide ores are shipped to autoclave processing facilities; carbonaceous ores are shipped to a roasting facility, etc. As a consequence, some ores at the various extractive locations probably could not be classified as ore, that is, as being capable of being processed at a profit, if they had to be processed at that location. Hence, because of this optimization, matching ore types to processing facility types, the whole is greater than the sum of the parts.

Newmont acquired its Valmy trend operations in its 1997 merger with Santa Fe Pacific Gold. This optimization process indicates one of the kinds of synergies generated by the current wave of consolidation in the industry. Similar results in Nevada, at least, occurred with Newmont's merger with Battle Mountain Gold in January 2001. With this merger Newmont acquired the undeveloped Phoenix deposit with over 6 million ounces of reserves calculated at $300 per ounce located between its Carlin and Valmy trend operations. Newmont will be able to develop extractive operations and integrate it into its processing system much more cheaply than Battle Mountain could have if it had to construct its own processing facilities.

If one wishes to define a mine as a single location of ore extraction, then Placer Dome and Kennecott's Cortez operations and Barrick Gold's Betze-Post pit would lead the list of top producing mines. These operations, however, are smaller than Kennecott's Bingham Canyon Mine, which, in spite of ranking sixth in 1999 and fifth in 2000 in gold production, produces gold as a by-product of copper. Bingham Canyon is also a major producer of silver, producing 4 million ounces in 1999 and 3.7 million ounces in 2000.

Table 2. Gold and silver production in 2000 by state

State	Gold			Silver			Total Value ($1,000s)	Percent of Total Value
	Production (1,000 oz)	Percent of Total	Value ($1,000s)	Production (1,000 oz)	Percent of Total	Value ($1,000s)		
Alaska	546	4.81	148,976	18,227	27.52	83,660	232,636	6.8%
California	447	3.94	121,882	23	0.04	107	121,989	3.6%
Colorado	248	2.19	67,667	na	na	na	67,667	2.0%
Idaho	72	0.63	19,645	12,905	19.48	59,233	78,878	2.3%
Montana	212	1.87	57,926	na	na	na	57,926	1.7%
Nevada	8,585	75.65	2,342,417	23,200	35.03	106,488	2,448,905	72.0%
S. Dakota	171	1.51	46,630	na	na	na	46,630	1.4%
Utah	700	6.17	190,995	3,939	5.95	18,080	209,075	6.4%
Washington	94	0.83	25,675	na	na	na	25,675	0.8%
Other	274	2.41	74,761	7,936	11.98	36,428	111,189	3.3%
Total	1,349	100.00	3,096,575	66,230	100.00	303,996	3,400,570	100.0%

Sources: Gold Fields Mineral Services, U.S. Geological Survey, state agencies, and company reports.
"Other" includes the states for which data are not available (shown as "na").

Table 3
Top 10 Producing Mines in 1999

Rank	Mine	Operator (Partner)	Production (1,000 ozs.)	Percent of U.S. Output	Cum. Percent
1.	Carlin/Valmy Trends (NV)	Newmont	2,498.7	24.3	24.3
2.	Cortez (NV)	Placer Dome (Kennecott)	1,328.5	12.9	37.3
3.	Betze-Post (NV)	Barrick	1,130.0	11.0	48.3
4.	Meikle (NV)	Barrick	978.0	9.5	57.8
5.	Round Mtn. (NV)	Echo Bay (Barrick)	541.8	5.3	63.1
6.	Bingham Canyon (UT)	Kennecott	470.0	4.6	67.7
7.	Jerritt Canyon (NV)	AngloGold (Meridian)	362.9	3.5	71.2
8.	Fort Knox (AK)	Kinross	351.1	3.4	74.6
9.	Ken Snyder (NV)	Newmont	260.0	2.5	77.2
10.	Cripple Creek (CO)	AngloGold	231.0	2.3	79.4

Top 10 Producing Mines in 2000

Rank	Mine	Operator (Partner)	Production (1,000 ozs.)	Percent of U.S. Output	Cum. Percent
1.	Carlin/Valmy Trends (NV)	Newmont	3,047.9	27.9	27.9
2.	Betze-Post (NV)	Barrick	1,646.6	15.1	42.9
3.	Cortez (NV)	Placer Dome (Kennecott)	1,009.9	9.2	52.2
4.	Meikle	Barrick	805.7	7.4	59.5
5.	Bingham Canyon (UT)	Kennecott	700.0	6.4	65.9
6.	Round Mtn. (NV)	Echo Bay (Barrick)	640.1	5.9	71.8
7.	Fort Knox (AK)	Kinross	363.0	3.3	75.1
8.	Jerritt Canyon (NV)	AngloGold (Meridian)	343.2	3.1	78.2
9.	Cripple Creek (CO)	AngloGold	248.0	2.3	80.5
10.	Ken Snyder (NV)	Newmont	216.0	2.0	82.5

Note: Cumulative percentages may not add correctly on table because of rounding.

While only a two-year trend, the increased concentration in the industry illustrated by the table can be compared to 1997 when the top three producing mines, Newmont's Carlin and Valmy trend complex and Barrick's Betze-Post and Meikle Mines, produced 43.9 percent of U.S. output vs. 52.2 percent in 2000. This trend is the result of a combination of factors that are likely to continue unless there is a significant change in prices and the regulatory environment. The largest producers are, first and foremost, those that have staked out the most productive ground with the largest reserves. These large-scale reserves offer significant economies of scale best illustrated by Newmont's optimization of its operations on the Carlin and Valmy trends. Barrick's contiguous operations at the open-pit Betze-Post Mine and the underground Meikle Mine offer similar economies by virtue of shared processing facilities. Similar economies can be achieved without common ownership and contiguous operations as when Placer Dome/Kennecott's Cortez Mine ships ore to AngloGold/Meridian's Jerritt Canyon Mine's mill for processing. However, this is an exceptional arrangement brought about by the low price and surplus processing capacity at Jerritt Canyon.

The trend toward consolidation is expected to continue because these large-scale operations have large reserves and are "permitted," i.e., they have operating permits from state and federal regulators on the facilities they operate. This means they can continue developing reserves in an economically defined operating area and operate at current or higher levels of production for the next five to ten years. In addition, smaller producers lack the benefits of economies of scale associated with large deposits, and must acquire permits to develop new, nonadjacent claims that generally cannot use existing infrastructure. Because the U.S. permitting process has become relatively onerous both in terms of the cost and the time required compared to other countries, smaller producers have largely chosen to invest overseas rather than in equal opportunities in the U.S. As cases in point, Hecla Mining is relying on investments in South America to replace its closing U.S. production, as are Meridian Gold, Glamis Gold, and numerous other "junior" and mid-sized producers. Dealing with the costs of the U.S. permitting process can be prohibitive for smaller companies and these costs will promote concentration in the industry in the U.S.

Another cost that has become an increasingly important barrier to entry by smaller producers is energy costs. The industry is very energy intensive, using large quantities of electric power for mineral processing and mine dewatering. In Nevada, for example, the industry used over 300 megawatts of power in 2000, approximately 25 percent of the capacity of the system in northern Nevada. Because the industry is located in the western U.S. in and near California, producers have seen significant increases in power costs as a consequence of energy shortages.

Large producers are able to secure lower power rates and, in some cases, are considering investments in generation facilities and co-generation alternatives. In addition, a law passed by the Nevada Legislature would allow major electricity consumers to purchase power from any supplier rather than the regulated monopoly supplier if it can demonstrate that other consumers will not be harmed. It is likely that only larger producers will be able to take advantage of this option. Hence energy costs constitute an emerging barrier to entry and a factor that will hasten the exit of junior and mid-sized producers from the U.S., leading to increased concentration in the future.

This does not mean that "juniors" and mid-sized producers will be unsuccessful or unprofitable as they move offshore. Meridian Gold, for example, has opened a very low cost mine in Chile as it closes down its operations in Idaho at the Beartrack Mine. Meridian's stock has been one of the best performing stocks on the New York Stock Exchange during a period of market and industry malaise. Similarly, Glamis Gold, Hecla, and others have new production in South America that will increase their production and bolster their financial statements. The point is that the lack of a substantial U.S. reserve base and infrastructure, and barriers to entry created by the regulatory environment make expansion in the U.S. impractical for "junior" producers. Hence, as junior producers' reserves are exhausted, the market share of the majors like Newmont, Barrick, Placer, and AngloGold will increase.

Evidence of this trend toward increased concentration of U.S. production is augmented by concentration measures based on company rather than mine production. While the top three mines and mining complexes accounted for 48.3 percent and 52.2 percent of production in 1999 and 2000, respectively, the top three mining companies accounted for 58.9 percent and 62.0 percent of U.S. gold production in 1999 and 2000, respectively. The obvious cause of these higher levels of concentration was multiple mine ownership by the major producers, which was largely due to mergers and acquisitions in the industry over the past several years.

The two largest producing companies in both 1999 and 2000 were, in rank order, Newmont and Barrick with a combined share of U.S. gold production of 47.4 percent and 51.5 percent in the respective years. Placer Dome was third in 1999 to bring the share of U.S. production of the top three to 58.9 percent. Placer Dome slipped to fourth in 2000 behind Kennecott which was fourth in 1999, because of the suspension of mining at Placer's Getchell Mine in Nevada and a significant increase in gold production from Kennecott's Bingham Canyon copper mine in Utah. The fifth largest U.S. producer in both years was Homestake Mining. The share of U.S. production accounted for by these five companies was 73.9 percent in 1999 and 76.6 percent in 2000.

The discussion of the trends toward increased concentration of output in (i) Nevada, or (ii) the largest mines and mining complexes, or (iii) the largest mining companies,

suggests by all measures that concentration is increasing. For example, the merger of Barrick Gold and Homestake Mining in mid 2001 marginally increased concentration as measured by company output. The resulting increase in U.S. concentration will only be marginal in spite of the fact that it moved Barrick over Newmont in worldwide production, because Homestake's production is largely outside the U.S. Barrick's ascent to number one North American producer based on worldwide production was short lived, however. In early 2002 Newmont outbid the world's largest producer, AngloGold, for Australia's largest producer, Normandy Mining. The acquisition included Franco-Nevada which held approximately 20 percent of Normandy and a substantial stake in Echo Bay Mines as well as royalties on the output of Barrick and other producers. This acquisition made Newmont the world's largest gold producer and, not coincidently, increased world wide industry concentration as well.

This concentration should not be considered an anti-trust problem because U.S. gold producers account for only just over 13 percent of world mine supply in 1999 of 2,576 tonnes (82.8 million ounces). Indeed, total world mine production is less than 2 percent of available aboveground stocks of 140,000 tonnes (4.5 billion ounces). (Klapwijk and others, 2000, p. 32–33) Hence, this degree of concentration gives U.S. producers and even all world producers combined no pricing power. This degree of concentration is also not likely to offer producers any significant monopsony (a single buyer from multiple sellers) power as purchasers of labor, equipment and supplies since these inputs are not unique to precious metals mining. Increased concentration, in this case, is simply a consequence of the phase in the commodity price cycle in which the industry currently finds itself. It is a pattern that can be observed in many other competitive industries and, it should be pointed out, the precious metals industry is still considerably less concentrated than it was in 1980 when there were only three significant U.S. producers—Homestake, Newmont, and Kennecott. In 2000, and in spite of recent increases in concentration, there were almost 20 companies publicly listed on U.S. exchanges engaged in large-scale mining activities and probably hundreds of others engaged in smaller-scale mining.

ECONOMIC IMPACTS

As may be expected from the discussion of the concentration of the industry in recent years, the economic impacts of the industry have also become increasingly concentrated. These impacts are measured in terms of jobs created, output stimulated in related industries such as suppliers of machinery, equipment and chemicals, and increases in household earnings in communities supporting the precious metals mining industry. Figure 2, showing the employment impacts of gold and silver mining in selected years for the U.S. and in Nevada, illustrates this concentration by the diminishing difference between U.S. and Nevada impacts.

The estimates of employment impacts include direct plus indirect jobs created by gold and silver mining in the indicated years. The estimates are derived from the "Regional

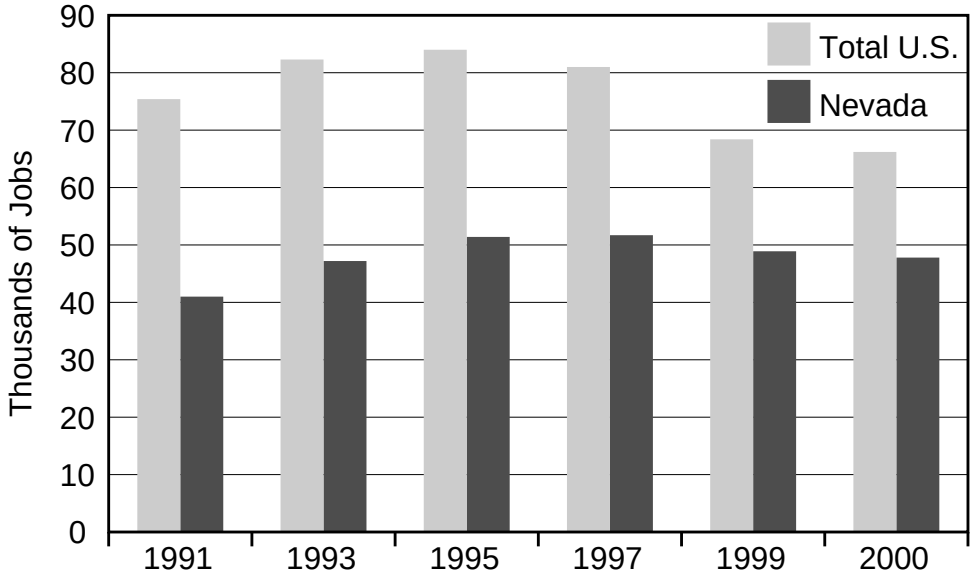

Figure 2. Direct and indirect employment impacts of gold and silver production in selected years.

Impacts Modeling System" (RIMS) developed by the Bureau of Economic Analysis of the U.S. Department of Commerce (1992) and are intended to reflect the change in final demand for, in this case, labor, in a given state resulting from a change in income in that state from a particular sector, in this case mining. Because most of the output of gold and silver mining is sold outside of the state in which it is produced it is considered an export good for that state and represents a net injection of income into the state.

Indeed, the U.S. as a whole is a net exporter of gold. In 1999, for example, the U.S. imported 221 tonnes of gold and exported 523 tonnes, for net exports of 302 tonnes or 9.7 million ounces. The difference between U.S. net exports and domestic production of 342 tonnes in 1999, or 40 tonnes, represents U.S. domestic consumption. Hence, over 88 percent of domestically mined gold is exported and constitutes an injection into the national economy. (U.S. Geological Survey, 2000)

The export nature of precious metals mining in the U.S. and in any individual state can be contrasted to the economic impacts of other economic activities such as retailing or tourism. If, for example, a New Yorker vacations in Montana, income is transferred from New York, where it was earned, to Montana, where it was spent. However, on the whole, there is no net national economic benefit beyond the fact that the New Yorker (presumably) received a greater benefit from the vacation than it cost Montanans to offer it. However, if a bank in New York purchases gold mined in Montana and sells it to a buyer in London, the value of that transaction represents a net injection of income into the national economy. The income is distributed between Montana to cover the costs of mining and New York for fees to facilitate the transaction.

The RIMS model attempts to estimate the impact of these net injections on final demand in individual states without regard to whether that change in demand is local or national. In the case of gold production, almost 100 percent of the economic impact is local and, using 1999 as a guide, over 88 percent is an injection at a national level, reducing the U.S. trade deficit by approximately $2.7 billion in 1999, for example.

Table 1 shows gold and silver production by state in 1999, and Table 2 provides the same data for 2000. In 1999 the total value of gold and silver production was approximately $3.4 billion. Because gold production data on the table are generated from reports of major producing mines in states and state agency reports from states like Nevada and Alaska when available, it varies slightly from data published by USGS (U.S. Geological Survey, 2001) and Gold Fields Mineral Services (GFMS; Klapwijk and others, 2000). USGS and GFMS estimates for 1999 were 340 tonnes and 341.9 tonnes respectively. The "other" category for gold production is calculated to make the total equal to GFMS's estimates. The "other" category for silver production is calculated to make the total equal USGS's estimate. Discrepancies in estimates are fairly minor, and estimates for gold, in particular, probably underestimate production significantly because of unreported placer production by recreational as well as commercial producers. The GFMS estimates primarily track shipments to refiners and thus miss dust and nugget production used for jewelry, hoarding, and other purposes. Placer and underground mines in Alaska and the old Mother Lode district in the central Sierra Nevada of California, which produce gold nuggets and "specimen" gold, some of which is used in the jewelry industry, are frequently not counted in production data. "Specimen" gold is also prized by mineral collectors and museums.

The more significant errors in estimating production, however, occur for individual states. Where the industry is

Table 4. Economic impacts of 1999 gold and silver production.

State	Jobs Multiplier	Jobs	Output Multiplier	Output ($1,000s)	Earnings Multiplier	Earnings ($1,000s)
Alaska	13.9	2,233	1.7724	284,782	0.5103	81,993
Arizona	31.8	977	2.4518	75,306	0.8130	24,971
California	18.5	2,278	2.0508	252,528	0.5646	69,523
Colorado	36.2	2,333	2.6351	169,830	0.6961	44,863
Idaho	22.1	2,367	1.8165	194,532	0.5305	56,812
Montana	25.2	1,018	2.0217	81,675	0.5844	23,609
Nevada	19.0	45,720	1.7843	4,293,615	0.5484	1,319,631
S. Dakota	25.5	1,513	1.8352	108,907	0.5768	34,229
Utah	32.8	4,986	2.6325	400,166	0.7782	118,294
Washington	22.2	644	1.8854	54,707	0.5574	16,174
Other	20.2	4,446	1.8660	410,738	0.5646	124,278
Total		68,516		6,326,785		1,914,377
Implied Multipliers		20.19		1.8660		0.5646

more important to the local economy, as in Nevada and Alaska, state agencies track production closely because of tax and other implications. In states where the industry is less economically important, however, there is less certainty about production figures. For example, we doubt that there was no gold production in Arizona as indicated by Table 1. Although there is no primary gold production in Arizona there has been by-product production from the state's copper mines. These production figures, however, are not readily accessible.

