

# The Economic Impact of The Mining Industry on The State of Arizona – 2011



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THE L. WILLIAM SEIDMAN RESEARCH INSTITUTE WOULD LIKE TO THANK THE ARIZONA MINING ASSOCIATION FOR THEIR SUPPORT OF THIS RESEARCH INITIATIVE. THE REPORT REPRESENTS AN INDEPENDENT ASSESSMENT OF THE INDUSTRY.

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## Executive Summary

The purpose of this report is to measure the impact of the mining industry on employment, income and tax revenues in the state of Arizona. The estimated impacts are for the year 2011. They include both the direct effects of mining operations and multiplier effects that arise when income is recycled within the state economy. For the first time in the long history of this report, economic impacts will be estimated for all segments of the mining industry, not just copper.

As of year-end 2011, there were 11,300 employees of Arizona mining companies living in the state. Of this total, 10,600 were employed by copper mining companies. The remaining workers were employed by companies engaged in coal mining, gold and silver mining, and uranium mining. Employees of Arizona mining companies are distributed widely across state counties. Each of five counties is home to at least 10 percent of the state's mining employees: Gila, Graham, Greenlee, Pima and Pinal. Three other counties—Maricopa, Mohave and Yavapai—have more than 500 mining employees in residence.

The total income paid to employees of Arizona mining companies in 2011 was \$1.22 billion. This includes wages, salaries, and fringe benefits such as employer contributions to health insurance and retirement plans. Overall, income per worker in the mining industry is \$108,000. This compares with an average income of \$47,000 per worker across all industries in Arizona.

Arizona mining companies spent a total of \$2.80 billion in 2011 purchasing goods and services from other Arizona businesses. This includes wholesale purchases of mining equipment, payments to construction firms, payments for outside services, and purchases of fuels, electricity and supplies. Expenditures on products from other Arizona businesses are estimated to support 8,700 jobs and labor income of \$606 million just among first-tier suppliers.

The economic impact of an industry is not limited to its own employees and the employees of its immediate suppliers. There are indirect effects associated with upstream purchases by first-tier suppliers, the consumer spending of all employees connected to the industry, and the spending of state and local governments out of new tax revenues. For the Arizona mining industry, these indirect effects amount to an additional 29,800 jobs and labor income of \$1.41 billion.

Including both the direct and indirect impacts, mining activity in 2011 is estimated to have provided a total of 49,800 Arizona jobs and labor income of \$3.24 billion.

Mining in Arizona serves not only to increase the absolute size of the state's economy but to raise the average standard of living of its residents. The average labor income of all employees directly and indirectly supported by the mining industry is \$65,000. This is significantly higher than \$47,000, the average labor income of all Arizona workers.

The mining industry makes an important contribution to the Arizona economy through the revenues it generates for state and local governments. In 2011, the mining companies

themselves paid \$212 million in business taxes to Arizona governments. Employees of mining companies are estimated to have paid \$96 million in individual taxes.

Because the provision of state and local government services is heavily tied to population, it is useful to compare the taxes paid per employee by an industry with the statewide ratio of total taxes to total employment. Industries with per employee tax contributions that exceed the statewide average are likely to be making a net fiscal contribution to the state. The companies and their employees pay in taxes an amount that exceeds the value of the services they receive, with the difference serving to subsidize the provision of public services to other residents of the state.

The business taxes paid by Arizona mining companies average out to \$18,700 per employee. This compares with an average of \$3,100 per worker paid in business taxes by all businesses in the state. Because of their relatively high compensation, the individual taxes paid by mining company employees are also higher than the statewide average. Individual taxes paid by mining employees are estimated to be \$8,500 per worker. This compares with a statewide figure of \$3,300 per worker.

In total, the mining companies and their employees pay to Arizona state and local governments \$27,200 per worker. This is more than four times as much as is paid by the average Arizona business and its workers.

## The Economic Impact of the Mining Industry on the State of Arizona, 2011

### Introduction

Mining has played a central role in the economic history of Arizona. In 1910, one-quarter of wage earners in Arizona were employed in the mining industry. By 1970, after the state population had increased more than eightfold, copper mining was still touted as one of the Five Cs which formed the backbone of the Arizona economy. Over the past four decades, the Arizona population has more than tripled in size and the economy has continued to become more diverse, experiencing rapid growth in new high-technology industries such as semiconductors and aerospace. Because of the growth and diversification of the state's economy, mining-related employment, including both direct and indirect effects, now represents approximately 1.5 percent of total Arizona employment. Nevertheless, the mining industry continues to play a significant role in the state's economy and remains one of the top ten economic base industries in Arizona.

The purpose of this report is to provide estimates of the impact of the mining industry on employment, income and tax revenues in Arizona. Estimated impacts include both the direct effects of mining operations in the state and multiplier effects that arise through interindustry linkages and the recycling of income within the local economy. Section I of the report provides an overview of the Arizona mining industry and a demonstration of its importance as an economic base industry in the state. Section II provides information and perspective on production and prices of copper, which continues to be the most important segment of the state's mining sector. Section III presents estimates of the total impact of the copper industry on employment and income in Arizona. Estimates of the economic impact of non-copper mining activities are presented in Section IV. These activities include coal mining, gold and silver mining, and uranium mining. Section V summarizes the total economic impact of the mining industry on the Arizona economy. The report concludes in Section VI with a review of the importance of mining as a source of tax revenues for state and local governments in Arizona.



### I. Overview of the Arizona Mining Industry

Copper has been the predominant output of mining activity in Arizona for more than a century. This continues to be the case today. In 2011, there were two large employers and several smaller employers of workers involved in copper mining. Companies with the largest employment are Freeport-McMoRan Copper & Gold, Inc. and ASARCO LLC. Freeport-McMoRan has its headquarters in Phoenix and operates mines in Gila, Graham, Greenlee, Pima, and Yavapai counties. ASARCO has administrative offices in Tucson and mining operations in

Gila, Pima and Pinal counties. Firms with smaller employment operating in the state are Mercator Minerals, Carlota Copper Company, BHP Billiton, Resolution Copper and Rosemont Copper. Mercator Minerals has a mine in Mohave County. Carlota Copper and BHP Billiton operate mines in Gila County. Resolution and Rosemont Copper are still in the developmental stage and are not yet producing copper.

Other notable segments of the Arizona mining industry include coal, gold and silver, and uranium mining. There is one large coal mine in the state, operated by Peabody Energy and located in Navajo County. The mine supplies coal to the Navajo Generating Station. Gold is a common ancillary output at copper mines. But Arizona also has operations that focus specifically on gold mining. Mojave Desert Minerals operates a gold and silver mine in Mohave County. American Bonanza Gold Corp. operates a mine in La Paz County.

#### *Mining as an economic base industry*

In explaining the growth of regions, economists find it useful to divide a region's economic activities into two groups. *Basic* activities satisfy demands from outside the region and generate export income that can be used to pay for the region's imports. *Nonbasic* activities exist to supply goods and services to local residents. Basic activities are a region's economic *raison d'être*, i.e., its *economic base*. Nonbasic activities are derived from that base and grow or shrink depending on the performance of basic industries.

Because of a lack of hard information on trade flows at the subnational level, economists commonly use employment data to identify the basic activities of a region. Industries with employment that is disproportionately large by national standards are presumed to be engaged in export activity. Such an economic base analysis was carried out for the state of Arizona. The results are reported in Table 1. Column (4) of the table shows the location quotients of individual industries. Location quotients are calculated as the ratio of an industry's employment share in the state economy to its share nationwide. Economic base industries are identified by a location quotient that exceeds one. Column (5) provides an employment-based estimate of the export activity in a basic industry. Export-base employment is the difference between actual industry employment and what would be expected were the share of industry employment in the region equal to the national average.