The economic impacts of the production shown on Table 1 are represented on Table 4. These impacts are estimated using the RIMS multipliers noted above. The RIMS system provides final demand multipliers that indicate direct plus indirect impacts of production in a particular industry in each state. The multiplier for employment shown on the table for Alaska, for example, indicates that there are 13.9 jobs in the mining industry and other industries, e.g., suppliers, and in the local economy (retail establishments, etc.) for every million dollars of output in the mining industry exported out of the local economy. As noted above, virtually 100 percent of gold and silver production is exported out of producing states.

Similarly, RIMS provides multipliers for state output and household earnings. These multipliers indicate dollar changes in Gross State Product and household earnings per million dollars of output in the industry exported out of the state. Changes in Gross State Product reflect increases in the incomes of other businesses in the state as a result of mining activity. This would include the incomes of suppliers of materials used in mining and other local businesses providing goods and services to mining employees. Finally, the household earnings multipliers indicate the fraction of the value of output that ends up as income of households in the state in all industries, not just mining employees.

Differences between various state multipliers reflect differences in economic development and diversification in their respective economies. Hence, Alaska, with a relatively undeveloped economy, lacks suppliers and infrastructure to support the industry that would hold more of the income generated by the industry in the state. These interstate differences, however, also point out one of the shortcomings of the RIMS system. Note, for example, that Colorado's employment multiplier is 36.2. While undoubtedly an accurate estimate on its own, it is likely inflated by the presence of numerous mining company headquarters in the Denver area. Hence, Colorado's multiplier reflects jobs created by mining in other states rather than just Colorado mining.

A second shortcoming of the multiplier analysis stems from the fact that the multipliers are based on a study that is almost a decade old and reflect the level of economic development and diversification in the local economies in the decade before the RIMS study was conducted. Following Adam Smith's famous dictum, "the division of labor is limited by the extent of the market" (Smith, 1776, p. 17), precious metals production in the 1970s and 1980s was not sufficient to allow specialization and division of labor to occur. As the industry grew larger and matured in the 1990s, however, the local economy developed an infrastructure to support the industry.

In Nevada's case, the scale of the industry has attracted numerous suppliers and manufacturers of a wide variety of industrial products, specialty chemicals, etc., that allow the local economy to serve the mining industry. This implies that businesses in the state are now capable of supplying much more of the needs of the industry which implies more jobs, greater output and higher household incomes in the state per dollar of mining industry output than a decade ago. Hence, Nevada's and Alaska's multipliers probably understate the true economic impacts of the industry.

Table 5. Economic impacts of 2000 gold and silver production

	Jobs Multiplier	Jobs	Output Multiplier	Output ($1,000s)	Earnings Multiplier	Earnings ($1,000s)
Alaska	13.9	3,234	1.7724	412,325	0.5103	118,714
California	18.5	2,257	2.0508	250,174	0.5646	68,875
Colorado	36.2	2,450	2.6351	178,309	0.6961	47,103
Idaho	22.1	1,743	1.8165	143,281	0.5305	41,845
Montana	25.2	1,460	2.0217	117,109	0.5844	33,852
Nevada	19.0	46,529	1.7843	4,369,582	0.5484	1,342,980
S. Dakota	25.5	1,189	1.8352	85,575	0.5768	26,896
Utah	32.8	6,858	2.6325	550,390	0.7782	162,702
Washington	22.2	570	1.8854	48,408	0.5574	14,311
Other	20.2	519	1.8660	47,910	0.5646	14,496
Total		66,807		6,203,063		1,871,774
Implied Multipliers		19.65		1.8660		0.5646

Finally, the "implied multipliers" shown on the table represent the weighted average multipliers for all states with identifiable production and are used for calculating the economic impacts of "other" production.

Tables 1 and 2 show gold and silver production in 10 states where primary gold production occurs. The exceptions are Arizona and Utah, where gold and silver are produced as by-products of copper mining. Due to both lower prices ($279 per ounce in 1999 and 2000 vs. $331 in 1997) and gold production (11.3 million ounces in 1997) the total value of production has declined by over $600 million from $4.02 billion reported in the previous edition of this report, to $3.39 billion in 1999 and $3.29 billion in 2000. In comparison to 1997 the major differences shown on Tables 3 and 4 is the concentration of production noted above. Nevada production increased from 7.85 million ounces in 1997 to 8.26 million ounces in 1999 and 8.58 million ounces in 2000. Nevada gold production in 2001 declined slightly to 8.13 million ounces. Meanwhile, production in all other states except Colorado has declined if only slightly.

The 2000 production and economic impact estimates shown in Tables 2 and 5, respectively, illustrate the slight increase in industry concentration noted above, with slightly higher percentages of production coming from Nevada, Alaska, and Utah.

Alaskan production has declined slightly since 1997 from 591,000 ounces to 546,000 in 2000. Unlike other states plagued with mine closures, however, Alaska's industry has considerable reserves at Kinross Gold's Fort Knox and True North deposits outside of Fairbanks and significant placer reserves. In addition, like Nevada, Alaska continues to attract exploration interest despite the general reduction in exploration spending in the U.S.

Reported California production has declined from 776,000 ounces of gold in 1997 to 447,000 in 2000. Aside from the placer and underground mining in the Mother Lode district noted above, most California production comes from the desert southeastern area of the state. Since 1997, Glamis Gold has ceased mining at its Picacho Mine although it continues to operate its relatively nearby Rand Mine. The largest producer is Newmont's Mesquite Mine although it has announced that it ceased mining in 2001. Similarly, the Castle Mountain Mine across the state line from Las Vegas, Nevada operated by Viceroy Gold and MK Gold has also announced that they ceased mining in 2001. Canyon Resources continues to operate the Briggs Mine in approximately the same area but, in general, California has a relatively small reserve base at current prices and production is expected to continue to decline.

As the tables indicate, Idaho is primarily a silver-producing state with its last primary gold-producing mine, Meridian Gold's Beartrack Mine, having closed in 2000. Several of Idaho's large silver mines have also closed or have announced closing is imminent: Sunshine Mining's Sunshine Mine, Hecla Mining's Lucky Friday Mine, etc. Consequently, Idaho's reserve base has shrunk considerably since 1997, and future production is expected to continue to decline without significant silver price increases.

Montana is another state where production has declined significantly since 1997 and where mining has attracted considerable controversy over the past few years. Montana gold production was 321,000 ounces in 1997 vs. 212,000 in 2000. Over the past four years Montana has gone from having five major operating mines and several reasonable prospects to having one operating mine and numerous reclamation projects, as well as lawsuits over denials of operating permits and related matters. The principal controversy surrounds a 1998 voter initiative that has banned open-pit mining and the use of cyanide for mineral processing in the state. The mining initiative was passed after another initiative banning corporate spending on ballot measures had passed so that mining interests were unable to campaign against the anti-cyanide initiative. The anti-corporate spending initiative was subsequently ruled unconstitutional, and the anti-cyanide initiative has been legally challenged.

While the outcome of these legal battles remains uncertain, the future of gold and silver mining in Montana can be predicted with relative certainty, at least in the short term. The state's last major producer, Placer Dome's Golden Sunlight Mine near Whitehall, announced that it would close earlier than previously anticipated when its operating permit was legally challenged and required to partially backfill its pit. More recently, Placer Dome has announced that it would close the mine even sooner because of rising power costs. At this time Golden Sunlight continues to mine, producing over 195,000 ounces in 2001, but its future is limited by market conditions and legal and regulatory issues. Hence, the future prospects for gold and silver mining in Montana are very dim, which is somewhat ironic for a state whose motto is "Oro y Plata."

It should be noted, however, that while the open-pit/cyanide processing ban makes future gold and silver mining in Montana unlikely, it does not foreclose it entirely. The ban forecloses use of particular mining and processing technologies that are not suitable for all deposits. So, for example, it may be possible to conduct underground mining and concentrate ores for processing out of state or for processing in state with different processes. There is no question, however, that the ban will render many orebodies uneconomic using currently best available technologies. The open-pit/cyanide processing ban also creates a significant disincentive to explore in Montana, so even if mining in the state is still technically possible, it is not likely to happen anytime soon.

South Dakota offers a similar, although less contentious, story. Homestake Mining's Homestake Mine in Lead has ceased mining. Opened in 1876, Homestake was the longest continuously operating gold mine in the U.S., having only been closed during wartime. As a

consequence, South Dakota's production has fallen from 500,200 ounces in 1997 to 170,000 in 2000, and is expected to continue to decline. The facilities at the site may be converted to an underground neutrino-detection laboratory, however, offering the community a sustainable use for the industry's invested capital.

Finally, and as indicated, Nevada mines continue to account for the bulk of U.S. production. However, its mines have not been spared the kinds of operating problems described above. In 1997 there were 35 major and medium sized precious metals mines operating in the state. By mid 2001, 16 of these had either closed or announced that closure was imminent in the next 12 to 18 months. Increased production since 1997 has come from expansion of output at the major mines and mining complexes described above. Consequently, the mines have continued to have a very significant economic impact in the state in spite of the generally depressed conditions in the industry, but the performance has been spotty.

The most significant impact on Nevada's economy has been the significant reductions in exploration expenditures and the virtual cessation of capital expenditures on mine development and expansion. Hence, while the economic impacts of production continue only slightly diminished, the impacts of the loss of capital spending have had a negative impact on the economy particularly compared to the 1995–96 period when the industry spent approximately one-half billion dollars per year on major mine development and expansion projects. As an indicator of the dearth of capital spending only two new mines have opened in Nevada since 1997: the Franco-Nevada and Euro-Nevada joint venture Ken Snyder Mine at Midas and Alta Gold's Olinghouse Mine near Fernley in the western part of the state. The latter closed relatively soon after opening when Alta Gold sought bankruptcy protection. The reduction in capital spending not only resulted in a loss of construction and service jobs in the state but also reduced sales and use taxes paid directly by mining companies by about 30 percent.

PRODUCTION COSTS

The previous study noted the strong correlation between commodity prices and production costs that is achieved by producers increasing the grade of materials processed. This occurs in aggregate when higher-cost producers processing lower-grade ores close down, thereby raising the average grade in the industry, and at individual operations where lower grade ores are bypassed or stockpiled. Whether viewed in aggregate or from the perspective of an individual operation, the result is a relatively close tracking of production costs and price and a relatively stable gross operating margin in spite of price variations.

Figure 3 illustrates this aggregate phenomenon showing gold prices, U.S. industry weighted average total cash costs and their difference (gross operating margins) from 1989 to 2000. In this case, total cash costs refer to direct production expenses for extraction, processing, and mine site administration as well as direct production and property taxes and production royalties. While direct production expenses for extraction, processing and on-site administration represent the actual cost of production, the latter cash expenses for taxes and royalties are legal obligations that must be paid to operate. Consequently, the difference between the commodity price and total cash costs, the gross operating margin, represents cash flows from operations.

While obviously related to profitability, gross operating margins or cash flows ignore noncash costs such as depreciation and depletion. These noncash items reflect the costs of recouping operators' investments. In addition, gross operating margins do not consider the costs of acquiring operators' most valuable asset—their orebodies—through exploration or acquisition. Consequently, rather than reflecting profitability, the gross operating margin reflects the ability of the operator to survive in the current price and regulatory environment with their current orebodies. Indeed, "total cash costs" are what conventional economics textbooks refer to as "average variable costs" and are used to define a firm's shutdown point. That is, when price is less than average variable costs, a producer will minimize its losses by shutting down. In this context, shutting down is suggested when gross operating margins are negative and there are no feasible means of reducing costs.

This conventional microeconomic analysis has to be modified somewhat to reflect the costs of closure, primarily reclamation costs and other possible obligations incurred in permitting and bonding processes. The prospect of facing sometimes large reclamation costs at a point in the mine's life when it is generating no, or significantly diminished, revenue, creates an economic incentive for operators to conduct "concurrent reclamation" activities. By reclaiming as much as possible while the mine is operating, the operator can reduce its tax liabilities and avoid some costs triggered by closure.

Viewed in the context of a single operation these closure costs should not influence a closure decision. Continuing operations would only increase losses. However, viewed in the context of an operator with multiple operations which increased industry concentration has led to, these closure costs can influence decision making at the margin. The marginal operation can be viewed as an option on future production that has value because prices could increase. Closing a marginal operation diminishes the option value because of the costs that would have to be incurred to reopen it.

Figure 3 shows U.S. industry gross operating margins fluctuating between a high of approximately $150 per ounce in 1989, 1990, 1994, and 1996 and a low of $88 in 1992. Since 1997 when gold prices dropped through the $300 level at year-end, gross operating margins have slowly eroded from $112 per ounce in 1997 to $101 in the most recent period. While this trend is clearly disturbing from the perspective of industry sustainability, it should be noted that these margins were obtained by bringing total cash costs down by one third, from $256 per ounce in 1995 to $172 in 1999 and $178 in 2000. Hence, the industry has demonstrated remarkable resiliency in the face of considerable adversity.

One reasonable question concerning the trends illustrated by Figure 3 is why producers do not always produce at lower costs if they are capable? The implication of the question is that producers are incurring unnecessary costs in periods of higher prices. While there have certainly been examples of unwise expenditures in the industry or, to put it differently, expenditures that have not increased shareholder value—and the author could easily compile a list of such things done by mining company executives with the benefit of hindsight-the point is that the trend illustrated by Figure 3 is the result of good management, not bad. These cost savings have come from numerous sources, as indicated above. At the aggregate, industry-wide level, closure of higher-cost producers has brought the average down. But, more significantly, cost cutting at individual properties has resulted in substantial cost savings. One natural source of cost reduction that results from price changes, in this case, reductions, is the adjustment of producer cut-off grades. A second source of sometimes significant cost savings comes from delayed spending on development and exploration.

In the case of adjusting cut-off grades operators are making an explicit marginal revenue versus marginal cost calculation. That is, operators are likely to have materials in their orebodies that vary both in grade and geochemical nature. Grade variations refer to the quantity of recoverable gold and/or silver per ton of ore. The average grade for all of the material planned to be mined over the life of the mine varies significantly among mines from under 0.02 ounces per ton to over one ounce per ton or fifty times richer ore. Likewise, the grade of materials available at an individual operation may vary from containing several ounces of gold per ton of ore to barren material. In determining a cut-off grade the operator determines what grade of ore breaks even at the margin or what grade generates just enough revenue to cover the cost of its production. Having determined the cut-off grade, the operator classifies all higher-grade materials as ore and lower grades as waste. In some cases an operator may have two cut-off grades, one for material that can be processed immediately and another for material to be stockpiled for processing later if market conditions warrant.

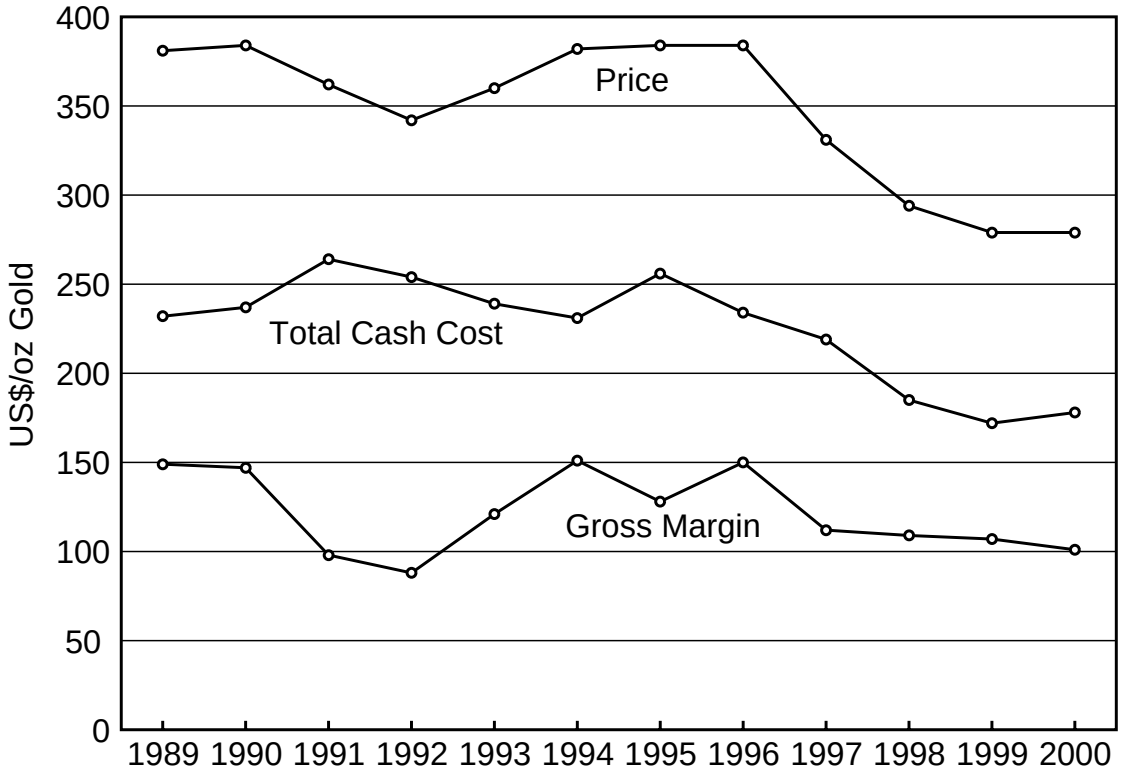

Figure 3. Average annual prices, total cash production costs, and gross margin, 1989–2000.

As a consequence of this practice, changes in prices naturally lead to adjustments of cut-off grades. Lower prices raise cut-off grades and imply that higher-grade materials will be processed. This, in turn, lowers costs. Price increases have the opposite effect, lowering cut-off grades and raising production costs. These adjustments, which all operators make if they are able, produce the correlation between price and production costs illustrated by Figure 3.