Copper mining is identified as one of the top ten economic base industries in Arizona. Copper mining has a location quotient of 38, by far the largest location quotient in the table, and it provides an export base of 10,120 workers when measured in terms of employment. Other industries identified as being important to the economic base of Arizona include call center and other backoffice operations (which are included in both nondepository credit intermediation and business support services), semiconductor manufacturing, aerospace industries such as guided missile manufacturing and the manufacture of search and navigation instruments, and air transportation.

The figures reported in Table 1 understate the importance of mining and other economic base industries on the Arizona economy. The figures are based on direct employment only and do not include employment related to industry suppliers and other indirect effects. The purpose

of economic impact analysis is to provide a full accounting of the contribution of an industry to a regional economy, including interindustry linkages and multiplier effects. An economic impact analysis of mining will be presented later in the report.

**Table 1: Economic Base Industries in Arizona, 2010**

	Arizona		United States	Location Quotient	Arizona Export Base
	Number of Workers (1)	Percent of Total (2)	Percent of Total (3)	Ratio of (2) to (3) (4)	Number of Workers (5)
Employment services	103,342	3.25	2.14	1.52	35,487
Nondepository credit intermediation	74,711	2.35	1.66	1.42	22,128
Semiconductors and related devices	18,304	0.58	0.10	5.50	14,976
Business support services	34,828	1.10	0.63	1.74	14,775
Diagnostic labs and outpatient care	37,411	1.18	0.76	1.55	13,215
Copper mining	10,400	0.33	0.01	37.57	10,123
Guided missile and space vehicle manufacturing	11,132	0.35	0.03	11.23	10,140
Construction of new residential structures	25,672	0.81	0.50	1.62	9,839
Search, detection and navigation instruments	8,245	0.26	0.08	3.08	5,566
Air transportation	13,867	0.44	0.26	1.65	5,470
All industries	3,175,459	100.00	100.00		

Source: Center for Business Research, L. William Seidman Research Institute, College of Business, Arizona State University, using IMPLAN 2010 data files.

Notes: Industries listed in the table are those with a location quotient of at least 1.40 and export-base employment of at least 5,000 workers. Industry definitions follow the IMPLAN sectoring scheme which is based on NAICS 4-digit codes.

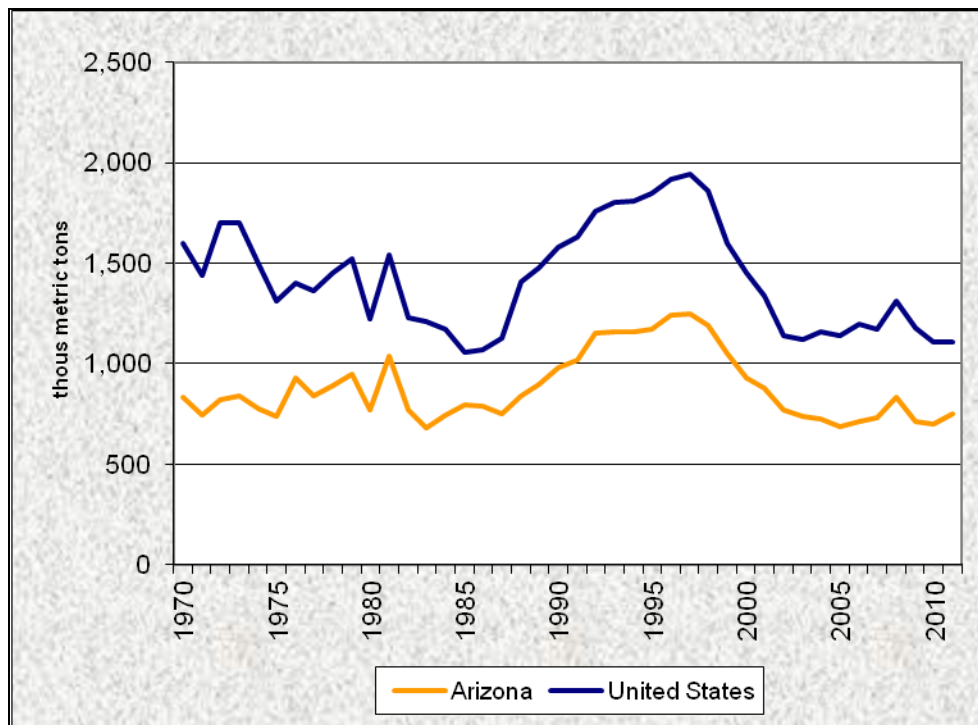


## II. Trends in Copper Production and Copper Prices

Production of recoverable copper at Arizona’s mines rose to 751 thousand metric tons in 2011 from 703 thousand metric tons in 2010. Because of mine closures and declining yields at mature sites, copper production in the state remains below the levels of the mid 1990s, despite record high prices for refined copper. Arizona copper production in 2011 was 60 percent of its level in 1997 (see Figure 1).



**Figure 1: Copper Production in Arizona and the United States, 1970-2011**



Source: U.S. Geological Survey

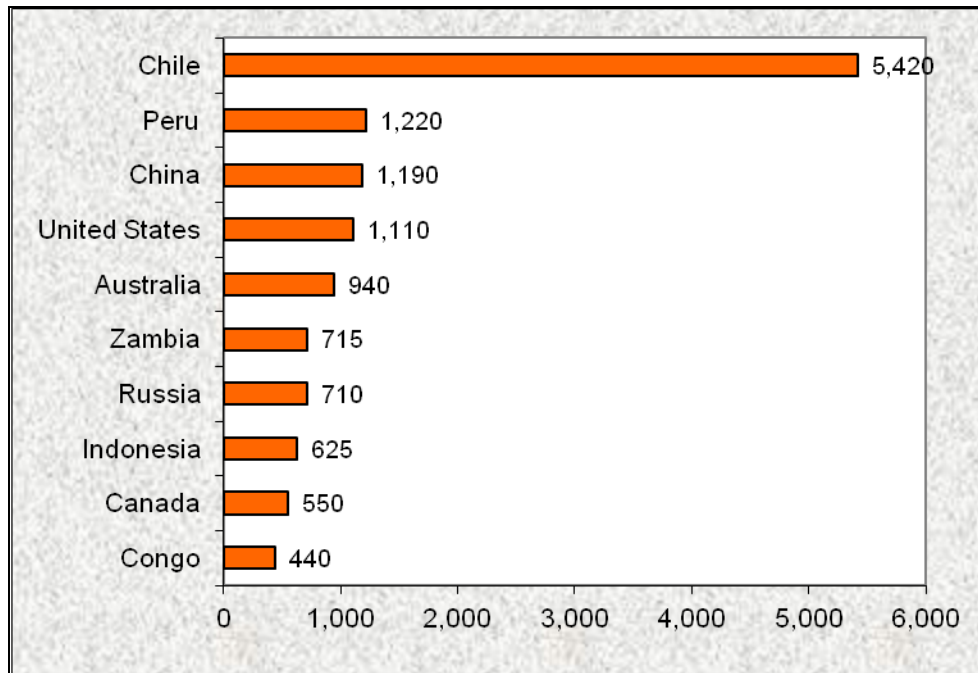
Arizona has been a top producer of copper in the United States for more than a century. In each year since 1973, Arizona has accounted for more than one-half of total U.S. copper production. In 2011, 68 percent of U.S. copper mining output came from mines in Arizona.