Another factor that contributes to the relationship between price and production costs, albeit in a less consistent way than cut-off grade adjustments, is adjustments in the timing of exploration and development expenditures. Exploration and development expenditures are frequently associated with finding a new orebody and developing a new mine to extract and process the ore. However, exploration and development are activities that virtually all mine operators conduct throughout most of the operating lives of their mines. Exploration activities near an existing mine seek to expand reserves and extent the operating life of the mine. Development activities can consist of removing overburden to get access to ore that will be mined in the future. Operators frequently drill exploration holes to determine the existence of mineralization in areas around known orebodies but stop short of drilling enough holes to prove a reserve, that is, prove that there is a 95 percent probability that ore can be mined at a profit.

When exploration and development occurs prior to production they are capitalized and become part of a mine's noncash costs. However, after a mine begins production these expenses become a use of cash flow that cuts into the gross operating margin of the mine. Even if accountants choose to capitalize these costs rather than expense them against current production and, thereby, lower their reported current total cash costs, these activities are a use of cash and subject to the same sort of marginal revenue versus marginal cost calculation employed in calculating cut-off grades.

Exploring for ore and developing orebodies that will not be mined until later not only have explicit, out of pocket, costs, but implicit costs including the cost of capital and the time value of money. Hence, reserves that may not be mined for several years have a lower net present discounted value than similar quality reserves that will be mined sooner. The operator must evaluate the expected gross operating margin on mining reserves in the future, and discount these net expected net margins to their present value. These discounted future gains must be compared with the cost of exploration drilling today to prove they exist. As prices decline, the net present value of proving reserves to be mined in the future decline.

The $6-per-ounce increase in total cash costs in 2000 shown in Figure 3 might suggest that the industry has wrung

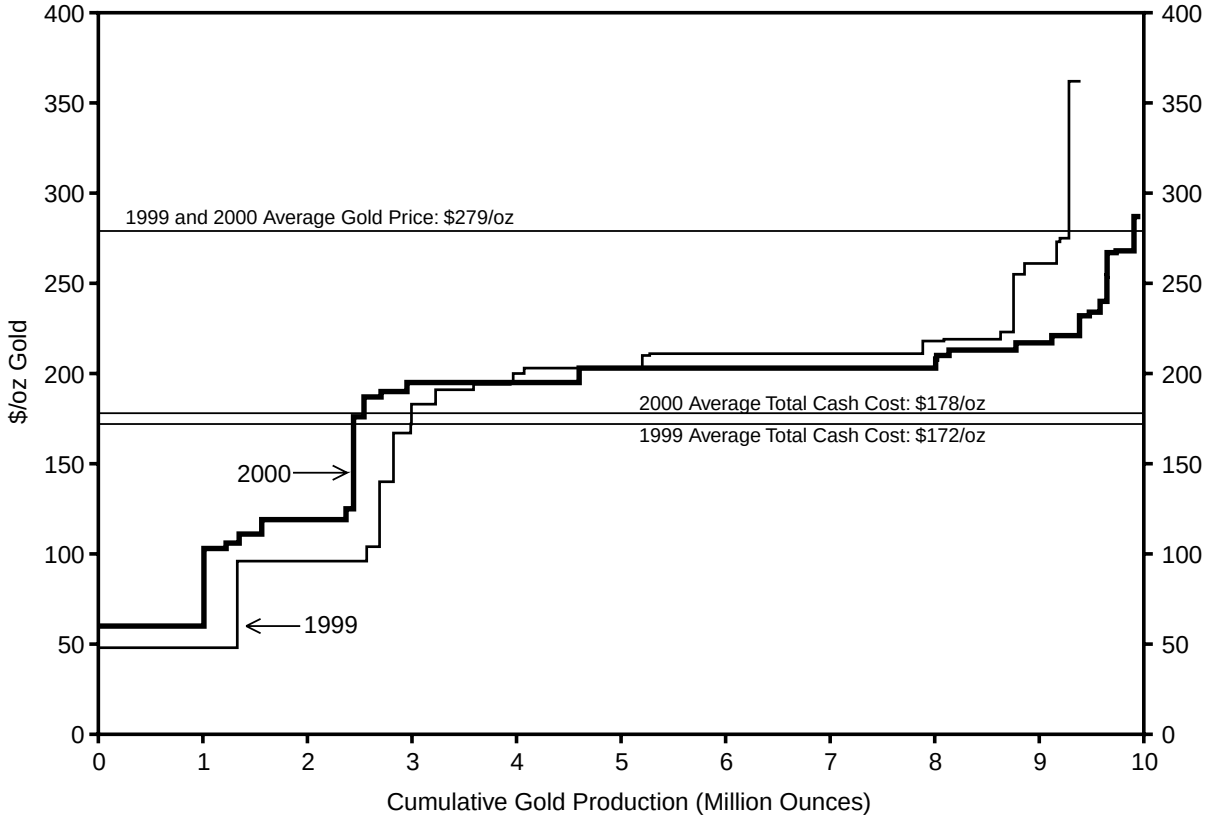

Figure 4. Total cash production costs in 1999 and 2000.

about all it can from its costs and that the downward trend in production costs that began in 1997 may be reversed. As indicated by Figure 4, this conclusion is unwarranted. Figure 4 shows 1999 and 2000 total cash costs for individual mines and mining complexes. Each horizontal segment of the total cash cost curves represents the output of one mine or complex arranged, left to right, from the lowest to highest cost producers. The length of the segment represents the output of that mine or complex measured in millions of ounces on the horizontal axis. The vertical axis indicates total cash production costs for that mine or complex and the vertical distance between the curve and the "1999 and 2000 Average Price - $279" line indicates the gross operating margin or cash flow from operations.

A comparison of the curves for 1999 and 2000 provides better insight into the cause of the $6-per-ounce increase and likely trends in production costs. Note that at the low-cost (left) end of the curves, the 1999 curve lies significantly below the 2000 curve up until about just over three million ounces. From that point until approximately five million ounces, the two curves are very close to each other. To the right of five million ounces on the horizontal axis, the 1999 curve lies above the 2000 curve and substantially more so on the far right of the figure.

This shift in the position of the curve is the result of several factors. First, at the low cost (left) end of the curves, several mines with extremely low costs saw their costs rise in 2000. These cost increases were actually fairly large in percentage terms, e.g., at the lowest cost producing mine in both years, Placer Dome and Kennecott's Cortez property in Nevada, total cash costs increased 25 percent, from $48 to $60 per ounce. Several other producers at this end of the curve also experienced relatively large increases in costs in percentage terms but, again, these percentage increases are calculated on very low initial costs. While these large relative cost increases on approximately one third of U.S. production increased the weighted average for the industry, they certainly do not suggest a threat to the industry's sustainability because they remain some of the most efficient mines in the world.

At the high cost (right) end of the curve there are some other significant differences between the 1999 and 2000 curves. Most notably, the lower 2000 curve indicates lower costs and the longer curve indicates greater output. The lower costs came about for several reasons; however, the most significant change came from the closure of one very high cost mine, Placer Dome's Getchell Mine in Nevada. Other mines were able to cut costs to lower the curve but, unfortunately, in several cases these cost savings were associated with decisions to close the mines, which implied that certain costs of ongoing operations were no longer necessary. As a result of these changes, it is likely that the 2001 curve will be even lower and average total cash production costs will come back down in 2001, particularly if increases in electricity costs are a temporary phenomenon. The key point with respect to the shift in the curve between 1999 and 2000 is that rationalization of production has reduced production generating negative cash flows from around 10 percent of production to about one percent of production.

While total cash costs are an important indicator of profitability, because the difference between realized price and total cash costs represents cash flow from operations or gross operating margins, they do not reflect the ability of operators to recoup their initial investment as well as cover other costs necessary to sustain operations over the long run. The latter costs would include exploration to replace reserves and corporate overhead costs. Total production costs shown on Figure 5 for 1999 and 2000 are better indicators of profitability, although they also do not generally include the latter kind of costs noted above. Total production costs include total cash costs and noncash costs such as depreciation of plant and equipment used in production and certain on-site development costs.

Because total cash costs are the largest component of total costs, the relationship between 1999 and 2000 total production costs is very similar to that described above for total cash costs. At the low (left) end of the curves 1999 costs were lower, with the crossover point around 3 million ounces. From the crossover point to approximately 7 million ounces, total production costs in the two years were approximately the same. As with Figure 4, the most significant differences between production costs is at the high cost (right) end of the curves with 2000 total costs substantially below 1999. Between the two years an additional million ounces were rationalized on a total cost basis with approximately seven million ounces and eight million ounces produced at a cost below the average price in 1999 and 2000 respectively.

Figures 6 and 7 present similar information for 1999 and 2000, respectively, showing total cash costs and total production costs in 1999 in Figure 6 and 2000 data in Figure 7. The difference between the two curves on each figure represents noncash production costs as noted above. Note, however, that because of different noncash costs between different mines, costs for particular mines only line up on the horizontal axis for the lowest and highest cost mines.

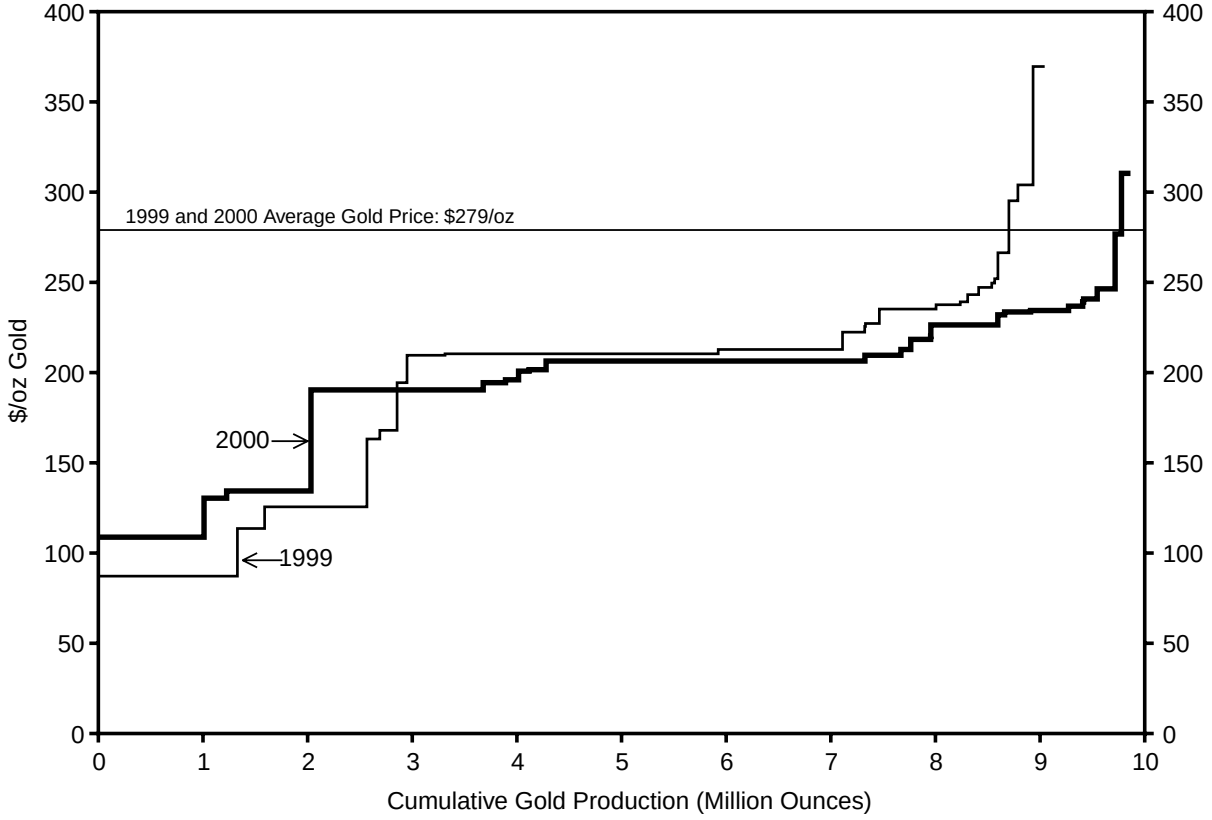

Figure 5. Average total production costs in 1999 and 2000.

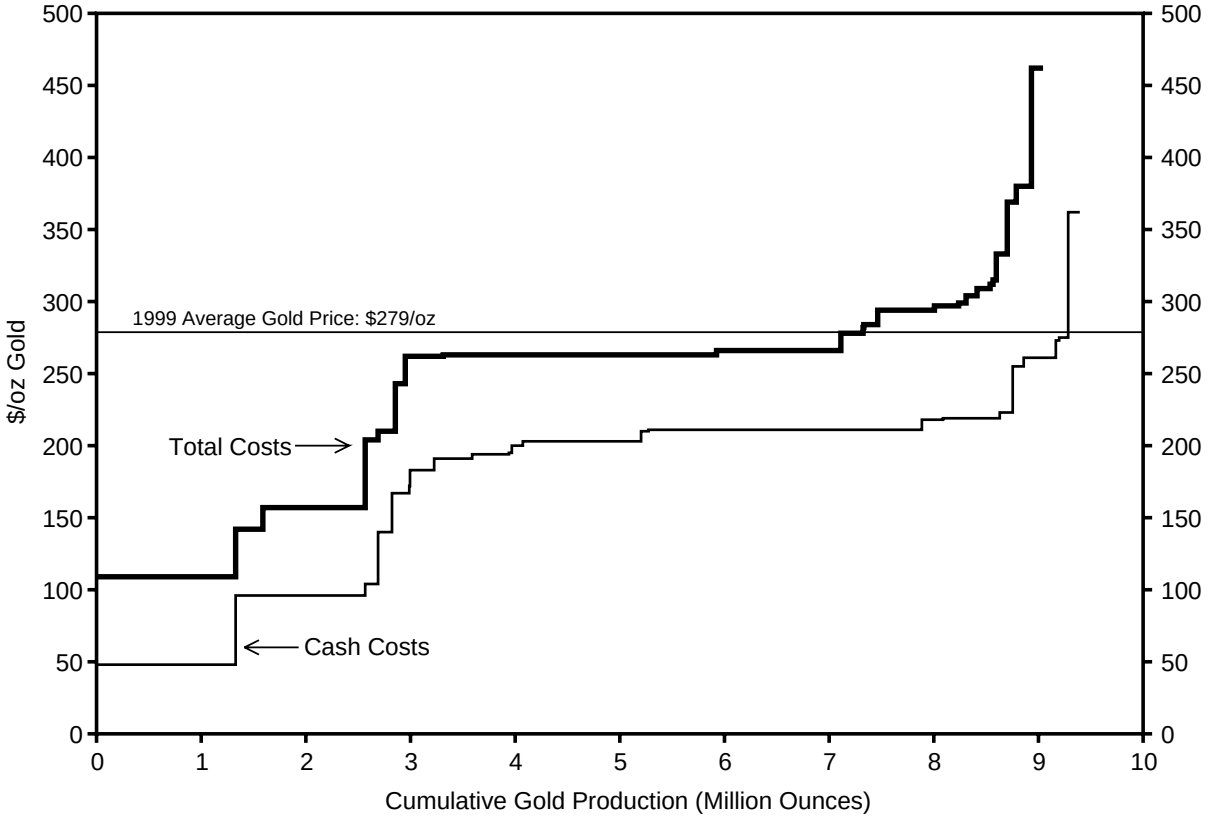

Figure 6. Average total cash costs and average total production costs in 1999.

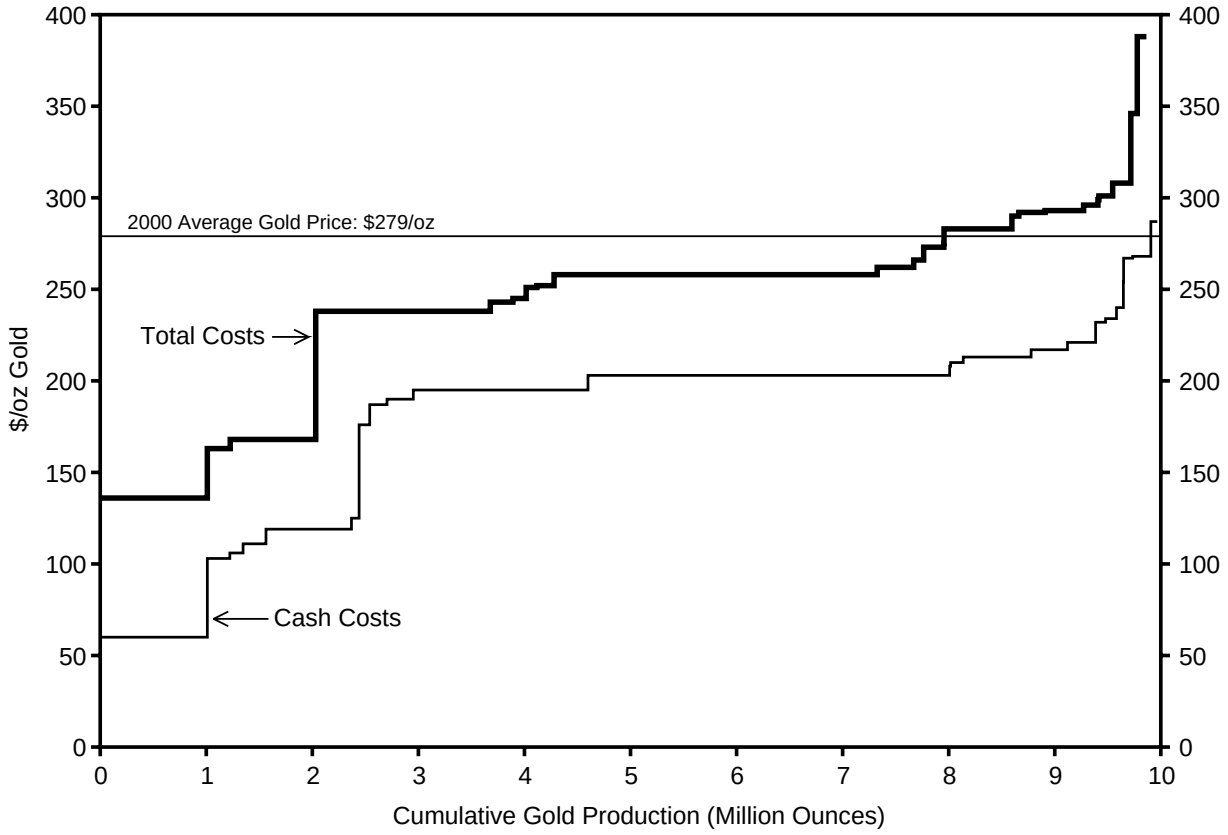

Figure 7. Average total cash production costs and average total production costs in 2000.