Over the past two decades, as copper production has surged in developing countries in Latin America and Asia, the share of world copper production accounted for by Arizona and the United States has fallen sharply. In 1995, the United States accounted for 19 percent of world copper production. By 2011 that share had fallen to 7 percent.



Nevertheless, Arizona and the United States remain among the top producers of copper in the world (see Figure 2). In 2011, the U.S. was the fourth largest producing nation in the world. Arizona itself was the sixth largest producer of mined copper.

**Figure 2: Top 10 Copper-Producing Countries in 2011**  
(in thous metric tons)



Source: U.S. Geological Survey

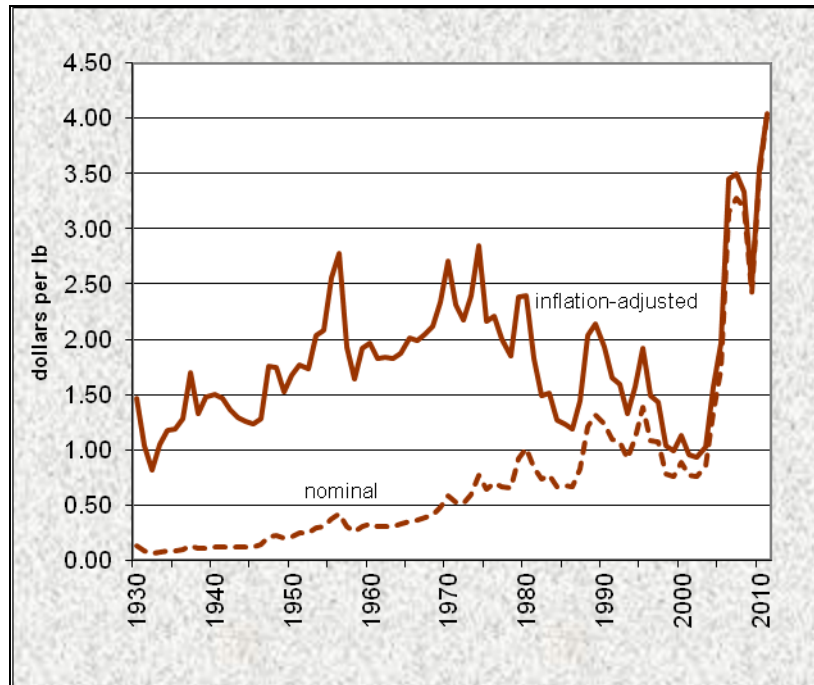
Copper prices are an important underlying determinant of copper mining and exploration activity in the state of Arizona. Figure 3 shows long-run trends in copper prices going back to 1930. Two series are shown: one nominal and the other adjusted for inflation. Over long periods of time, the inflation-adjusted series provides a more accurate measure of the relative financial rewards associated with using labor and capital in copper mining rather than other productive activities in the United States. The inflation-adjusted series is in 2011 prices, and the adjustments are made using the U.S. GDP deflator.

Figure 3 reveals three distinct periods in copper prices. From the early 1930s through the early 1970s, U.S. producer prices of cathode increased 150 percent, from approximately \$1.00 per pound to \$2.50 per pound (when expressed in 2011 dollars). There were important short-run fluctuations in prices over this period, fluctuations associated with wars and business cycles. But there was a clear and significant upward trend in copper prices over this forty-year period.

Real copper prices then began to fall in the mid 1970s and continued a trend decline for the next twenty-five years. The inflation-adjusted price of copper fell from \$2.84 in 1974 to \$0.99 in 1999. The drop in prices was the result of both a significant increase in world copper production during the 1960s and early 1970s and a slowdown in economic growth that began in

the 1970s and continued on into the 1990s. The rise in production is attributed to the development of new, high-yield mines and improvements in mining and refining technologies.

**Figure 3: History of U.S. Copper Prices**  
(domestic producer, cathode)



Source: U.S. Geological Survey

The most striking development apparent in Figure 3, however, is the surge in copper prices that began in the early 2000s and continues to this day, albeit with a significant hiccup during the recession of 2008-2009. Over the past decade, U.S. producer prices for cathode copper have quadrupled, going from \$1.12 per pound in 2000 to \$4.05 in 2011. Propelling the rise in prices of copper and other industrial raw materials has been strong economic growth in China, India, Brazil and other highly-populated developing countries. These countries recently have made large investments in construction and electricity infrastructure. The demand for copper also has been boosted by increased purchases of consumer electronic equipment in both developed and less developed countries.

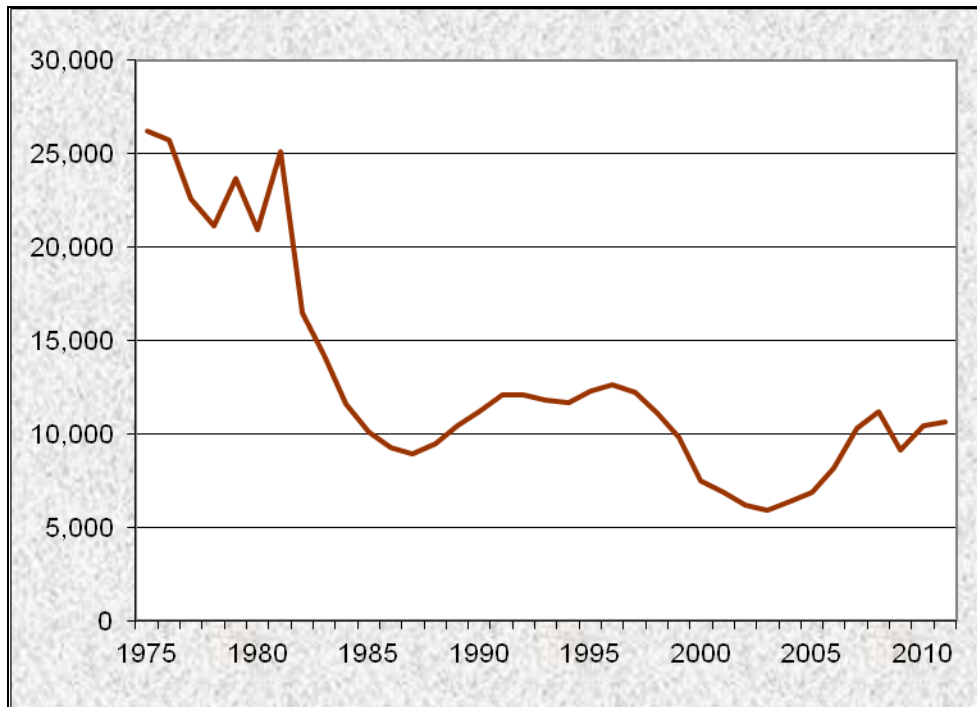
### III. Economic Impact of the Copper Industry

This section of the report presents estimates of the economic impact of copper mining and exploration on the state of Arizona. The estimated impacts are based on two sources of information: (1) surveys of copper mining companies operating



in Arizona and (2) the IMPLAN input-output model. Surveys sent to mining companies collected information on employment, payrolls, state and local taxes, and purchases from local suppliers. IMPLAN was used to estimate the multiplier effects associated with the operations of mining companies. Impacts are for the year 2011. Appendix A provides a complete account of the economic impact methodology.

**Figure 4: Arizona Employment in the Copper Mining Industry**



Source: Surveys of Arizona copper mining companies

One of the most important ways in which copper mining companies contribute to the local economy is by providing jobs to Arizona residents. Through the support of the Arizona Mining Association, information on employment and payrolls of copper mining companies has been collected from Arizona companies each year for the past forty years. The historical series on copper mining employment is shown in Figure 4. The figures include employees at administrative offices as well as those working at mine sites.

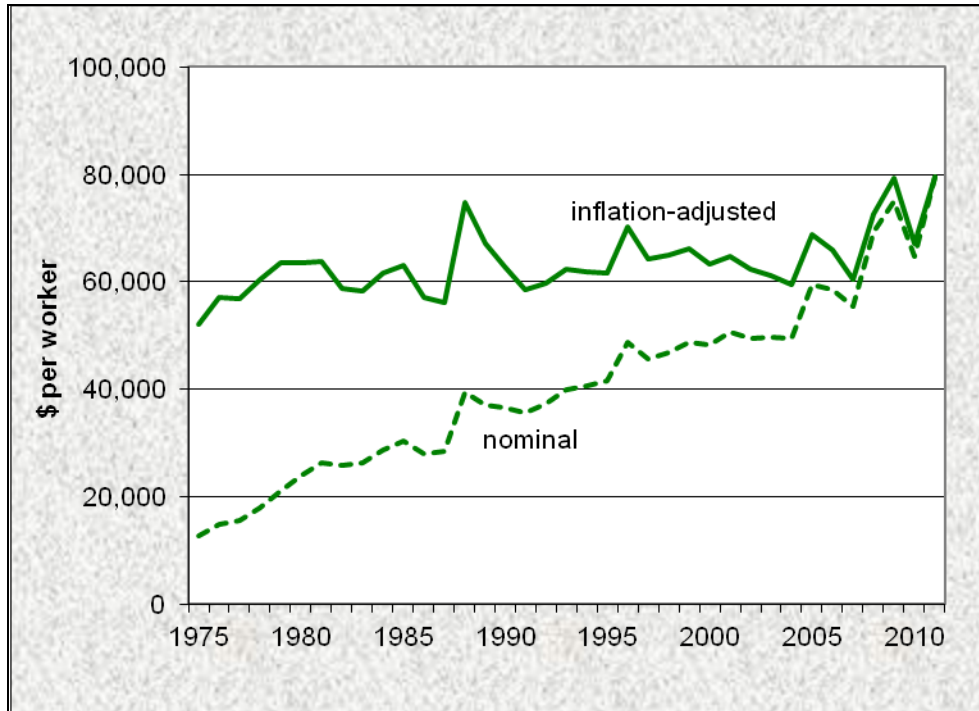
Copper mining employment in Arizona increased in 2011 to 10,637 workers from 10,400 workers in 2010. Employment in the industry has now almost fully recovered from the recession and is only 15 percent below the highs of the mid 1990s. Because of declining yields, however, copper production remains more than 40 percent below the levels of the mid 1990s.

Figure 5 provides an historical perspective on the average wages and salaries paid to employees of Arizona copper mining companies. Two series are shown: one nominal and another with an adjustment for inflation made using the CPI. Average wages and salaries were \$79,700 per worker in 2011. On an inflation-adjusted basis, mean wages and salaries have

increased at a 3.4-percent annual rate since 2003. From 1975-2003, real wages and salaries per worker increased at an average annual rate of only 0.6 percent.

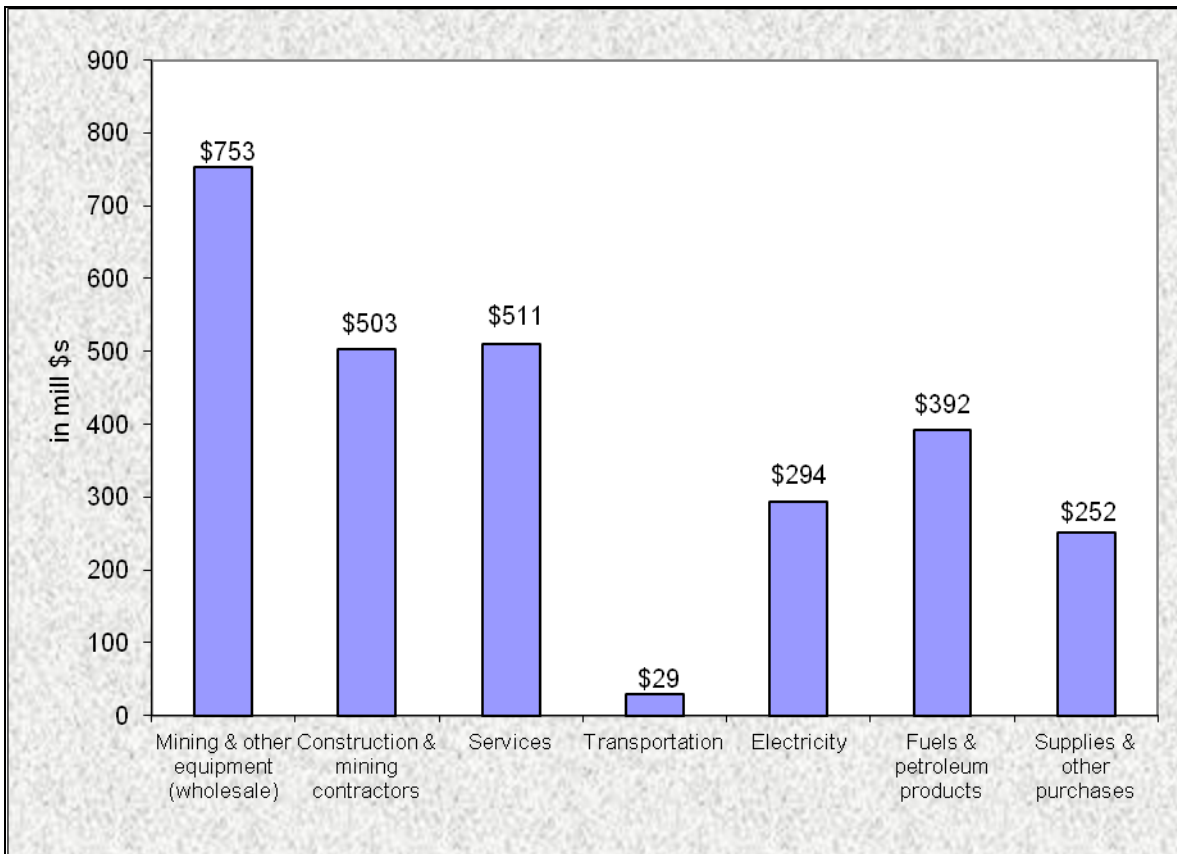
A more complete measure of labor income takes into account not only wages and salaries but payroll taxes paid by the employer, supplemental unemployment insurance, and fringe benefits such as employer contributions to health insurance and retirement plans. For 2011, copper mining companies reported an average total income of \$108,200 per employee.

**Figure 5: Wages and Salaries per Worker in the Arizona Copper Industry**



Source: Surveys of Arizona copper mining companies

Figure 6: Purchases by Copper Mining Companies from Other Arizona Businesses, 2011



Source: Surveys of Arizona copper mining companies

Another way in which mining companies affect the Arizona economy is by buying goods and services from other Arizona businesses. For 2011, Arizona copper mining companies reported purchasing \$2.73 billion worth of goods and services from Arizona vendors. Figure 6 shows the composition of this spending by major category. In 2011, Arizona’s copper mining companies spent \$753 million on wholesale purchases of mining and other equipment. They paid \$503 million to construction and mining contractors, and they spent \$511 million on outside services such as engineering, legal, and maintenance and repair. Other major categories of business purchases were fuels and lubricants (\$392 million) and electricity (\$294 million). The IMPLAN database includes estimates of industry production functions which make it possible to estimate the Arizona jobs and incomes that are associated with these purchases of goods and services by Arizona copper mining companies.