PUBLIC POLICY ISSUES

In general, the U.S. gold industry has some of the most efficient mines in the world as measured by production costs. Were gold and silver mining simply a matter of extracting and processing ore, there would be little concern about the sustainability of the industry beyond the normal concern of exhausting individual orebodies. And, indeed, the exhaustion of individual orebodies has not historically been a threat to industry sustainability because the industry has had an outstanding record of replacing mined gold and silver with new reserves through exploration.

At the present time, questions concerning industry sustainability are much more closely linked to the regulatory environment than to issues of engineering and geology. Two significant public policy and regulatory issues facing the industry are the "3809" reform process and the U.S. Department of the Interior (USDI) Solicitor's "Millsite" opinion issued in 1997. The first issue refers to the rewriting of Surface Management regulations authorized by the Federal Land Policy and Management Act of 1976 (FLPMA) found in 43 C.F.R. § 3809 in the last years of the Clinton administration. The so-called "millsite" opinion refers to an opinion issued by the USDI Solicitor John Leshy that limits operators on federally owned lands managed by the Bureau of Land Management (BLM) to one 5-acre millsite claim per one 20-acre mining claim. Both of these issues illustrate the fairly open hostility toward the industry that developed during the latter half of the tenure of Bruce Babbitt as Secretary of the Interior.

At this point, as a result of the change in administration, some of the provisions most objectionable to the industry have been dropped or held for reconsideration. However, the general objectives of the advocates of public land law and regulatory reform have not changed, and these issues are likely to resurface in a future administration. The issues are highly divisive, indeed, as divisive as the 2000 election itself. Further, it should be noted that parts of the reform package were warranted, like financial guarantees for reclamation, and in the best interests of a sustainable industry even if some in the industry objected to them.

The "3809" rule-making has significant implications for the industry because the new regulations include procedural and substantive changes that will, according to the BLM's Environmental Impact Statement (EIS), impose substantial economic losses on the industry and the communities dependent on it. These losses, according to the BLM's EIS, will include an estimated 3,200 jobs, reductions in industrial output of between $180 and $540 million per year, and reductions in household income between $89 and $249 million per year (BLM, 1999a).

To estimate these losses, the BLM has apparently assumed a pro rata reduction in mining activity on federal lands affected by the regulations. This type of estimate, however, arguably errs in two ways. First, it probably overstates the initial impact of the regulations, and second, it probably significantly understates the long-run impacts.

The initial impacts are likely overstated because, as noted above, most U.S. production is coming from large, long-lived properties that are already permitted. These operations are not likely to be affected—at least initially—by the regulations although they may be affected in the future if they seek to modify their operating permits for expansions or other changes. We will undoubtedly see some current operations close in the near term, but this is the result of low prices, high operating costs, and exhaustion of orebodies. It is unlikely that many of those mines that close in the next year or so, or have closed in the past couple of years, would do so or would have done so if the price of gold were $400 per ounce and the price of silver were $8 per ounce.

As noted, the most significant impacts of the new regulations will occur in the long run. These impacts will occur when current viable operations seek to modify their operating permits to allow them to expand or modify operations. In addition, and perhaps most significantly, the new regulations could create significant disincentives to explore for new orebodies on federal lands. The potential impacts on future exploration are perhaps best illustrated by the denial of an operating permit for Glamis Gold's Imperial project in southeastern California. This case is currently being litigated as other projects undoubtedly will be in the future. This case is discussed briefly below, but at this point suffice it to say that revised regulations grant the BLM broad authority to deny operating permits based on purely subjective grounds unrelated to performance standards such as environmental quality regulations or regulations concerning wildlife habitat, and cultural and historical resources.

The mining industry believes that the economic losses noted above are significant underestimates in the long run because the primary effect will be to reduce mineral exploration, which will mean that operators currently producing in the U.S. will not discover new mineral deposits to replace those currently being mined. This, in turn, will mean that when currently producing orebodies are exhausted over the next five to ten years, mining operations will shut down.

Despite these substantial costs, the proposed regulations offer little in the way of environmental protection except, and exclusively from, the BLM's prediction that there will be less mining if the regulations are adopted. Moreover, the BLM's EIS also acknowledges that current surface management regulations already incorporate most of the substantive environmental protection requirements included in the revised regulations, which became effective January 20, 2001.

There are several controversial issues inherent in the 3809 rule-making that arise from both procedural and substantive issues. For example, a significant substantive issue concerned regulation of water quality and quantity or, the allocation of water for various uses. However, it is on the reform process itself where controversy was most evident because, the industry argued, the BLM lacked a clear Congressional mandate for its revision of the 3809 rules. Indeed, it was argued that the BLM acted in spite of Congress.

On the procedural side of the controversy, the late 1980s and early 1990s saw several attempts in Congress to amend the 1872 Mining Law. The proposed changes included imposition of a leasing system, a federal royalty, and other fiscal initiatives. Also proposed was greater federal authority to restrict access to public lands, managed by the BLM and the U.S. Forest Service, for exploration and mining operations. Although the industry supported some limited types of reforms, the reforms proposed by environmental interest groups sought to significantly limit mineral industry access to public lands, and these reforms were opposed by the industry. These reform efforts generally ended in failure although Congress did make small changes such as imposing a moratorium on patents, i.e., selling surface rights to mine operators for $2.50 per acre, and replacing the annual $100 per claim assessment work requirement with a $100 per year holding fee.

Reform of the 1872 Mining Law was viewed by environmental interest groups as essential for limiting mineral development on public lands because FLPMA did not give BLM authority to limit mining. FLPMA directed the Secretary "by regulations or otherwise, [to] take any action necessary to prevent *unnecessary or undue degradation* of the public lands." (FLPMA § 302(b), emphasis added) This phrase became the primary legal authority for BLM's regulation of mining, but it only allowed BLM to restrict degradation of public lands that were *unnecessary* to mining. Disturbances on the public lands that were *necessary* to mining were beyond the BLM's regulatory authority. The same section FLPMA stated:

> "... no provision of this section, or any other section of this Act shall in any way amend the Mining Law of 1872 or impair the rights of any locators or claims under that Act, including, but not limited to, rights of ingress and egress." (FLPMA § 302(b))

It should be noted, however, that disturbances of the public lands that were *necessary* to mining were still regulated by all applicable environmental regulations promulgated under the Clean Water, Clean Air, Antiquities, and other Acts. This is not to suggest that the industry has a spotless environmental record. Some operators have damaged water resources in violation of these laws and regulations. However, these incidents provide an argument for better implementation and enforcement of existing regulations, not the elimination of mining on federal lands.

Moreover, since mining operators are subject to state reclamation laws and need approved reclamation plans before creating a disturbance, it is unlikely that they would cause *unnecessary or undue degradation* of the public lands since this, if it had any practical consequences, would likely increase their reclamation costs.

In any event, as hopes of Congressional reform of the mining laws faded with changes in Congressional leadership, Secretary of the Interior Babbitt directed the BLM to resume revising the 3809 surface management regulations. In his directive he stated:

> "It is plainly no longer in the public interest to wait for Congress to enact legislation that corrects the remaining shortcomings of the 3809 regulations." (Babbitt, 1997)

Hence, the BLM sought to impose rules through the regulatory process that Congress expressly refused to enact.

What followed the Secretary's 1997 directive has been controversial both within the federal government and between the federal government and affected states. Within the federal government, and indicative of the BLM's lack of a Congressional mandate, Congress subsequently addressed the 3809 rule-making process on five separate occasions. Congress directed the BLM to perform certain tasks before the rules could be adopted. Among these tasks were to conduct a study considering specific issues. Congress also attempted to limit revisions of existing 3809 rules. All of these Congressional directives can reasonably be interpreted an as attempt to "rein in" the agency.

Among the tasks BLM was required to perform before issuing its final 3809 regulations was the commissioning of a study by the National Research Council (NRC). The NRC formed a Committee on Hard Rock Mining on Federal lands in late 1998 comprised of thirteen members with diverse backgrounds and areas of expertise. The Committee held hearings seeking input from the mining industry, state officials, environmental groups and the public at large. In addition, members of the Committee conducted field inspections of mining and exploration operations permitted under the existing regulations. The Committee reviewed hundreds of documents to produce a peer-reviewed study published in September of 1999 entitled *Hardrock Mining on Federal Lands* (National Research Council, 1999). The general findings of the report included:

> "Existing regulations are generally well coordinated, although some changes are necessary. The overall structure of the federal and state laws and regulations that provide mining-related environmental protection is complicated but generally effective."
>
> "Improvements in the implementation of existing regulations present the greatest opportunity for improving environmental protection and the efficiency of the regulatory process." (p. 5–6)

Following the release of the report the BLM was prepared to issue the final regulations without apparent regard for the findings of the report and in spite of requests to extend the comment period in light of the NRC findings. Congress overruled the BLM's refusal to extend the comment period in an emergency supplemental appropriations bill adopted in May, 1999.[1]

The following November Congress weighed in again, restricting changes in the 3809 regulations to rules that were "not inconsistent with the recommendations contained in the National Research Council report ..." [2] In response, Interior Department Solicitor sent a directive to the BLM instructing it to only consider portions of the NRC report that were plainly labeled as "recommendations." In addition, the Solicitor indicated that "rules addressing issues that are not directly covered by the NRC's recommendations would not run afoul of this [Congressional] limitation." [3] In other words, in the Solicitor's view, the Congressional limitation did not limit anything unless it contradicted something plainly labeled as a "recommendation" in the NRC report.

Because the final 3809 regulations had not been issued before the Congressional limitation expired, Congress had to weigh in again. In the Interior Department Appropriations Act for FY 2001 the Conference report attempted to made Congressional intent clear:

> "Section 156 allows the BLM to promulgate new hardrock mining regulations that are not inconsistent with the National Research Council Report entitled "Hardrock Mining on Federal Lands." This provision reinstates a requirement that was included in Public Law 106-113... The statutory requirement was based on a consensus reached among Committee Members and the Administration. On December 8, 1999, the Interior Solicitor wrote an opinion concluding that this requirement applies only to a few lines of the Report, and that it imposes no significant restrictions on the Bureau's rulemaking authority. *The Committee does not agree with the solicitor's opinion, and does not intend the language in this section to constitute any ratification of or agreement with that opinion."* [4]

[1] Emergency Supplemental Appropriations Act of 1999, Pub. L. No. 106-31, § 3002, 113 Stat. 57 (1999).
[2] Consolidated Appropriations Act for FY 2000, Pub. L. No. 106-113, § 357, 113 Stat. 1501 (Nov. 29, 1999).
[3] Memorandum from Department of Interior Solicitor's Office to BLM (Dec. 8, 1999).
[4] Pub. L. No. 106-291, § 156, 114 Stat. 1011 (2000) (emphasis added).

The general presumption is that federal agencies promulgate regulations to implement Congressional intent. Indeed, implementing Congressional intent is the source of an agency's authority to issue regulations. However, in this case, it is difficult to divine Congressional intent from the actions of the BLM. On the contrary, as noted above, the DOI and BLM appear to have acted in spite of Congress.

Somewhat ironically, on August 4, 1999, as this process was going on, President Clinton signed Executive Order 13132, which requires a federal agency issuing regulations to consult with state governments and report on the nature of that collaboration and report what it has done to accommodate state concerns to the Office of Management and Budget. As a consequence, it is also useful background to look at federal-state interactions concerning the rewriting of the 3809 regulations.

Western public lands states, acting individually and collectively through the Western Governors' Association (WGA), repeatedly sought to influence the BLM. Because of Nevada's leading position in the industry, the State consistently questioned the need for the new regulations. The State referred to the BLM's own assessment in its Draft EIS that Nevada's regulatory requirements effectively protected the environment, that cooperation between the BLM and Nevada's regulatory agencies was good, and that mining in Nevada was carefully regulated.

In June 1997 the WGA adopted a resolution stating:

> "[r]evisions to the 3809 regulations may not be necessary. More consideration should be given to compliance with existing regulations. States have filled and should continue to fill any deficiencies identified in the statutory and regulatory framework and its enforcement. *Establishing burdensome or duplicative new BLM regulatory requirements for mining is not in the best interest of states or the nation*." [5]

In addition to this resolution, the Governors asked the BLM to consult with them individually and collectively regarding the 3809 rule-making. Apparently before the BLM could respond to this request, in the fall of 1997 Congress adopted language in the FY 1998 Interior appropriations bill prohibiting the BLM from conducting any further work on the revisions of the 3809 regulations until it had certified that it had consulted with every governor and/or his or her representatives in states with public lands open to mineral entry.[6] Three days after the appropriations bill was passed, and without any apparent further contact between the BLM and the western governors individually or collectively, the BLM Director sent letters to the Chairmen of the appropriate Congressional Committees certifying that the required consultation had been done.[7] The WGA later disputed this claim, stating in a letter several months later that "we feel that consultation has yet to truly begin." [8]

As the rule making process proceeded, western state governors continued to interject themselves individually and through the WGA. Commenting on one of BLM's "working drafts" of the regulations, the WGA restated western states' concerns with the proposed changes:

> "[W]e remain concerned that BLM has still not made a compelling case for the need to rewrite the existing regulations. We believe that the current system is working well. ... To garner state support for the proposed changes to its 3809 regulations, *it is incumbent upon BLM to demonstrate that there is a problem that needs fixing*." [9]

And, later, in a request that BLM extend its public comment period until after the NRC Report could be published, Wyoming Governor Jim Geringer, on behalf of the WGA, stated:

> "From the very beginning of the rule-making process that you initiated two years ago, the governors of the Western Governors' Association, collectively and individually, have repeatedly requested an explanation of why the BLM believes that mining on public lands is not proper under the current 3809 regulations. *Let me put it in simple terms: What's broken?"* [10]

In Senate hearings in the spring of 1998, Nevada Governor Bob Miller again stated Nevada's position, which concurred with the findings of the BLM's Draft EIS, that the current system worked well in protecting the environment and that Nevada's regulatory framework was more than adequate. It was at this point that Governor Miller recommended that Congress require BLM to seek an independent evaluation of the existing 3809 regulations, which eventually led to the NRC report.[11]

What is clear from these attempts of western governors is that they had little or no impact on the BLM, which was determined to revise the 3809 regulations. The BLM apparently viewed its public comment periods, during which states were allowed to submit comments along with members of the public, as seeking consultation with the states. The states, on the other hand, apparently sought more deference: the deference of a sovereign-to-sovereign consultation. This never occurred nor, it should be added, does it appear to be required under the National

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[5] Western Governors' Association, "Resolution 97-006, Regulation of Mining" (June 24, 1997) (emphasis added).
[6] Department of the Interior and Related Agencies Appropriations Act of 1998, Pub. L. 105-83, § 339, 111 Stat. 1543,1603 (1997).
[7] Letter from Pat Shea, Director, BLM, to Chairmen of Congressional Energy and Natural Resources, Resources and Appropriations Committees (November 17, 1997).
[8] Letter from Western Governors' Association to BLM Director Pat Shea (February 5, 1998).
[9] Letter from Western Governors' Association to Bob Anderson, 3809 Task Force Leader, BLM (Oct. 9, 1998) (emphasis added).
[10] Letter from Wyoming Governor Jim Geringer on behalf of the Western Governors' Association to Sec. Bruce Babbitt (March 21, 1999) (emphasis added).
[11] Statement of Governor Bob Miller, Testimony on S. 1102, S. 326 and S. 327, S.Hrg. 105-668, Hearings before the Subcommittee on Forests and Public Land Management of the Committee on Energy and Natural Resources, (April 29, 1998).

Environmental Policy Act (NEPA), which created the process requiring federal agencies to present a DEIS to the public for comment. The western states did, however, manage to influence the process through their Congressional delegations, which intervened on their behalf to commission the NRC Report and forced the agency to extend its deadlines for public comment. While influence over the process is some impact, however, it is not clear that states or the Congress had any meaningful impact in the substantive issues addressed by the regulations.

On a substantive level, the original version of the regulations would have fundamentally altered the nature of state management of its water resources. Performance standards for water quality and allocation, for example, caused serious concerns in some quarters. The Director of the Nevada Department of Conservation and Natural Resources' assessment of the impact of the BLM's revisions of the 3809 regulations is that they "clearly attempt to undermine the state's primacy in water quality protection of both surface and ground water, and the State Engineer's authority to allocate water from both surface and underground sources." [12] It should be noted, however, that some of these performance standards have been eliminated, at least temporarily, and many of these issues are yet to be resolved.

With respect to water quality requirements in the revised regulations, the old 3809 regulations require all operators to comply with applicable federal and state water quality standards.[13] Federal regulators, generally the Environmental Protection Agency (EPA), set discharge and other standards and the states may make these standards more stringent based on local conditions. The proposed regulations, on the other hand, would have required operators to *minimize* changes in water quality, (43 C.F.R. § 3809.420(b)) where *minimize* means to

> "reduce the adverse impact of an operation to the lowest practical level. During review of operations, BLM may determine that it is practical to avoid or eliminate particular impacts." (43 C.F.R. § 3809.5)

This difference might appear minor, but it is significant both in terms of potential costs and risks to prospective operators and state authority to regulate water quality. A prospective operator may propose to discharge water that meets EPA and state water quality standards yet, if the BLM determines it "practicable" to improve the quality of the water discharged, the operating permit could be denied. The costs and risks to prospective operators implicit are fairly clear. The "practicable" means of improving water quality are likely to increase its costs—otherwise, in all likelihood, it would have chosen to do it voluntarily. In addition, this provision would simply give BLM one more reason to deny a permit. In light of the fact that a proposed plan of operations could meet or exceed EPA pollution standards, it would also give the BLM the right to *supersede* EPA regulatory authority.