Estimates of the full economic impact of copper mining operations in Arizona are presented in Table 2. Economic impacts are measured in terms of three variables: employment, labor income, and total income. Employment is a count of both full- and part-time jobs. It includes both wage and salary workers and the self-employed. Labor income is the sum of employee compensation (including fringe benefits) and proprietor income (income of the self-employed). Total income is synonymous with value added. It includes not only labor income but the business taxes paid by companies (property, severance, etc.) and, with one exception,

capital or property income. Capital income is not included in the value added generated directly within copper mining companies since that income largely accrues to shareholders worldwide rather than to residents of Arizona.

The first two lines of Table 2 show the direct impacts of copper mining companies operating in Arizona. The companies themselves employ 10,637 Arizona residents and pay a total income to employees equal to \$1.15 billion. This amounts to an average of \$108,200 per employee. In addition to labor income, the total income figure in line one includes business taxes of \$146 million which mining companies pay to various state and local governments in Arizona.

The second line shows the jobs and incomes supported among the first-tier suppliers of Arizona mining companies. By purchasing \$2.73 billion worth of goods and services from other Arizona businesses, copper companies directly generate 8,470 jobs, labor income of \$590 million, and total Arizona income equal to \$990 million. The total income figure of \$990 falls well short of the \$2.73 billion paid by mining companies to Arizona vendors. There are two reasons for this. First, some of these expenditures serve to compensate suppliers for parts, components and services produced outside of Arizona. This is clearest in the case of mining equipment, which may be purchased from wholesalers in Arizona but is produced entirely out of state. Some income accrues to Arizona, but only the portion that represents a payment for wholesale trade services. Secondly, some of the expenditures serve to compensate first-tier suppliers for goods and services they purchase from other Arizona businesses. The jobs and income associated with these upstream effects are included in the third line of the table.

The lower part of the table shows the indirect or so-called “multiplier” effects of mining company operations. The third line includes two types of indirect effects: (1) impacts stemming from upstream purchases by first-tier suppliers of Arizona mining companies and (2) impacts generated by the consumer spending of both mining company employees and all other employees connected with the economic impact process. There are a total of 17,800 jobs generated by this part of the multiplier process, labor income of \$810 million, and total Arizona income of \$1.38 billion.



**Table 2: Economic Impact of Copper Mining on the State of Arizona, 2011**

	<b>Total Income</b> (in mill \$s)	<b>Labor Income</b> (in mill \$s)	<b>Employment</b>
<b>Direct effects from:</b>			
Company operations	1,297	1,151	10,637
Supplier purchases	990	590	8,470
<b>Indirect effects from:</b>			
Consumer spending out of direct and indirect labor income	1,376	810	17,800
Spending out of S&L government tax revenues	650	493	9,637
<b>Total impact</b>	<b>4,313</b>	<b>3,044</b>	<b>46,543</b>

Source: L. William Seidman Research Institute,  
W.P. Carey School of Business, Arizona State University

Notes:

1. Excluded from total income in the first line is capital income which accrues to shareholders worldwide.
2. Impacts shown on the third line include effects from upstream purchases by first-tier suppliers.

The fourth line of the table presents estimates of a final piece to the multiplier process: the jobs and incomes supported by the spending of new tax revenues by Arizona state and local governments. Copper mining activity in Arizona is estimated to generate, both directly and indirectly, a total of \$436 million in state and local tax revenues (to be discussed further in Section VI). The spending of these tax revenues creates 9,637 jobs, labor income of \$493 million, and total income of \$650 million. These impacts are large, especially the employment impacts. The number of jobs generated by the spending of new tax revenues is larger than the number of jobs directly supported by mining company purchases from first-tier suppliers. There are two reasons for the large size of the tax impacts. First, copper mining companies generate a large amount of tax revenue. This is due partly to the high business taxes they pay and partly because their employees are highly compensated. Second, provision of government services is a highly labor intensive activity. A given quantity of dollars spent on government services supports a relatively large number of jobs.

For 2011, the total economic impact of copper mining is estimated to be 46,543 Arizona jobs, labor income of \$3.04 billion, and total income of \$4.31 billion. For perspective, the total employment impact of the copper mining industry, including all direct and indirect effects, is 1.5

percent of total Arizona employment and the impact of the industry on labor income is 2.0 percent of total Arizona labor income.

#### IV. Economic Impact of Non-Copper Mining Activities

This section presents estimates of the economic impacts of segments of the Arizona mining industry other than copper. The following non-copper segments were surveyed and economic impacts calculated in a way similar to the way the copper industry was handled: coal, gold and silver, and uranium.

Estimates of the economic impacts of non-copper mining activities on the Arizona economy are shown in Table 3. Altogether, companies in this part of the mining industry employ 645 Arizona residents and pay labor income of \$66 million. Average income per worker is \$103,000.

Adding together all of the economic impacts, including impacts from supplier linkages and the various multiplier effects, the non-copper segment of the Arizona mining industry accounts for 3,301 jobs, labor income of \$194 million, and total Arizona income of \$318 million.



**Table 3: Economic Impact of Non-Copper Mining Activities on the State of Arizona, 2011**

	<b>Total Income</b> (in mill \$s)	<b>Labor Income</b> (in mill \$s)	<b>Employment</b>
<b>Direct effects from:</b>			
Company operations	132	66	645
Supplier purchases	26	16	235
<b>Indirect effects from:</b>			
Consumer spending out of direct and indirect labor income	48	28	637
Spending out of S&L government tax revenues	111	84	1,783
<b>Total impact</b>	<b>318</b>	<b>194</b>	<b>3,301</b>

Source: L. William Seidman Research Institute,  
W.P. Carey School of Business, Arizona State University

Notes:

1. Impacts shown on the third line include effects from upstream purchases by first-tier suppliers.
2. Mining activities covered in this table include coal, gold & silver, and uranium.

## V. Total Economic Impact of the Arizona Mining Industry

Estimates of the total economic impact of mining on the state of Arizona, including both copper and non-copper mining activities, are shown in Table 4. Including multiplier effects, mining generates employment for 49,844 Arizona residents and accounts for a total of \$3.24 billion of the labor income and \$4.63 billion of all income received by Arizona households and governments. The mining industry accounts, both directly and indirectly, for 1.6 percent of total employment in Arizona and 2.2 percent of total Arizona labor income.