These aspects of the impacts of the proposed 3809 regulations make it clear that it will become riskier to explore for minerals on public lands. This discretion, combined with other features of the revised regulations, would appear to create strong disincentives to operate on public lands.

For example, the revised regulations provided a new definition of FLPMA's reference to the Secretary's obligation to prevent *unnecessary or undue degradation* of the public lands. Under the new definition the BLM can deny permits to operate in a manner *necessary to mining* and within the guidelines of all applicable federal and state environmental laws if, in the opinion of the BLM, the operations *unduly* degrade the environment.[14] Hence, the regulations essentially rewrote the legislation authorizing them.

Another example is what has come to be known as the "mine veto provision." This provision was subsequently dropped in the revisions to 3809 regulations that became effective on December 31, 2000. However, the mine veto provision provides a perspective on what was proposed. The provision also expands the definition of *unnecessary or undue degradation* to include practices that "result in substantial irreparable harm to significant scientific, cultural, or environmental resource values of the public lands that cannot effectively be mitigated." (43 C.F.R. § 3809.5) While seeking to avoid "irreparable harm" certainly sounds like a worthy goal, it is important to be specific about what kinds of harms that mining can cause even if these practices violate no existing environmental laws and regulations or laws and regulations protecting wildlife habitat, or cultural and historical resources. Primarily, since mining generally involves altering the landscape, "irreparable harm" can consist of digging a pit that is not back-filled, removing some portion of a mountain or, more generally, failing to return the land to its original contours through reclamation. Indeed, it is entirely possible that "irreparable harm" could be determined to occur by simply disturbing a site even if it is fully reclaimed to original contours. Undoubtedly, one could find some individual who claims that a particular place is sacred and that its disturbance would cause "irreparable harm" and an administration seeking to limit mining could deny operating permits.

Lest this example seem far-fetched, and as an indication of how this provision can be implemented, Glamis Gold was recently denied a permit for its Imperial Project at a site near the Arizona-California border because there are trails on the site believed to be used by a local Native American tribe to visit religious sites. The final EIS for the

[12] Turnipseed, R.M., 2000, Director, Nevada Department of Conservation and Natural Resources, memorandum to Governor Guinn (November 28, 2000).
[13] 43 C.F.R. § 3809.2-2 (1999).
[14] 65 Federal Register at 70017.

project could not identify any religious sites or archeological resources on the mining project site, nor could it confirm that Native Americans used these trails in the past 50 years. Nonetheless, the project was stopped by the final environmental impact statement because the EIS claimed that it would have disturbed these cultural resources that are no more substantial than the "setting, feeling and association" of the area. (BLM, 2000)

If this incident provides an example of how the "irreparable harm" standard can be applied then it is not difficult to see why mining companies may be hesitant to explore for minerals in the United States. Mineral exploration is a risky proposition in any event, and the uncertainty of going forward with an exploration or mining project is only made worse by this new standard.

State Concerns

A significant source of state concerns about the revised 3809 regulations stems from fears that the BLM can use these regulations, and it stated an intent to do so, to extend federal authority over areas of traditional state sovereignty. In the arid western U.S., where water has always been a source of controversy, this assertion of new federal powers is a serious concern.

As an example of the nature of state concerns, the water quality performance standards in the revised regulations put the BLM in a position to overrule permits issued by states which have primacy, or primary regulatory oversight authority under environmental laws. Since these regulations only relate to permits for exploration and mining on BLM administered lands, they could be viewed as a reasonable effort to protect water quality on BLM lands. However, because of extensive federal land ownership and BLM land management in western states, potential for conflict between state and federal regulators is clear. In Nevada, for example, which is 86 percent federally owned, and most of which is managed by the BLM, virtually all surface waters and aquifers flow over or are under BLM lands in some part. Hence, this same seemingly reasonable logic would give *all* water quality regulatory authority in Nevada to the BLM.

The revised 3809 regulations also assert a federal right to determine water use and make water allocation decisions on federal lands that, with the exception of "reserved rights" created by Congressional actions, have been regulated by state law. These provisions primarily relate to mine dewatering activities in which operators sometimes pump large volumes of water to prevent it from seeping into open pits and underground works. In Nevada, permits to dewater mines are issued by the Nevada State Engineer and typically call for reinjection of the water into the same aquifer to recharge it some distance from the mine. In some cases the water is used for irrigation, replacing groundwater that would have to be pumped under prior existing state issued water rights. When neither of these options is practicable, the State Engineer has allowed water to be discharged into surface streams.

These allocations of water for mine dewatering are temporary, largely nonconsumptive, although a small quantity of water may be used for mineral processing and some may be lost to evaporation, and are made with respect to prior existing rights. None of these rights, it should be added, belong to the federal government since the land management activities of the BLM do not constitute a "beneficial use" under state water law. That is, the BLM does not provide water for human consumption, grazing, mining, or manufacturing.

The revised 3809 regulations require that an operator "must conduct operations to minimize changes in water quantity in preference to water supply replacement," and "conduct operations affecting ground water, such as dewatering, pumping and injecting, to minimize impacts on surface and other natural resources, such as wetlands, riparian areas, aquatic habitat, and other features that are dependent on ground water." (43 C.F.R. § 3809.420(b)(2)) Moreover, in response to public comments on the BLM EIS (BLM, 1999a) questioning BLM authority to allocate water, BLM responded:

> "While allocation and permitting of water use is primarily the responsibility of the States, the 'prevention of unnecessary or undue degradation' mandate *makes it BLM's responsibility* to address impacts to water resources on the lands under its jurisdiction, in deciding whether to approve plans of operations under these regulations." [15]

The proposed regulations and BLM's asserted authority to overrule the State Engineer, creates a *de facto* water right for "wetlands, riparian areas, aquatic habitat, and other features that are dependent on ground water." With the possible exception of wetlands protection authorized by legislation, there does not appear to be Congressional intent that would create a "reserved right" under FLPMA. In addition, BLM's asserted authority under the revised 3809 regulations would a *de facto* federal right to determine "beneficial use," a right that heretofore has been the exclusive right of the state legislatures.

The use of a "minimization" performance standard in the context of water allocation is problematic, as it was in the context of impacts on water quality, although for slightly different reasons. In this case, dewatering activities generally simply move water from one area, in the vicinity of mining operations where it is a nuisance, to another area where it may generate environmental benefits. For example, discharge of mine water into the Humboldt River in Nevada has benefited downstream users, i.e., irrigators,

[15] 65 Fed. Reg. At 70053 (emphasis added).

temporarily improved downstream aquatic habitat, created temporary wetlands, and improved biodiversity. Indeed, the filling in of open pits after mining and dewatering operations may create more permanent aquatic habitat and recreational resources for the state's citizens and tourists. The focus on minimizing impacts "in preference to water supply replacement" which may be purely local, misses the bigger picture.

In granting dewatering permits the State Engineer makes a determination that is subject to appeal by other water rights owners, that the proposed water allocation is a beneficial use and promotes the general welfare of the state. These criteria are likely to be inconsistent with impact minimization.

The State Engineer has legislative authority to consider the general welfare of the state, a sovereign authority. The BLM, in contrast, appears prepared to focus on minimizing local impacts but, more significantly, maximizing its authority to deny operating permits that the State Engineer's Office may approve in pursuit of its view of the general welfare of the state.

Congress and the courts have long recognized that water rights do not derive from federal laws.[16] The regulations also contravene the clear language of FLPMA that "[n]othing in this Act shall be construed as . . . expanding or diminishing Federal or State jurisdiction, responsibility, interests, or rights in water resources . . . " [17] Indeed, the 3809 revisions appear to revive a dispute that was, until now, put to rest in the early 1980s-that FLPMA does not grant BLM authority over water resources. (Shurts, 1984)

The Potential Benefits of Regulatory Reform

As some of the comments from the Western Governors' Association above should have made clear, one of the contentious issues in the revision of the 3809 regulations was the need for the revisions in the first place. As noted, then-Secretary of the Interior Babbitt believed they were necessary because Congress refused to reform the general mining laws in a manner to his liking. Secretary Babbitt's views were, and are, supported by numerous environmental interest groups. The Bush administration's decision early on to open up the regulations, which went into effect on Inauguration Day, January 20, 2001, to more public comment was harshly criticized by these groups. This decision was later reversed in light of this criticism and then the regulations were revised and reissued on December 31, 2001. At the time of this writing, the status of some of the provisions of the regulations remains unclear. However, some of the more onerous provisions from the perspective of the industry have been removed. The so-called "mine veto provision" based on "irreparable harm" has been eliminated, for example, so a "wait and see" perspective is probably most appropriate.

In light of both the controversy surrounding the revision of the surface management regulations and the acknowledged costs, it seems reasonable to look into the potential benefits that regulatory reform can bring. Aside from improving enforcement of existing regulations, the major change in regulations recommended by the NRC study focused on financial guarantees to assure that operators or the BLM can reclaim lands affected by mining. Hence, it is not argued that regulatory reform was unnecessary. The following focuses on the "Benefit-Cost Analysis/Unfunded Mandates Reform Act Analysis" (BLM, 1999b) conducted pursuant to Executive Order 12866 (BLM B-C Analysis), which is a companion document to the EIS.

In valuing the benefits of proposed regulations to protect public lands from unnecessary and undue degradation, the first task is to identify what the proposed changes would accomplish if adopted. In an analysis of any policy, program or regulation it is not sufficient to demonstrate that a problem exists to justify government intervention. It is necessary to identify the actual net marginal benefits that regulatory intervention will induce, and then compare these benefits to the costs of the intervention. (Gramlich, 1991; Posner, 1998, p. 56) In this case, this implies a need to carefully specify what the proposed changes in 3809 regulations can reasonably be expected to produce in terms of improved environmental protection.

This analysis proceeds from the premise that some activities conducted on public lands that are governed by 3809 regulations can and sometimes do cause unnecessary and undue degradation of the public lands. The issuance of Notices of Noncompliance under part 3809 regulations since their publication in 1980 is direct evidence of this. The question to be addressed, however, is to what extent will the proposed regulations prevent this degradation in the future? That is, what harm that is currently being done to the environment will be prevented under the proposed rules?

The BLM B-C Analysis correctly uses estimated environmental damages avoided by the proposed rule as a proxy for benefits. However, after a careful examination, it does not appear that the benefits of the proposed 3809 regulatory changes, as described in the EIS, are addressed by the BLM B-C Analysis.

Before examining the BLM B-C Analysis, however, it is first necessary to characterize the major regulatory initiatives in the revised regulations that may generate benefits for the public and the environment. Then, the BLM B-C Analysis can be viewed from the perspective of the

[16] See, for example, Andrus v. Charlestone Stone Production Co., 436 U.S. 604, 611-14 (1978).
[17] FLPMA § 701(g)(2); 43 U.S.C. 1701(g)(2).

environmental benefits that the revised regulations can be expected to produce.

The major change in surface management regulations, as noted in the EIS (BLM, 1999a, p. 92-93) primarily relate to "Notice Level Actions." These actions, under the old 3809 regulations, were actions that disturbed less than five acres. Under the old 3809 regulations, individuals or operators seeking to conduct operations such as mineral exploration or extraction and processing that disturbed more than five acres are required to file a "Plan of Operations" which is subject to much more federal and state regulatory oversight than Notice Level Actions. Plans of Operations, because they require more detailed planning and oversight, also consume more regulatory and industry resources and require more time.

As the EIS points out (p. 92–93), the major changes envisioned by the revised 3809 regulations would, in some cases, require a Plan of Operations for some activities that could be carried out under Notices of Intent under the old regulations. In addition, the revisions would require bonding for Notice Level operations.

With respect to Plan Level activities conducted under the old regulations, the EIS repeatedly points out that the revised regulations will have little effect. For example, in the impact matrices provided in Appendix E of the EIS it is stated (p. A-115):

> "For most types and sizes of mining activities the proposed regulations received a relatively small negative score (Table E-3). For small mining operations, specifically Notice-level operations, adverse effects are expected to be somewhat higher than for the larger operations...Except for financial guarantee requirements, *large operations would not be affected by these proposed regulation changes*." (emphasis added)

Further, in discussions of its mine cost models, the EIS states (A-123) in the context of discussing its exploration model (although exploration is frequently a Notice-level activity, large scale exploration projects require Plans of operations):

> "Impacts to exploration would be slight because BLM and industry are already generally following these procedures in authorizing operations and accepting regulations."

Similarly, in the context of its discussion of its placer mining model, the EIS (p. A-130) states:

> "Impacts to the industry would be minimal because BLM and industry are generally following these procedures in authorizing operations and accepting final closure and reclamation."

Virtually the same phrase can also be found on page A-139 with respect to the BLM's strip mine model and on page A-151 with respect to its open pit mine model. While these repeated statements are likely intended to assure operators that the revised regulations will not impose large costs, the obvious question these statements raise, from the perspective of quantifying the benefits of the proposed regulations to the environment is, if the regulations are relatively benign, then what benefit will they provide to the environment? Furthermore, if operators operating with Plans of Operations issued under the old regulations could improve environmental protection at virtually no cost, why would they not already be doing it? Again, the unanswered question is what harm was being done to the environment that the revised regulations will avoid?

The EIS does make a number of statements about "Alternative 1: No Action" and "Alternative 2: State Management" which appear to be indictments of the current regulations and western state regulatory oversight without saying, specifically, where the system has failed. As a consequence, it is not possible to determine what environmental costs have been incurred and which of these would be avoided. For example, on page 119 the EIS states:

> "The Revised regulations would not change the existing framework of federal and state laws that protect water resources. It would, however, increase protective measures for water resources and reduce the risk of water resource contamination by implementing tighter controls ..."

Since, as noted above, Congress and the courts have repeatedly affirmed the states' right to regulate water, it is difficult to imagine how the revised regulations can tighten controls without changing the "existing framework of federal and state laws that protect water resources." One possible answer to this question comes from the EIS's repeated references to performance standards. That is, through the establishment of

> "performance standards that are mainly outcome based, describing the resource condition that must be achieved or the performance a particular operating component must meet...," (p. 42)

the regulations can specify some post-mining environmental quality.

This, however, was already done, but under the auspices of state laws. Federal standards would, in effect, create a uniform standard across all western public lands states. States, however, argued through the Western Governor's Association that this would offer little or no benefit because a single standard across states with disparate climatic, geological and other conditions from Alaska to Arizona, for example, would not be practical. The EIS did not address the issue of how uniform performance standards would be flexible enough to avoid unnecessary prohibition of beneficial mineral industry activities in places where standards may be too stringent, or prevent undue and unnecessary environmental degradation where they may be too loose.

Moreover, in public hearings on the proposed regulations as well as in the statements above, the BLM implied that its performance standards are generally in conformance with existing state regulations. So, again, there does not appear to be any significant net benefit to the environment that will be achieved for Plan level operations by the revised regulations.

One performance standard the EIS notes has environmental benefit refers to the backfilling of open-pit mines (p. 44). The revised regulations establish a presumption of backfilling open pits after mining is completed and, indeed, the open-pit cost model in Appendix E assumes backfilling. The language in EIS presumes that failing to backfill a pit causes environmental damage that would be remediated by backfilling.

The latter presumption flies directly in the face of BLM's own study of backfilling (BLM, 1998) which points out that open pits can have desirable environmental consequences. For example, high pit walls provide raptor habitat. Raptors have located in the high walls of at least one Nevada operation during operational phase and the BLM study suggests reclamation techniques to enhance high wall suitability as raptor habitat after mine closure. Further, pit floors, because they will accumulate storm runoff, will generally provide enhanced habitat for raptor prey in arid areas. In short, as long as toxic materials are not left exposed, which is currently not allowed, backfilling may be expected to reduce biodiversity in the mine area.

In cases where pit lakes form, after treatment, pit lakes and wetlands can also create wildlife habitat and, potentially, recreation areas. This, of course, is not to suggest that this would universally be the case. But it does call to question the presumption in the EIS that backfilling should be required unless it is not feasible. Any benefits from backfilling need to be carefully weighed against the environmental benefits that can be gained from a more reasoned approach. The EIS does suggest that it intends a more reasoned approach with various statements but the actions of the BLM has created numerous skeptics.

With these points in mind, the revised regulations offer benefits to the public of preventing undue and unnecessary degradation of public lands resulting from Notice Level activities that were allowed under the old regulations. Furthermore, the bonding requirement in the revised regulations offers the public the further safeguard of providing funds that would allow the BLM to direct and fund the cleanup of sites previously disturbed under Notices of Intent.

An analysis of the benefits of the revised regulations, it is argued, requires a close examination of the record of the industry under the old regulations to identify undue and unnecessary environmental degradation that can be avoided. This examination would include industry conduct under the old regulations and the nature and frequency of Notice Level disturbances found to be in noncompliance with these regulations. The nature and frequency of noncompliance under the old regulations are discussed in general terms in the EIS. The EIS also provides projections of Notice Level activities that would be in noncompliance both with and without the revised regulations.

Analysis and quantification of environmental benefits derived from the revised regulations of Plan Level activities, however, is problematic since the EIS provides no specific information on past costs and how they will be avoided. Indeed, it is curious to suggest, as the EIS and the BLM B-C Analysis imply, that the revised regulations will result in significant benefits at virtually no cost to operators. If this were the case, operators would have already voluntarily taken the steps needed to provide improved environmental quality at no significant cost. In short, the data provided by the EIS is nebulous and does not lend itself to quantification. Hence, the following focuses on the only specific information provided.

As indicated, it is argued that an analysis of the benefits of regulatory actions should, as a matter of reasonableness, be based on the actual net marginal benefits that the proposed regulatory actions are likely to produce. In this case, it has been further argued, these benefits consist of avoiding undue and unnecessary degradation that was caused by Notice Level activities on the public lands under the old regulations. Since the revised regulations do not demonstrably raise performance standards on Notice Level activities, the impacts on public lands of Notice Level activities that comply with current performance standards cannot be considered benefits. Furthermore, any impacts related to larger scale disturbance of public lands, affecting more than five acres, already requires a Plan of Operations and would continue to under the revised regulations. Hence, environmental benefits measured in terms of avoided undue and unnecessary environmental degradation from Plan Level uses of public lands are not expected to change under the revised regulations.