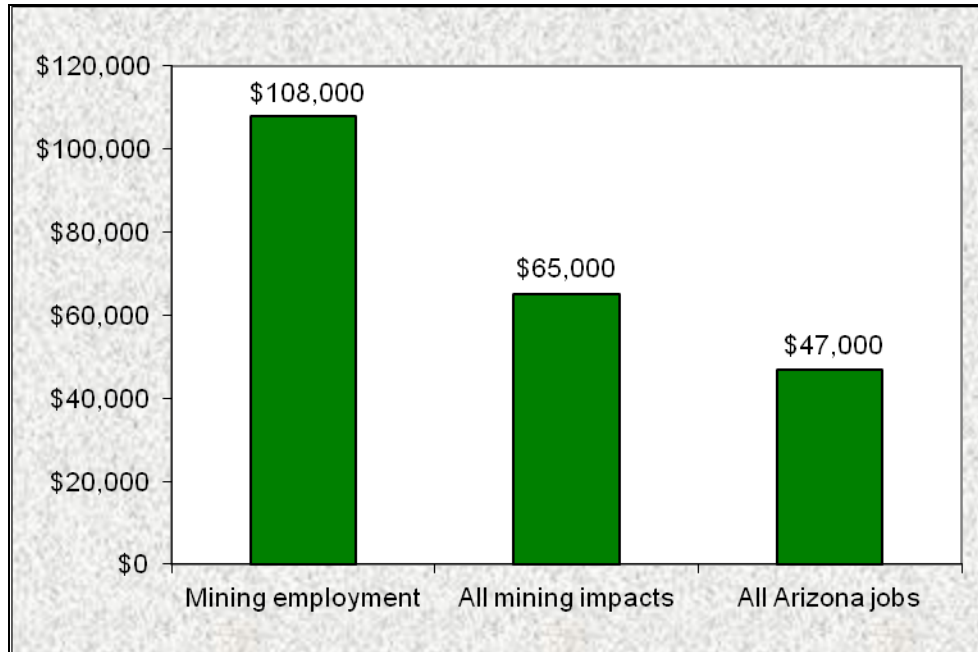
Looking at employment, 40 percent of the total impact of the mining industry consists of jobs either at the mining companies themselves or in companies that are first-tier suppliers of mining companies. Thirty-seven percent of the total effect mining activities have on Arizona employment comes from multiplier effects associated with the upstream purchases of first-tier suppliers or with the induced consumer spending of mining company employees and other employees involved in the economic impact process. The remaining 23 percent of the total impact mining has on Arizona employment comes from the spending of new tax revenues by Arizona state and local governments.

**Table 4: Total Economic Impact of Mining Activities on the State of Arizona, 2011**

	<b>Total Income</b> (in mill \$s)	<b>Labor Income</b> (in mill \$s)	<b>Employment</b>
<b>Direct effects from:</b>			
Company operations	1,429	1,218	11,282
Supplier purchases	1,016	606	8,705
<b>Indirect effects from:</b>			
Consumer spending out of direct and indirect labor income	1,424	837	18,437
Spending out of S&L government tax revenues	762	577	11,420
<b>Total impact</b>	<b>4,631</b>	<b>3,238</b>	<b>49,844</b>
Source: L. William Seidman Research Institute, W.P. Carey School of Business, Arizona State University			
Notes:			
1. Impacts shown on the third line include effects from upstream purchases by first-tier suppliers.			

The mining industry in Arizona serves not only to increase the absolute size of the state's economy but to raise the average standard of living of its residents. As shown in Figure 7, the average labor income of mining company employees is \$108,000 per worker. The average labor income across all employment directly and indirectly supported by the mining industry is \$65,000. Both figures are significantly higher than \$47,000, the average labor income of all Arizona workers.

**Figure 7: Comparing Labor Income per Worker**



Source: L. William Seidman Research Institute, W.P. Carey School of Business, Arizona State University

A considerable effort was made to track and measure economic impacts at the level of individual counties. The methodology is summarized in Appendix A. The county-level results are shown in Table 5 and in Figures 8 and 9.

Mining activity is distributed widely throughout the state of Arizona. As indicated in Figure 8, each of five counties is home to at least 1,200 mining company employees (or 10 percent of total mining employment): Gila, Graham, Greenlee, Pima and Pinal. Three other counties—Maricopa, Mohave and Yavapai—have at least 500 mining company employees as residents. No county accounts for more than 25 percent of Arizona mining company employment.

The total economic impacts from mining, including all direct and indirect effects, are much more concentrated (see Table 5 and Figure 9). Maricopa County accounts for 36 percent, and Pima County accounts for 28 percent, of all mining-related jobs. No other county accounts for as much as 7 percent of total mining-related employment. Economic impacts that stem from supplier purchases are heavily concentrated in Phoenix and Tucson. Consumer spending in rural counties is supported by goods and distribution services from large urban areas. Finally, because of their large populations, Maricopa and Pima counties claim a large share of the jobs supported by the spending of mining-related general tax revenues.

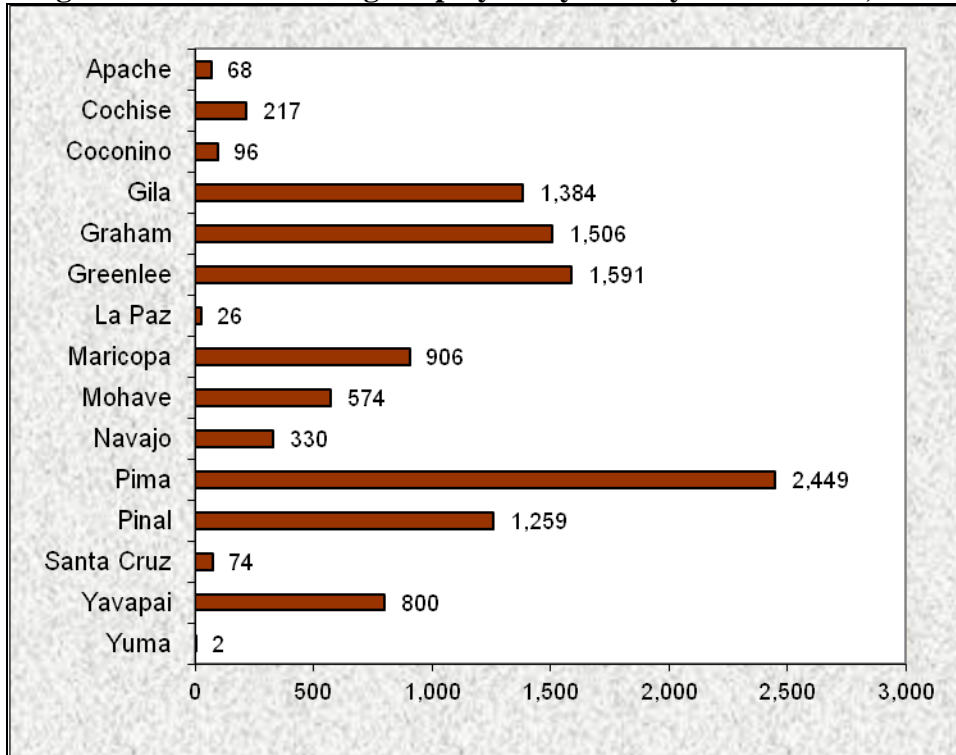
**Table 5: Total Economic Impact of Mining Activities by County, 2011**

<b>County</b>	<b>Total Income (in mill \$s)</b>	<b>Labor Income (in mill \$s)</b>	<b>Employment</b>
Apache	27	22	403
Cochise	64	46	721
Coconino	66	46	771
Gila	289	231	3,224
Graham	217	190	2,548
Greenlee	237	192	2,296
La Paz	5	4	75
Maricopa	1,700	1,095	18,177
Mohave	121	85	1,516
Navajo	161	78	1,277
Pima	1,268	879	13,870
Pinal	272	221	2,787
Santa Cruz	5	4	80
Yavapai	174	126	1,752
Yuma	24	18	347
<b>Total impact</b>	<b>4,631</b>	<b>3,238</b>	<b>49,844</b>

Source: L. William Seidman Research Institute,  
W.P. Carey School of Business, Arizona State University