In examining the BLM B-C Analysis, it is apparent that BLM analysts have, for the most part, used a different measure of benefits than that proposed above. For example, in one instance (p. 54) the BLM B-C Analysis used environmental damage caused in the Clark Fork Basin in Montana as an illustration of measuring environmental damages using the contingent value method. This is not to suggest anything wrong with contingent value methodology; the problem is that the operations that caused environmental damages in the Clark Fork Basin in central Montana could not be permitted under the old regulations. Hence, assuming a 0.05% chance of producing a situation with 10% of the severity of the kind of environmental conditions that exist in Anaconda and Butte is taking a valid study out of context.

The kind of tailings disposal employed at Anaconda, where toxic metals are allowed to run off into streams simply would not be allowed under the Clean Water Act and regulations promulgated under it as well as other acts. In

other words, environmental damage in the Clark Fork Basin has nothing to do with 3809 regulations. In addition, a tailings impoundment that could be built under the old regulations could not be built under a Notice of Intent. It would require a Plan of Operations that, as noted above, are not materially affected by the revised regulations. Furthermore, the type of tailings impoundment at the Clark Fork Basin could not be permitted under the old 3809 regulations. Therefore, the environmental damage in the Clark Fork Basin, or even a small percentage of that environmental damage cannot reasonably be used as a measure of the benefits of the proposed regulations.

The same criticism applies to the use of other studies of water quality in the BLM B-C Analysis. Without questioning the validity of the studies referred to on Table 22, p. 61 of the BLM B-C Analysis, it is not clear what they have to do with the benefits of the revised regulations. As with the analysis based on the Clark Fork Basin in Montana noted above, the analysis of potential impacts of mining on water quality described on p. 61 is based on an assumption concerning potential catastrophic events. The problem with this formulation of the potential benefits of the revised regulations is that the regulatory changes will not reduce the probability of a catastrophic event affecting Notice or Plan level activities. Consequently, the elimination of these potential events cannot be considered a benefit of the revised regulations. Nor, for that matter, could Notice level activities, which largely consist of mineral exploration, create conditions that could trigger much environmental damage even in a catastrophic event like an earthquake, landslide or flood.

As the EIS points out on pages 92 and 93, the major changes envisioned by the revised regulations would require, in some cases, Plans of Operations for some activities that could previously be conducted under Notices. In addition, the revised regulations would require bonding for Notice Level operations. The problem with this analysis is that the types of activities described such as building a tailings impoundment, could not be done under a Notice under the old regulations. In addition, the tailings impoundment referred to in the Clark Fork Basin could not get approved under the old regulations. Consequently, the types of groundwater and drinking water contamination described on page 61 of the BLM B-C Analysis would not be avoided by the revised regulations and, therefore, cannot be considered as benefits.

Reassessing the Benefits of Regulatory Reform

The first objective of the alternative analysis of benefits to be offered is a reformulation of the problem. Specifically, assuming the proposed regulations work perfectly by avoiding all undue and unnecessary environmental degradation, what environmental costs will be avoided? The answer, at least in part, can be found in the EIS. The BLM B-C Analysis does not suggest that mining activities that meet existing environmental regulations pose environmental threats but refers to the possibility of accidents and the industry's record of noncompliance as the source of environmental costs and, hence, benefits to be achieved by the revised regulations.

Hence, the relevant data are the cost of noncompliance under the old regulations. According to the EIS, from 1981 to 1997 on all BLM lands in the U.S., 948 Notices of noncompliance have been issued; 690 (38 per year) of these for Notice level operations and 258 (15 per year) for Plan level operations.

Looking just at the Notice Level violations because, according the EIS, Plan Level activity will be unaffected; the EIS provides a breakdown of the nature of the violations:

72% for failure to reclaim
15% for operational problems
13% for failure to file a Notice

The EIS further indicates that the average Notice affects 2.12 acres.

The BLM B-C Analysis focuses on contingent value and willingness to pay analyses for values of affected environmental resources. This methodology attempts to put a value on these resources. However, as a practical matter, society should bear no cost higher than the cost of mitigating the damage caused by noncompliance. The BLM analysis is analogous to assuming that, if the water pump goes out on a $30,000 automobile, the cost is $30,000, when, in fact, the cost is the several hundred dollars that it costs to replace the water pump. What needs to be done, in our view, involves verifying the nature and extent of noncompliant Notice Level activities, their cleanup costs, and trends in rates of compliance with the old 3809 regulations. The discussion below focuses on seven scenarios for the purpose of estimating the costs of undue and unnecessary degradation and the expected benefits of the revised regulations. These scenarios are summarized in Table 6.

Note that Table 6 shows the results of the following calculations using a 3 percent discount rate as was used in the BLM B-C Analysis. Also, like the BLM B-C Analysis, the benefit estimates below do not include "non-use" values or values associated with impacts on wildlife habitat and aesthetic values. Unlike the BLM analysis, however, we do not argue that these unquantified values are significant. Given the nature of Notice Level activities, i.e., small scale, short term, and generally out of public view, we would argue that these values are generally negligible. Most Notice Level activities would be exploration, which typically involves leveling a thousand-square-foot, or 0.023-acre pad to place a mobile drill on and grading a crude access road. The latter typically accounts for a majority of the average 2.12 acres of disturbance. After exploration is completed, the area is recontoured and, if appropriate, revegetated.

Table 6. Estimated benefits of regulatory changes

		#	Area (acres)	Unit Cost ($/acre)	Freq.	Annual Total Cost	10 Yr. PV (@ 3%)
1. Nevada						64,400	549,332
2. USFS	D_1 (Exp.)	38	2.12	3,140	72%	182,130	
	D_2 (Op.)	38	2.12	3,640	15%	43,986	
	D_3 (FF)	38	2.12	3,225	13%	675	
	Total					226,791	1,934,530
3. Net Benefits							
	D_1 (Exp.)	8	2.12	3,140	72%	38,343	
	D_2 (Op.)	8	2.12	3,640	15%	9,260	
	D_3 (FF)	8	2.12	3,225	13%	142	
	Total					47,746	407,269
4. Post 1993 Rates							
	D_1 (Exp.)	6	2.12	3,140	72%	28,757	
	D_2 (Op.)	6	2.12	3,640	15%	6,945	
	D_3 (FF)	6	2.12	3,225	13%	107	
						35,809	305,452
5. Maximum Case							
	D_1 (Exp.)	38	2.12	5,000	72%	290,016	
	D_2 (Op.)	38	2.12	10,000	15%	120,840	
	D_3 (FF)	38	2.12	5,850	13%	1,225	
	Total					412,081	3,515,054
6. Break-Even Case							
	D_1 (Exp.)	38	2.12	71,900	72%	4,170,430	
	D_2 (Op.)	38	2.12	143,800	15%	1,737,679	
	D_3 (FF)	38	2.12	84,123	13%	17,620	
	Total					5,925,729	50,546,471
7. Net Break-Even Case							
	D_1 (Exp.)	8	2.12	341,500	72%	4,170,125	
	D_2 (Op.)	8	2.12	683,000	15%	1,737,552	
	D_3 (FF)	8	2.12	399,555	13%	17,619	
	Total					5,925,296	50,542,771

Scenario #1. Cases of Noncompliance in Nevada

In an effort to examine the nature of noncompliance with the old regulations a list of "BLM-Nevada State Record of Environmental Problems Associated with Notice-Level Mining or Exploration" was obtained and screened by a professional engineer familiar with mining sites and involved in the reclamation business in Nevada. The list was provided to Nevada Assemblywoman Marcia deBraga (chair of the Nevada Assembly Committee on Natural Resources, Agriculture and Mining) by Nevada State BLM officials.

The list contains 156 Notice Level disturbances consisting of 90 for which a Record of Noncompliance was issued, 25 for which a Notice of Noncompliance was issued, and 41 of which are described as "miscellaneous." These problem Notice Level activities, however, consisted of 138 sites since some sites had multiple Notices. In the screening it was determined that 112 (81 percent) probably were actually mining-related activities, primarily exploration, that had occurred under 3809 regulations between 1981 when the old regulations were promulgated and 1997. The balance were either not Notice Level disturbances because they exceeded the 5-acre limit, disturbances that predated 3809 regulations, i.e., historical mining and nonmining disturbances, such as trespass on public lands for other purposes, and a few cases where private funds have been used to already reclaim the disturbance. Based on this screening, a cost estimate of $1,095,000 for reclaiming 124 of the sites that appeared to be Notice level mining activity was provided.

Since 3809 regulations allowing Notice Level activities have been in existence for approximately 17 years, it would appear that the annual damage done to public lands in Nevada by noncompliant mining activity is approximately $64,400. Further, as a first approximation, this could also be considered the annual benefit of the revised regulations in Nevada, where most exploration on public lands occurs in the U.S., if the revised regulations succeed in avoiding all such undue and unnecessary degradation in the future. Over a ten-year period, discounted at 3 percent, the present value of this avoided cost would be a paltry $549,300.

Scenario #2. Estimated Benefits Using USFS Bonding Standards

In a further effort to investigate the actual expected benefit, reclamation costs from a company operating on U.S. Forest Service (USFS) lands were examined. These costs were examined because USFS lands tend to be in more mountainous terrain, which adds to reclamation costs and involves more sensitive habitat. Figures examined were from a reclamation plan approved for bonding by the USFS.

Costs of recontouring and revegetating lands disturbed by exploration activities, the primary activity currently allowed in Notice Level disturbances on BLM lands and the activity that would be affected by the proposed rule, varied by the steepness of terrain. The steepest terrain, in excess of 45 percent slope, recontouring cost approximately $6,000 per acre. This figure is considerably higher than the per-acre costs used to derive the cost estimate above and does not include revegetation, which is estimated to add an additional $240 per acre. These recontouring and revegetation costs range down to approximately $700 per acre for land with zero to ten percent slope. The mean cost weighting four categories of terrain equally was approximately $3,140 per acre.

Using rates of noncompliance on Notice level activities provided by the EIS (BLM, 1999a, Table 3-6, p. 88) of 690 (38 per year) from 1981 to 1997, average area of disturbance (2.12 acres), and the breakdown of the type of disturbance provided by the EIS, the expected annual cost of failures to reclaim Notice level exploration activities would be:

$$D_1 = (38)(2.12 \text{ ac.})(\$3,140)(0.72) = \$182,130.$$

This estimate, however, does include noncompliant activities described in the EIS as "operational problems." These can include more significant activities ranging from major recontouring to cleanup of hazardous chemical left on sites. The latter, however, is less likely and was a very small proportion of the sites provided on the Nevada BLM list for Nevada. In an effort to estimate these costs the bonding costs for mining operations on USFS lands were examined since this would be an example of major regrading. These costs were $3,640 per acre. This would yield an estimate of the cost of "operational problems" of:

$$D_2 = (38)(2.12 \text{ ac.})(\$3,640)(0.15) = \$43,986.$$

Finally, the estimate of the benefits of the revised regulations needs to consider the remaining 13 percent of incidents of noncompliance that are described in the EIS as a failure to file a Notice. Since the EIS does not indicate a rate at which these incidents result in undue and unnecessary damage one assumption would be that they result in damage in the same proportion as all other Notice level activities. That is, 2 percent of Notice Level activities result in undue and unnecessary damage, and of these, damage is proportional to cases where the cause of damage is known (83 percent of the damage is the result of a failure to reclaim and 17 percent from operational problems). These assumptions use a weighted average of the two calculations above and would yield an estimate of damage to the public lands that could be avoided of:

$$D_3 = (38)(2.12 \text{ ac.})(0.02)(.13)((\$3,140)(0.83) + (\$3,640)(0.17)) = \$675$$

Combining these categories of estimated annual damage that could be avoided yields estimated total annual undue and unnecessary damage of:

$$\mathbf{D^{usfs}} = D_1 + D_2 + D_3 = \$226,791$$

Following the methodology used in the EIS for comparative purposes (Table 25 of the BLM B-C Analysis), this would imply a present discounted value of damage that could be avoided over a ten-year period, discounted at 3 percent, of $1,934,530.

Scenario #3. Net Benefits of the Revised Regulations

The EIS (BLM, 1999a, p. 93) indicates that under the revised regulations, there will be 600 notices of noncompliance over the next 20 years (30 per year). Since the record of the industry since 1981 indicates a rate of 38 per year, this indicates that the Revised regulations will result in a net benefit of a reduction in cases of noncompliance of eight per year. Using this assumption, the calculation (as indicated on the accompanying table) yields a net damage estimate, based on the BLM's own estimate of the effectiveness of its revised regulations of:

$$\mathbf{D^{net}} = D_1 + D_2 + D_3 = \$47,746$$

This would imply a present discounted value of damage that could be avoided over a ten-year period, discounted at 3 percent, of $407,269.

Scenario #4. Trends in Noncompliance

An extremely important point to consider in the effect of the revised regulations is the trend in noncompliance with existing 3809 regulations. The BLM's EIS indicates, as noted above, that there will be 600 notices of noncompliance over the next 20 years. However, an examination of the list of Notices of Noncompliance in Nevada indicates that of the 156 Notice of Noncompliance issued between 1981 and 1997, only 11 have been since 1993, and one of these is for a non-mining use of public lands. Hence, over the most recent five-year period available for analysis, there have been two mining-related notices of noncompliance in Nevada per year. Since Nevada accounts for 39 percent of total Notices (BLM, 1999a, Table 3-4, p. 87), this would imply a national rate of six per year on public lands over the 1993-97 period, and half of these occurred in 1993.

The significance of 1993 is that it was in that year that Congress eliminated the $100 work assessment and adopted the $100 per year holding fee. As a practical matter, the elimination of the $100 per year diligence requirement meant that claim holders were no longer required to conduct $100 worth of work to maintain their claims. As a result, claim holders were no longer required to cut roads and dig exploration trenches to satisfy assessment standards. This change apparently resulted in a significant reduction in disturbances that could be considered undue and unnecessary degradation if no further exploration work is done and the disturbances were not reclaimed.

Based on the rate of noncompliance since 1993, the annual gross cost of noncompliance, which would represent the annual undue and unnecessary degradation avoided by the revised regulations of:

$$D^{post'93} = D_1 + D_2 + D_3 = \$35{,}809$$

This would imply a present discounted value of damage that could be avoided over a ten-year period, discounted at 3 percent, of $305,452.

It should also be pointed out that the 1993–1997 rate of noncompliance in Nevada is less than the rate of noncompliance projected for the next 20 years by the BLM under the revised regulations. As noted above, the EIS (p. 93) indicates that under the revised regulations, over the next 20 years, there will be 600 notices of noncompliance (30 per year). This would imply that under the revised regulations would result in 24 *more* violations per year than occurred under the old regulations after the $100 per year work assessment was replaced with the $100 per year holding fee.

We do not intend to imply that the revised regulations will result in more undue and unnecessary environmental degradation, which is what the numbers provided by the BLM would imply. But, if we did combine post-1993 trends with the trends projected in the EIS it would show an increase in undue and unnecessary environmental degradation as a result of the revised regulations.

Scenario #5. Maximum Case

It can be argued that the bonding costs used above undervalue undue and unnecessary degradation of the environment by mining-related uses of public lands. Consequently, the next three scenarios look at the upper bounds of the potential benefits of the revised regulations.

In what is referred to as a "maximum case" we use what is considered to be the most it could reasonably cost per acre of disturbance to reclaim Notice Level activities on the average number of noncompliant uses of public lands for the 1981 to 1997 period. In this case, estimates of $5,000 per acre for reclaiming exploration activities (D_1) and $10,000 per acre for operational problems (D_2) were used. Estimates for damages resulting from failure to file a Notice were again calculated as the weighted average of the above proportionate to their occurrence. These assumptions yield an estimate of annual damage of:

$$D^{max} = D_1 + D_2 + D_3 = \$412{,}081.$$

This would imply a present discounted value of damage that could be avoided over a ten-year period, discounted at 3 percent, of $3,515,054. The significance of this figure is that if avoided costs are measured in terms of the most that it could reasonably cost to mitigate the damages caused by Notice Level activities on federal lands, these benefits would only amount to 0.2 percent of BLM's low estimate of annual industry output lost and 0.5 percent of BLM's low estimate of the annual household income lost from the revised regulations.

Scenario #6. Break Even Case

An alternative analysis of the upper bounds of potential damages caused by violations of the old 3809 regulations that might be prevented by the revised regulations can be viewed in terms of asking what the damage would have to be to break even from a benefit-cost perspective. The BLM B-C Analysis indicates (p. 67) that the lower bounds of the present value of the costs of implementing the revised regulations (using a 15 percent discount rate) are $50.5 million. In the Break Even Case analysis, we have sought to determine what unit costs, in terms of damage done per acre, would have to be assumed to justify incurring what the BLM's analysis indicates is the minimum cost of implementing the revised regulations.

In developing these estimates it has been assumed that environmental damage done by "operational problems" (D_2) are twice as costly as failure to reclaim exploration activities. Although this approach is somewhat arbitrary, it is useful in addressing criticisms of both the BLM and this analysis for failure to consider nonuse and other unquantifiable environmental amenity values.

As indicated on the accompanying table, the implied unit costs of all such violations would have to be $71,900

per acre for exploration related damages and $143,800 for operations related damages. This assumed level of damages would produce a gross benefit estimate of:

$$D^{gb\text{-}e} = D_1 + D_2 + D_3 = \$5{,}925{,}729$$

Scenario #7. Net Break Even Case

As with the discussion of net benefits above, the damage estimates in the breakeven case are calculated on a gross basis. That is, the benefit estimates above, in terms of damages avoided, are only valid if it is assumed that the revised regulations will eliminate all damages associated with violations. As also discussed above, if the bonding of Notice Level activities proposed in the revised regulations were adopted, this might be substantially achieved. However, the EIS indicates that even if the revised regulations were undertaken, there would still be 30 violations per year so that the net benefit would be eight cases of noncompliance avoided.

Using these assumptions, the estimated approximate level of assumed damages per acre of disturbance implied for the avoided costs to approximately equal the minimum cost estimated by the BLM of $50.5 million. As indicated on Table 6, the implied unit costs of all such violations would have to be $341,500 per acre for exploration related damages and $683,000 for operations related damages. These assumed levels of damages would produce a gross benefit estimate of:

$$D^{nb\text{-}e} = D_1 + D_2 + D_3 = \$50{,}542{,}771$$

It is probably not necessary to point out, but as a practical matter, the latter two damage estimates exceed the costs of cleaning major Superfund sites such as the Clark Fork Basin, which the BLM refers to in its analysis. For example, construction of the Old Works golf course at Anaconda, Montana on an abandoned millsite cost $44 million to reclaim 250 acres, or $176,000 per acre. The quality of reclamation done in this instance far exceeds anything that would be necessary for reclamation of disturbances caused by activities carried out under either a Notice of Intent or a Plan of Operations under the old regulations. Another well-known example of reclamation of noncompliant operations is at Summitville, Colorado, where a Plan of Operations was violated and led to significant water quality degradation. In that case, cleanup costs are estimated at $150 million for approximately 650 acres for a cost of $231,000 per acre.

Hence, it is possible for costs to reach the levels necessary to break even with the costs the BLM projects the revised regulations will have, but it was not likely under the old regulations. Note that the cleanup costs in the Clark Fork Basin were for activities that could not be permitted under current regulations. In the case of Summitville, damage was the result of noncompliance with a Plan of Operations and the failure of regulators to utilize existing enforcement powers.

In assessing the various scenarios above it is important to recognize that the provision in the revised regulations that offers the most benefit to the environment is the bonding requirement. This conclusion conforms to the findings and recommendations of the NRC report referred to above. Here too, the revised regulations are limited in their ability to protect the environment. Bonding costs are based on an assumption of compliance. When operators on Notice level or Plan level disturbances are out of compliance, bonding levels will likely be inadequate. What is required to avoid undue and unnecessary environmental damage is greater utilization of existing oversight and enforcement powers. The revised regulations simply cannot prevent regulatory failure.

In conclusion, this analysis of the benefits of the revised regulations finds that the BLM's estimates of benefits to be grossly exaggerated and only tenuously related to what the revised regulations can actually achieve. We believe that a more careful analysis of what the revised 3809 regulations can actually achieve would yield much more modest benefits, and levels of benefits that cannot justify either the economic losses or the costs of implementing the regulations.

The Millsite Opinion

In November 1997, USDI Solicitor Leshy issued an opinion that mining operations were limited to one five-acre millsite claim for each 20-acre mining claim. A millsite claim is land in the vicinity of the orebody that is used for mills, other processing facilities such as heap leach pads, holding ponds, tailings impoundments, waste dumps and other necessary facilities. A millsite claim is distinguished from a mining claim in that it does not establish a right to underlying mineral rights. Indeed, an operator would not want to put these facilities on a mining claim because they would likely have to be moved to mine the underlying minerals.

In issuing the opinion the Solicitor invoked the intent of the Mining Law. Curiously, since the passage of the Mining Law mining operators have been allowed as many millsite claims as were reasonably necessary to develop the mineral resource. Indeed, the BLM Manual (BLM, 1991) in effect at the time the ruling was issued stated that "[t]here is no limit to the number of millsites that can be held by a single claimant." (§ 3864.1.B). Of course, there is no limit to the number of mining claims that a single claimant may hold either, providing that they are valid claims, which means they can be mined at a profit. The upshot of the opinion, however, is that there can be no more than a one-to-one correspondence between the number of mining claims and millsite claims.

The significance of this opinion is that it could make the Mining Law unworkable in some cases, in the sense of making mining impractical. The mitigating circumstances

would be when an operator has private land available to use for necessary facilities or if the federal agency, the USFS or BLM is willing to sell, lease or swap needed land. The latter, of course, simply expands the prerogatives of the federal agency to deny an operating permit in cases where operators do not have access to private lands, which is frequently the case.

The reason the opinion renders the mining law unworkable is most easily seen in the case of waste rock dumps where operators place nonmineralized overburden and other materials that cannot be processed or tailings impoundments where they place materials that have already been processed. In these cases it is physically impossible to take materials out of a 20-acre area and place all of it on a 5-acre area. Physical restrictions on the slope of waste rock piles dictate that traditional engineering practices simply would not be allowed in spite of the fact that these practices have generally had no deleterious environmental impact other than to alter terrain.

Like the revised 3809 regulations, the millsite opinion is clearly an attempt to thwart new mine development on public lands or, at least, give federal land managers more discretion to block new mine development. Hence, it appeals to one of the complaints frequently heard from environmental interest groups that the mining laws give mineral development the highest priority use of the land. This frequently heard claim is only true in a very limited sense, however. Congress has removed millions of acres of land from mineral entry to create parks, monuments, wilderness, and other uses based on their special characteristics and amenity values. These regulations simply give regulators and the public another chance to block mineral entry. These factors add uncertainty to an already risky venture and create greater incentives for mining companies to reduce their investments in the U.S.

Also like the revised 3809 regulations, the millsite opinion generates little or no benefit to the public or the environment other than limiting an otherwise lawful activity. Existing mines will be largely unaffected, only future mining would be affected if the opinion stands legal challenges and the change of administration. A new solicitor could simply issue a new opinion. One thing is certain, however, both of these public policy issues will remain hotly contested issues in a divisive political environment.

INDUSTRY PERFORMANCE

As the discussion of production costs above indicated, industry efforts to cut costs and the closure of high cost operations have largely succeeded in maintaining gross operating margins. These cost-cutting efforts and the closure of high cost producers have, of course, been necessitated by low gold prices (Fig. 8) and have allowed the industry to

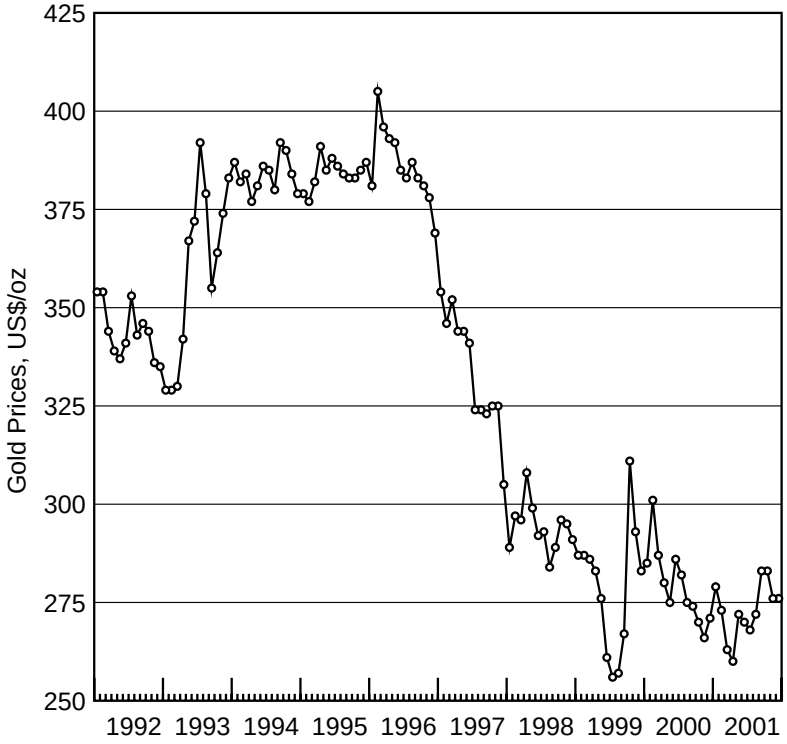

Figure 8. Monthly average London PM gold fix, 1992–2001 (www.kitco.com).

recover somewhat from fairly dismal financial performances in the immediate aftermath of the fall in prices in 1996 and 1997. Nonetheless, the industry's financial performance and the prospects for its sustainability in the long run have been overshadowed by the events in the public policy arena described above and the precipitous decline in precious metals prices since 1996.

Gold Prices

Advocates of mining law and regulatory reform affecting the industry have generally denied that these reforms adversely impact the industry and that, if they do, the damage is only marginal. Rather, the blame for falling industry output and declining U.S. exploration expenditures is laid at the feet of: i) gold markets and, specifically, weak prices, and ii) the dubious proposition that all of the gold in the U.S. has already been discovered. (The latter explanation for declining exploration expenditures was made to the author in person by a former director of the BLM in the Clinton administration.) The second explanation for declining U.S. exploration is belied by both continued U.S. exploration in the face of significant political and regulatory uncertainty and, more significantly, continued exploration successes. However, there is certainly some credence to the effects of weak gold prices.

Weak gold prices are an obvious problem facing the industry. And, while the principal purpose of this study has never been to provide an in-depth analysis of gold markets, it is worth addressing in some detail to distinguish between the effects of gold prices on the U.S. industry and environmental regulations.

Two long-term trends in gold markets are unmistakable. First, over the past two decades worldwide industry production has increased substantially, from 31 million ounces (962 tonnes) in 1980, (Murray and others, 1990) to 82.8 million ounces (2,576 tonnes) in 1999 (Klapwijk and others, 2000), a 160 percent increase. Much of this increase occurred in the 1980s. Since 1989, mine supply has increased from 66.3 to 82.8 million ounces (2,063 to 2,576 tonnes), a 25 percent increase.

The second trend is of more recent origin is the increase in the supply of physical gold into the market from above-ground sources, principally central bank sales and lending by central banks and private bullion banks to facilitate producer hedging. Total supply in 1981 was 39.6 million ounces (1,231 tonnes) and grew to 131.6 million ounces (4,093 tonnes) in 1999, a 332 percent increase. Hence, the growth in total supply, augmenting mine output with above-ground supplies sold into the market, has far outstripped growth in mine supply.

The first trend, the increase in world mine production, in itself cannot completely explain price declines since prices remained in the mid $300 range for most of this period. It appears that the world market was willing to absorb rising mine supply for various reasons, but principally because of rising Asian affluence and demand. In addition, during most of the 1980s central banks were buyers of gold, taking a net 32.1 million ounces (998 tonnes) off of the market during the decade. The periods during the past decade that saw the sharpest declines in prices, such as 1992 and 1997, were also periods during which there were sharp marginal increases in supply from above-ground sources. In the case of 1992, supply from above-ground sources increased by 29 percent from the previous year with the principal source of marginal increase being central bank sales coincident with the signing of the Maastrich agreement which set the ground rules for creating the single European currency. 1992 central bank sales hit their highest level of the decade at almost 20 million ounces (622 tonnes), up from 3.6 million ounces (111 tonnes) in the previous year. In the case of 1997, supply from above-ground sources increased by over 50 percent from the previous year. In this case, however, the culprits were a 350-percent increase in producer hedging and a 36-percent increase in central bank sales over the previous year.

These marginal changes in supply are shown on Figure 9. The left axis the figure shows Annual Change in Tonnes Supplied by source of supply: mine supply (ΔMS), official sales (ΔOS), and hedging (ΔH). The right hand axis shows Year-to-Year Changes in Gold Prices (ΔP). Note that changes in mine supply (ΔMS) have been relatively steady with the largest year over year increase in mine supply occurring in the first year shown, 1989. After that, changes in supply coming from underground have been modest compared to changes in supply coming from hedging and official sales.

Note that official sales reached a peak in 1992, coinciding with years of low gold prices. A sharp drop in official sales in the next two years also coincided with improving prices. Since 1995, however, official sales have been relatively constant source of supply and, given the agreement reached among European central banks in late 1999, this is expected to continue.

Again since 1995, the most destabilizing element of supply in the market has been producer hedging, fluctuating in seesaw fashion from 1995 to 1999. Price declines in 1997 coincided with a sharp increase in hedging but subsequent declines in hedging in the following year were offset by record increases in supply from scrap (not shown on the graph) because of the Asian currency crisis.

While this logic seems compelling, it does not stand up well to statistical analysis. Regressing year-to-year changes in supply from various sources against changes in gold prices over the 1989 to 1999 period leads to a different conclusion. Table 7 presents the results of a relatively simple statistical analysis of the relationship between changes in the components of gold supply, namely mine supply, official sales, supply from all identifiable above-ground sources, and hedging, and changes in gold prices. The analysis is limited to annual data that greatly limits what can be done with the data. Nonetheless, the analysis yields quite reasonable results.

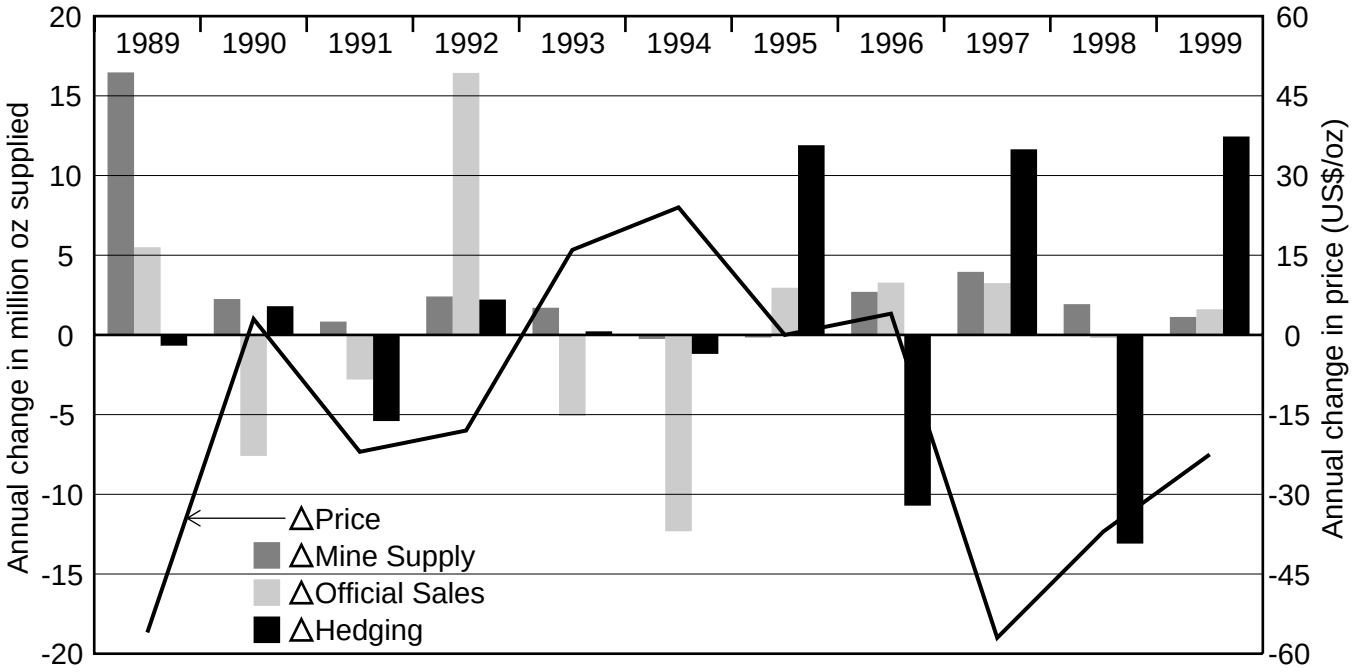

Figure 9. Annual changes in gold prices, mine supply, official sales, and producer hedging, 1989–99.

Table 7. Regression analysis of the effects of components of gold supply on prices.

Dependent Variable – Changes in Average Annual Gold Prices, 1989–1999		
Independent Variables	**Coefficient (t-statistic)**	**R^2**
Change in Mine Supply	-0.118 (2.40)	0.389
Change in Supply from All Above Ground Sources	-0.053 (1.60)	0.221
Change in Supply from Official Sales	-0.059 (1.80)	0.265
Change in Supply from Hedging	-0.008 (0.23)	0.006

As Table 7 indicates, increases in mine supply were more strongly correlated to prices than the other variables examined as indicated by the magnitude of its coefficient. Changes in mine supply were also the most statistically significant determinant of price changes with an absolute t-statistic of 2.40. However, changes in supply from official sales are also a statistically significant variable.

The difference in the magnitudes of the coefficients for the variables for mine supply and official sales reflects nothing more than the differences in the mean annual changes in supply from the various sources. Changes in supply from official sales during the 1990s have generally been more variable and larger in magnitude, hence the lower measure of statistical significance (t-statistic). Changes in mine supply have been smaller on a year-to-year basis and less variable to explain the high t-statistic. Changes in hedging have been the most variable as discussed above and illustrated by the graph. This will tend to yield insignificant statistical results but does not refute the noted destabilizing effect of hedging in the latter part of the time series.

The results lend some credence to arguments that central bank actions have been disruptive to markets because of the high variability of sales in the first half of the 1990s. However, with growing transparency arising out of the marketing agreement among European central banks coordinated by the European Central Bank, this variability will likely end. The liquidation of European central bank gold will likely proceed in a more orderly and less disruptive manner.

The results fail to lend credence to arguments for greater producer discipline in hedging. However, statistical analyses should not prevail over reason. While producer hedging has yielded benefits to some, it has done so when part of a long-run strategy, most notably in the case of Barrick. Short-run changes in hedging strategies, however, appear to have been destabilizing to the market as a whole and have proven to be ill advised for all market participants. Central bankers, at least, have realized that discipline is required to unwind their long position in gold. While it is not likely to be achieved because of free-rider problems, that is, because it is to the advantage of individual producers to hedge despite the aggregate impact on the market, a more orderly and transparent hedging strategy would clearly benefit the industry.

As occurs in many circumstances, an alternative theory to fundamental analysis is a conspiracy theory, that a cabal of bankers and politicians has somehow manipulated the market. Under the circumstances, however, fundamental analysis is more than sufficient to explain the decline in gold prices. Put simply, when central banks, as they did in 1999, endorse an agreement to sell a historically unprecedented quantity of gold in a relatively short period of time, there is no compelling reason to hold gold as an investment vehicle. And, indeed, we have seen a significant decline in investment demand. The more compelling logic is to sell before the central banks.