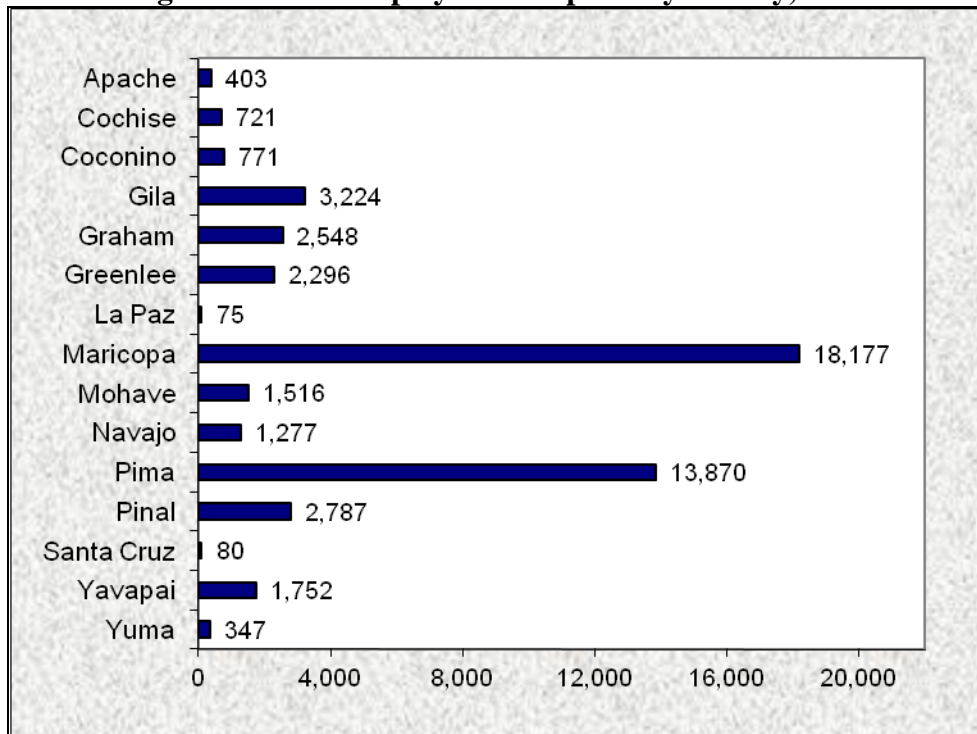


**Figure 8: Arizona Mining Employees by County of Residence, 2011**



Source: L. William Seidman Research Institute, W.P. Carey School of Business, Arizona State University

**Figure 9: Total Employment Impacts by County, 2011**



Source: L. William Seidman Research Institute, W.P. Carey School of Business, Arizona State University

**VI. State and Local Government Revenues**

The mining industry makes an important contribution to the Arizona economy through the taxes that are paid both directly and indirectly to state and local governments. Table 6 summarizes estimates of the fiscal impact of the mining industry. The methods used to make these estimates are explained in Appendix A.

In 2011, the mining companies themselves paid \$212 million in business taxes to Arizona state and local governments. The most important categories of business tax payments were property, severance, royalty payments for mining on state-owned or tribal land, and sales taxes. Employees of mining companies are estimated to have paid \$96 million in individual taxes. Finally, Arizona state and local governments are estimated to have collected \$205 million in revenues because of the indirect effects of the mining industry on jobs and incomes in the state, including economic activity associated with supplier purchases and activity supported by the consumer spending of workers whose incomes are directly or indirectly connected to mining.

**Table 6: Impact of Mining on Arizona State and Local Government Revenues, 2011**

	<b>Copper Mining</b>	<b>Other Mining</b>	<b>Total</b>
Business taxes paid by mining companies	146.0	65.5	211.5
Individual taxes paid by mining company employees	90.9	5.3	96.2
Taxes generated through the multiplier process	198.6	6.3	204.9
<b>Total Arizona state and local taxes</b>	<b>435.6</b>	<b>77.0</b>	<b>512.6</b>

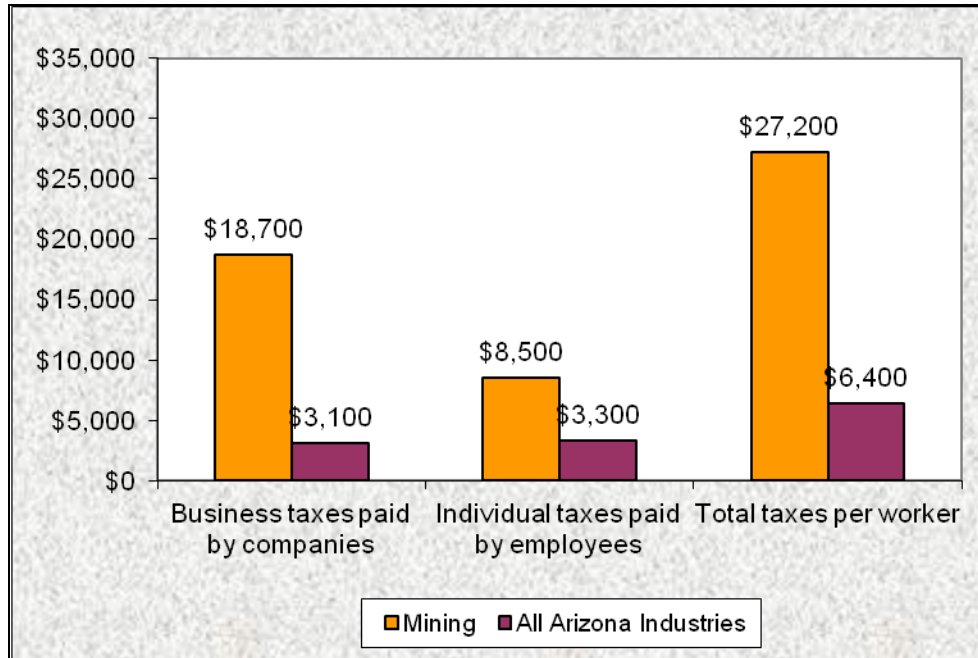
Source: L. William Seidman Research Institute, W.P. Carey School of Business, Arizona State University

Because the provision of state and local government services is heavily tied to population, it is useful to compare the taxes paid per employee by the mining industry with the statewide ratio of total taxes to total employment (see Figure 10). Industries with per employee tax contributions that exceed the statewide average can be thought of as making a net fiscal contribution to the state. The companies and their employees are likely to be paying in taxes an amount that exceeds the value of the services they receive. The difference effectively serves to subsidize the provision of government services for other residents of the state.



The business taxes paid by mining companies operating in the state average out to \$18,700 per company employee. Total business taxes collected in the state amount to approximately \$3,100 per Arizona worker. On this basis, mining companies in Arizona pay more than six times as much in taxes as does the average Arizona business.

**Figure 10: Comparing Taxes per Worker**



Source: L. William Seidman Research Institute, W.P. Carey School of Business, Arizona State University

Because of their relatively high compensation, the individual taxes paid by mining company employees are also higher than the statewide average. Individual taxes paid by mining employees are estimated to be \$8,500 per worker. This compares with a statewide figure of \$3,300 per worker.

In total, the mining companies and their employees pay to Arizona state and local governments \$27,200 per worker. This is more than four times as much as is paid by the average business and its workers.

## Sources

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U.S. Census Bureau, *State and Local Government Finances, FY 2009*, <http://www2.census.gov/govs/estimate/09slsstab1a.xls>

U.S. Geological Survey, Minerals Information, <http://minerals.usgs.gov/minerals/>

## Appendix A: Economic Impact Methodology

The economic impact estimates presented in this report are based primarily on two sources of information: (1) surveys of mining companies operating in Arizona and (2) the IMPLAN input-output model and software. Surveys sent to mining companies collected information on employment, payrolls, state and local taxes, and purchases from local suppliers related to mining and exploration operations in Arizona during 2011. IMPLAN was used to estimate the economic interdependencies or so-called multiplier effects generated by the operating expenditures of mining companies.