Even more compelling for some speculators given these market fundamentals in the late 1990s was the "gold carry trade." Speculators borrowed gold from a bullion bank to sell it into the market, the proceeds were then used to purchase bonds or stocks. The securities were then sold, generally at higher prices, to repurchase gold, generally at lower prices, to repay the bullion loan. As long as gold prices fell and the market rose, the gold carry trade made money both ways. Because the gold market is relatively small compared to other financial markets, practices such as these undoubtedly exacerbated the decline in gold prices and destabilized the market. However, the point is that it does not take a conspiracy to recognize a trading opportunity.

The "shakeout" phase of the long-run cycle for a perfectly competitive industry confers survival on those with competitive advantages. In this case, larger, higher-grade, orebodies, existing operating permits, and lower costs of production constitute the most significant forms of competitive advantages. The shakeout phase is significant in the context of the discussion of gold prices above because it suggests a decrease in supply from underground sources and implies upward pressure on prices to meet demand.

Table 8 was constructed to provide a visual and quantitative perspective on the shakeout. It shows U.S. precious metals properties that are producing, have produced, and might have produced gold dating back to the mid-1990s. The list is fairly complete.

The list shows 1999 gold and silver production and, when available, gold production for 2000 and gold reserves. Most significantly, gray cells in the table indicate mine closures and instances where prospects with reserves were never developed because, in some cases, of a failure to secure operating permits or, in other cases, because their reserves were not reserves at current prices. In some cases, gray cells also indicate that the prospect is uneconomic under current operating requirements that raise their costs. The light gray cells in the table indicate that data are missing or production is limited to residual production derived from the rinsing of heaps or production from stockpiles. In several cases data are missing because of companies in bankruptcy protection.

U.S. production for 1999 indicated on the table is approximately 9.4 million ounces (293 tonnes). This figure misses placer and by-product production with the largest missing components being gold production from Kennecott's Bingham Canyon Mine in Utah and Alaskan placer production. Assuming that most viable properties continue their production as planned over the next years, the gray closure indicators suggest a loss of over 1.2 million ounces (37 tonnes) of production by 2002, or almost 13 percent of 1999 production.

While this is clearly bad news for operators and perhaps bankers who have financed marginal operators, we refer back to our comments on how money is made in this business. This "adjustment," while unpleasant in the short

Table 8. U.S. Precious Metals Properties.

State	Mine	Operator/Source	Partner(s)	Type	Status	Production (1,000 oz.)					Reserves (1,000 oz)	
						1999		2000	2001	2002	2000	
						Gold	Silver				Gold	Silver
Alaska												
	Kensington	Coeur d'Alene		UG	D							
	Greens Creek	Kennecott	Hecla	UG	P	23.8	3,100.0				403	48000
	Fort Knox	Kinross		OP	P	351.1		333.6				
California												
	Briggs	Canyon Resources		OP	P	86.7	24.0	86.6			392.3	
	Imperial	Glamis Gold		OP	D							
	Picacho	Glamis Gold		OP	C	6.7						
	Rand	Glamis Gold		OP	P	71.0		99.9			560	
	McLaughlin	Homestake		OP	C							
	Hayden Hill	Kinross		OP	C							
	Mesquite	Newmont		OP	C	164.6		130.3				
	Castle Mtn.	Viceroy Gold	MKGold	OP	P	95.0		142.8				
Colorado												
	Cripple Creek	AngloGold		OP	P	231.0		248.0				
Idaho												
	Black Pine	Apollo/Pegasus		OP	C							
	Coeur	Coeur d 'Alene		UG	P							
	Galena	Coeur d 'Alene		UG	P		2,200.0					34400
	Grouse Creek	Hecla		UG	C							
	Lucky Friday	Hecla		UG	C		4,400.0					25200
	DeLamar	Kinross		OP	C							
	Beartrack	Meridian		OP	C	133.0		60.0				
	Sunshine	Sunshine		UG	C		5,200.0					
Montana												
	Beal Mtn.	Apollo/Pegasus		OP	C							
	Diamond Hill	Apollo/Pegasus		UG	P							
	Montana Tunnels	Apollo/Pegasus		OP	P							
	Zortman	Apollo/Pegasus		OP	C							
	McDonald	Canyon Resources			D							
	Golden Sunlight	Placer Dome		OP	P	144.8		212.3	195.5			
Nevada												
	Newmont NV	Newmont			P	2,498.7		3,047.9	2,703.2		28,037	
	Meikle	Barrick		UG	P	978.0		805.7	668.9		3,816	
	Rodeo-Griffin	Barrick		UG	D						3,900	
	Jerritt Canyon	Meridian	AngloGold	OP/UG	P	362.9		343.2	3.26.7			
	Ken Snyder	Newmont		UG	P	260.0	2,068.0	239.3			2,128	26,075
	Mineral Ridge	Golden Phoenix		OP	C							
	Betze-Post	Barrick		OP	P	1,130.0		1,646.6	1,611.7		18,000	
	Dee	Glamis Gold		OP	P	31.2						
	Ruby Hill	Barrick		OP	C	124.0		125.2			417	
	Florida Canyon	Apollo/Pegasus		OP	P							
	Pinson	Barrick		OP	C							
	Getchell	Getchell		OP	C	111.0						
	Marigold	Glamis Gold		OP	P	54.4		65.5			408.9	
	Goldbanks	Kinross			D							
	Hycroft	Vista Gold		OP	C							
	Battle Mtn. Co.	Battle Mtn		OP	C							
	McCoy/Cove	Echo Bay		OP/UG	C	124.5	8,430.0	162.8	94.6			
	Cortez	Placer Dome	Kennecott	OP	P	1,328.5		1,009.9	1,188.1		5,580	
	Candelaria	Kinross		OP	C							
	Denton/Rawhide	Dayton	Kennecott	OP	P	126.5						
	Bullfrog	Barrick		UG	C							
	Round Mtn.	Echo Bay	Homestake	OP	P	541.8		640.1	747.0		5,875	
	Daisy	Glamis Gold		OP	P	28.3		8.7				
	Rochester	Coeur d 'Alene		OP	P	88.6	6,200.0				381	52,500
	Rosebud	Hecla	Newmont	UG	C	112.7	247.9					
	Olinghouse	Alta		OP	C							
	Griffon	Alta		OP	C							
	Kinsley	Alta		OP	C							
	Bald Mtn.	Placer Dome		OP	P	105.5		134.5	108.4		1,290	
	Robinson	BHP		OP	C							
South Carolina												
	Ridgeway	Kennecott			C							
	Haile				C							
South Dakota												
	Homestake	Homestake		UG/OP	P	212.7		170.9				
Utah												
	Mercur	Barrick		OP	C							
	Barney's Canyon	Kennecott		OP	C							
	Bingham Canyon	Kennecott		OP	P							
Washington												
	Crown Jewel	Crown Resources			D							
	Kettle River	Echo Bay		UG	P	104.4		94.1	50.3		162	
Total						9,631.3	31,870.0	9,807.9	7,787.1		70,933.2	186,175.0

OP = open pit; UG = underground; C = closed; D = under development; P = producing.

run, is necessary and a precursor of better times to come. Shrinking mine supply will help stabilize prices and offset the liquidation of central bank reserves.

Profitability

Under the circumstances described above, industry profits would appear to be a casualty of low gold prices and regulatory overkill. However, this is not entirely the case. Some higher-cost producers have, indeed, turned in poor financial performances over the past few years but, overall, industry consolidations and rationalization of operations have allowed the industry to gradually improve aggregate performance.

Table 9 provides a summary of aggregate performance of 16 publicly held precious metals producers with operations in the U.S. For 2000 these include: AngloGold, Barrick Gold, Cambior, Canyon Resources, Echo Bay Mines, Franco-Nevada, Glamis Gold, Hecla Mining, Homestake Mining, Kinross Gold, Meridian Gold, MK Gold, Newmont Mining, Placer Dome, and Vista Gold. Indicative of the dynamic nature of the industry in the past few years, financial results for earlier years shown on the table and in previous studies included Alta Gold (currently in bankruptcy protection), Rayrock Resources (acquired by Glamis Gold), Pegasus Gold (in bankruptcy protection and subsequently reorganized as privately held Apollo Gold), and Battle Mountain Gold (merged with Newmont Mining) and Getchell Gold (acquired by Placer Dome). Future reports will include further changes in the composition of the group to reflect more recent merger and acquisition activities. For example, one of the U.S.'s oldest precious metals producers, Homestake Mining, has recently merged with Barrick Gold to create the largest North American-based producer. The Barrick/Homestake combination is the second largest producer in the world based on 2000 production behind South African-based AngloGold. In addition, Normandy Mining, the largest Australian producer, acquired the U.S. mining operations of Franco-Nevada for approximately 20 percent of its shares of stock outstanding. However, as noted above, because of Newmont's acquisition of Normandy in 2002, Normandy will be included as part of Newmont. Hence, the financial results presented in Table 9 represent the results for a very dynamic group of firms.

One of the dominant factors in the mergers, acquisitions, and bankruptcies noted above has been the decline in gold prices over the period. Another factor, however, has been the difficulty of replacing U.S. reserves because of the combined effects of the current regulatory climate and low prices. This situation creates incentives to acquire reserves through mergers and acquisitions rather than risky exploration that may yield deposits that cannot be developed because of regulatory considerations, e.g., Glamis Gold's Imperial project noted above, Battle Mountain Gold's Crown Jewell project in Washington State, and Canyon Resource's MacDonald project in Montana. Given these regulatory risks, producers focus on acquisition of a company with reserves that have a reasonable chance of being put into production at current prices or if prices improve.

Such was the case in Newmont's merger with Battle Mountain Gold in which it acquired, in addition to some foreign operations, the largest known undeveloped gold deposit in the U.S., Phoenix, virtually in the middle of Newmont's current operating area in north central Nevada. A similar scenario was no doubt envisioned in Placer Dome's acquisition of Getchell, which operated a single property in Nevada, the Getchell Mine. Unfortunately for Placer, it paid a high price for reserves at an operating mine that it was forced to close because of high operating costs.

Table 9. North American gold industry financial indicators, 1997–2000.

	1997	1998	1999	2000
Gold Price	$ 331	$ 294	$ 279	$ 279
Gold Production (1,000 oz.)*	16,897	16,556	24,244	24,609
Sales**	$ 7,327.5	$ 6,615.1	$ 8,671.7	$ 8,794.3
Assets**	$ 17,626.7	$ 16,757.5	$ 22,137.6	$ 19,870.2
Equity**	$ 10,046.2	$ 9,983.4	$ 11,986.1	$ 9,995.6
Net Income**	$ (1,710.7)	$ (1,026.3)	$ 243.1	$ (989.7)
ROE (%)	-17.03%	-10.28%	2.03%	-9.90%
NIBTWD***	$ 326.5	$ 479.6	$ 911.7	$ 862.4
ROE (%)	3.25%	4.80%	7.61%	8.63%
Market Capitalization**	$ 20,251.5	$ 19,293.7	$ 24,035.8	$ 19,727.1

* Reflects worldwide production of companies with production in North America
** In millions of U.S. Dollars
*** Net Income before federal taxes and asset write downs (in millions of U.S. Dollars)

Another factor driving the consolidation wave is, quite simply, the point in the price and supply cycle that the industry finds itself. As noted at the outset, the industry conforms fairly closely to the economic model of a perfectly competitive industry. There are many buyers and sellers of the commodity, and relatively few entry barriers—although these have been increasing because of regulatory changes. In these circumstances, we expect investment to flow into the industry when profits are being earned as in the 1980s and early 1990s, and flow out of the industry when earnings fall as they have in the late 1990s.

This latter phase of the cycle is illustrated somewhat by Table 9 in that we see assets declining over time when adjusted for production. Note, for example, that in 1998 industry assets declined while production remained relatively constant. This indicates that, in the aggregate, nonproductive assets were written down and not replaced with new investment. Assets increased in the aggregate in 1999; however, this was the result of adding AngloGold, the world's largest producer into the group. On a per-ounce basis, however, industry assets fell from $1,012 in 1998 to $913 in 1999. This decline continued in 2000, falling to $807 per ounce. Hence, in aggregate, the industry is writing down assets and not replacing them through new investment. In aggregate, the firms in the analysis wrote down $1.85 billion in 2000, or 8.4 percent of the previous year's assets.

In some cases these write-downs reflect profitable operators simply acknowledging that investments made during the early 1990s when prices were high, were not viable in the current environment. In several cases, however, it reflects an exit strategy executed by management. That is, given the phase of the cycle and other factors at work such as the ages of key members of senior management, the management of several companies simply decided they wanted out of the business and sold their operations. Acquiring companies then proceeded to write down nonperforming assets. This is the likely explanation of Glamis Gold's acquisition of Rayrock, in which Glamis, the smaller company, used Rayrock's money to buy it. Similar, although less extreme, scenarios were involved in the sale of Getchell to Placer, Battle Mountain Gold to Newmont, and Franco-Nevada's sale of its Midas operations in Nevada to Normandy. The latter got Franco-Nevada out of the mining business although it retained a large royalty business and got nearly 20 percent of Normandy in the process.

Further inspection of Table 9 suggests that 1999 and 2000 may well have marked a turning point in the industry. In spite of low commodity prices and regulatory difficulties in the U.S., the industry's return on equity (ROE) on net income before federal taxes and asset write-downs improved over the four-year period represented on the table. These returns on equity are meager for a period in which the general U.S. economy boomed, and this is one reason why investment capital has, on net, flowed out of the industry. However, the trend is clear and likely to continue unless there are underlying changes in industry fundamentals such as commodity prices, exploration and production technologies, etc. Although perhaps counter-intuitive, profitability is likely to continue to rise during the "shake-out" phase because the highest cost and least profitable producers will continue to either drop out of the industry or be acquired and restructured around their remaining profitable assets.

Another significant factor in perpetuating this trend in the current price and regulatory environment is the increasing offshore investment by North American-based operators. These offshore investments have, in numerous cases, yielded relatively low cost operations and projects that can be put into operation relatively quickly because operators do not generally face entrenched and well financed opposition from environmental interest groups. Indeed, host countries generally welcome the investment and the jobs and taxes that come with development.

It is perhaps even more counter-intuitive to suggest that this trend of improving financial results is likely to end when the current poor fundamentals turn around. For example, a rise in prices would result in an initial increase in gross operating margins but it would then induce investment in marginally profitable projects and the processing of lower grade ores. Hence, operators would receive higher gross operating margins on their current production but would see an increase in operating and development costs that would dissipate these higher margins and possibly lower overall profitability.

INDUSTRY OUTLOOK

Clearly, an important element of this review of the outlook for the U.S. gold industry is surviving the regulators. The new administration provides a window of opportunity but not a pardon. It is incumbent upon the industry to make its case for regulatory and mining law reform that it can live with. It is not time to claim victory because President Clinton and Secretary Babbitt have left town. If the industry is going to advocate more moderate regulatory reform, it is time for it to redouble its efforts to educate policy makers and the public.

Foremost on this agenda is addressing the revised federal Surface Management "3809" Regulations. Much of the issue here is addressing the presumption in the revised regulations that mining cannot be conducted in an environmentally responsible manner. The NRC study in 1999 of existing regulations that found that the current

system is basically sound should be the industry's guide. The industry should address the identified "regulatory gaps," with the most significant of these being bonding requirements. The other key point is that the regulations issued in January 2001 confer very few environmental benefits and fail miserably in a cost benefit analysis.

From an economic perspective, bonding requirements raise industry entry barriers and break down the characterization of the industry as a perfectly competitive industry. In other words, this burdens junior companies and start-ups relative to existing large producers. While these regulations would be anti-competitive, they would be pro-environment and pro-existing producers—enhancing survivability. Junior producers and small miners will object. Major producers should view this as a matter of survival.

A related problem is counter-party risk in bonding and the need for short-term financing in the event of bankruptcies. In the past several years we have seen a bonding company default and numerous instances where generally small operators have simply walked away from mines because of bankruptcies. The danger of bonding company default is that it could trigger an operator's bankruptcy leaving the federal government with unfulfilled reclamation obligations. The danger in operator bankruptcies is that frequently pumps for fluid management, monitoring wells, etc., need to be kept operating for some period of time after closure. Short-term financing to bear these costs until a reclamation bond can be released may be necessary to prevent a variety of problems. Nevada has provided the industry access to the State's bond pool for these purposes, but a broader solution would be better.

There are numerous other issues that divide the major from the junior and would-be producers. Claim fees, for example, create an entry barrier for junior producers and claim holders that would raise the costs of major producers for acquiring claims if rescinded. The imposition of claim-holding fees also coincides with a significant decline in violations of old "3809" regulations. As unpopular as it may be with small miners and exploration interests, maintaining $100 per year claim-holding fees is an insurance policy for major producers against environmental damages.

Other issues not addressed by the NRC study (National Research Council, 1999) such as royalties can also be addressed by the industry. It could, for example, create a fund based on a voluntary **net proceeds** royalty that the industry would support and that it would owe if such a royalty were passed by Congress for the purposes of funding abandoned mine reclamation. The industry already funds abandoned mine reclamation in Nevada through claim fees and voluntary contributions. Why not put those dollars to use in the federal area where they can deflect some criticism?

The political arena offers numerous risks to the industry. But, at this point, most of these risks are on the down side. And, to return to a point made at the outset, environmental "incidents" like tailings dam failures and ground and surface water contamination not only generate external costs on society—which is the terminology economists use for "pollution" —they generate external costs for other operators. For example, the tailings dam failure in Romania becomes the "poster child" for environmental fundraisers who then use these resources to prevent mine development in the U.S. and/or hire lawyers and lobbyists to rewrite surface management regulations. The point here is that the industry will bear the costs of these incidents one way or another, directly in the form of having to meet onerous regulations or indirectly by paying lawyers and lobbyists to fight onerous regulations, or both.

Attacks against the Bush administration's environmental record on other issues such as ANWR and arsenic standards promise to steal the headlines from the mining industry—which is a good thing. But, because the mining industry has such a small constituency, sustainability requires that it take advantage of its window of opportunity.

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