### *Company surveys*

Completed surveys were received from 12 companies with mining and exploration operations in Arizona (see Table A1). Seven of these are copper mining companies. Non-copper mining companies surveyed include Peabody Energy, which operates a large coal mine in Navajo County, Mohave Desert Minerals which operates the largest gold mine in the state, and Denison Mines which operates the only active uranium mine in Arizona.

The survey generated information on employment headcounts as of Dec. 31, 2011 and totals for the year for wages and salaries and other payroll costs, including payroll taxes and fringe benefits such as employer contributions to health care and retirement plans. The survey also provided information on mining company purchases from other Arizona businesses broken out by major category (mining equipment, construction and mining contractors, professional and business services, transportation, electricity and fuels). The survey also gathered detailed information on property, severance and other state and local taxes paid or accrued in 2011.

### **Table A 1: Mining Companies Surveyed**

ASARCO  
BHP Billiton  
Carlota Copper  
Denison Mines  
Freeport-McMoRan Copper & Gold  
Mercator Minerals  
Mohave Desert Minerals  
Peabody Energy  
Resolution Copper  
Rosemont Copper  
UraniumOne  
VANE Minerals

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*IMPLAN*

In economic impact analysis, estimates of the effects of a company's operations on the local economy are not limited to the direct jobs/incomes provided by the company or the jobs/incomes supported among its first-tier suppliers. The estimated impacts also include indirect or so-called multiplier effects that arise when a business' immediate suppliers place upstream demands on other producers, when workers directly or indirectly associated with company operations spend a portion of their incomes in the local economy, and when governments spend new tax revenues. Estimates of multiplier effects are made using an "input-output" model—a system of linear equations which describes the interindustry relationships in an economy. The input-output model used in this study was an Arizona-specific version of IMPLAN, a model used widely by researchers throughout the United States. In addition to providing estimates of multiplier effects, IMPLAN has a detailed database which makes it possible to estimate the jobs and incomes directly supported by purchases from first-tier suppliers.

The specific model used was based on IMPLAN's 2010 economic database. In building the model, trade flows were calculated using IMPLAN's "regional purchase coefficients," which are econometrically-derived estimates of the percentage of demand for a specific commodity that is satisfied by local producers. Type SAM (Social Accounting Matrix) multipliers were used with the amount of recycled spending limited to the private sector. State and local tax revenues generated during the process were also assumed to be recycled, but these calculations were performed outside of IMPLAN. First, an estimate was made of the direct and indirect effects of mining industry operations on tax revenues (see below). IMPLAN was then used to estimate the impact of this money being spent by Arizona governments.

*Economic impact variables*

Economic impacts were measured in terms of three variables: total income, labor income, and employment. *Total income* is synonymous with gross product or value added. It is the sum of employee compensation, proprietor income, property income, and indirect business taxes. *Labor income* is the sum of proprietor income (income of the self-employed) and the total compensation of payroll employees. Employee compensation consists of wages, salaries and benefits, including employer contributions to health insurance and retirement pensions. *Employment* is a count of full- and part-time jobs. It includes both wage and salary workers and the self-employed. All monetary variables are expressed in 2011 dollars.

*Estimates by county*

When possible, estimates of the jobs and incomes generated by the mining industry were allocated across individual counties on the basis of the residences of employees rather than the location of their employment. In the survey, mining companies were asked to provide a breakdown of the counties in which their employees reside. Employment totals and the labor income earned by mining company employees were allocated across counties using this information. The county distribution of mining company payrolls was also helpful when estimating the geographic incidence of impacts relating to consumer spending by mining company employees.



In the survey, mining companies were asked to provide detail on the commodity composition of their supplier purchases, but they were not asked to report the county locations of their suppliers. One important exception, however, was Freeport-McMoRan which provided information on the county destinations of all payments sent to Arizona businesses. With the detailed information made available by Freeport-McMoRan, it was possible to make reasonable estimates of the county distribution of supplier payments of other mining companies based on the locations of their operations.

#### *Estimating state and local tax revenues*

One of the objectives of this report was to estimate the impact of mining operations on Arizona state and local tax revenues. The survey collected information on the business taxes paid by mining companies—property, severance, sales, etc. Much more difficult to estimate are taxes paid by mining company employees and all of the taxes connected with the economic impact process.

Many taxes are local—for example, the property taxes paid to school districts or sales taxes paid to cities. In theory, to estimate these, one would need to have and utilize information with a high degree of geographic granularity on the incomes and spending of employees, suppliers and anyone else connected with the multiplier process. Such an analysis is beyond the scope of this project.

To make the calculations manageable, tax revenues generated at any phase of the economic impact process (apart from the business taxes paid directly by mining companies) were estimated by multiplying the income attributable to production in that phase by the statewide ratio of state and local taxes to income. The most recent year for which tax data are available is FY2009. In that year, total Arizona state and local taxes paid by individuals (measured by taking total state and local taxes and subtracting estimates from Ernst and Young on taxes paid by businesses) represented 7.9 percent of total employee compensation in the state. With this in mind, taxes connected with income earned and spent by mining company employees was estimated by taking 7.9 percent of their total compensation. In FY2009 total Arizona state and local taxes represented 8.4 percent of Arizona gross product or value added. So for all other phases of the economic impact process, e.g., the direct purchases from suppliers and multiplier effects related to consumer spending, taxes generated were estimated by multiplying the estimated incremental value added by 8.4 percent.

Inherent in the above methodology is an inability to separate state taxes from taxes accruing to local governments. Estimates of tax revenues generated by the mining industry, therefore, are reported at the state level only.

#### *Spending of tax revenues*

One channel to recognize in the economic impact process is the effect mining companies have on the Arizona economy when new tax revenues are spent by state and local governments. As noted above, we were generally unable to estimate new tax revenues at local levels of government. Also, because of intergovernmental flows of revenues, it is difficult to associate taxes raised at the level of a local government with provision of government services to that local

area. Some taxes, for example, are collected by the county but sent to the state to be redistributed. Because of these difficulties, the only practical way of recognizing tax-related impacts at the county level is to assume that the county gets a pro rata share of the total state and local tax revenues generated. The pro rata share used in our calculations was based on the county's share of the state population.

An exception to the procedure described above was the treatment of property taxes reported by surveyed mining companies. Property taxes paid by mining companies were assumed to be spent entirely within the counties in which the mining operations are located.

## Appendix B: Data Series from Company Surveys

For the past four decades, the Arizona Mining Association (AMA) has supported annual surveying efforts to collect economic statistics from copper mining producers operating in the state. Up until 2010, these data were collected and assembled by George F. Leaming of the Western Economic Analysis Center. Beginning with the 2011 operating year, the surveys and data collection have been taken over by the L. William Seidman Research Institute at Arizona State University. To maintain historical continuity in these data, series going back to 1985 are reproduced in this appendix. Data from earlier years are available from the AMA.

Table B1 provides statistics on Arizona copper mining employment, payrolls and goods and services purchased from Arizona businesses. Table B2 shows the primary business taxes paid by copper mining companies operating in Arizona.

**Table B 1: Copper Mining Operating Statistics as Reported by Arizona Copper Producers, 1985-2011**

	<b>Employment</b>	<b>Wages &amp; Salaries</b> (in mill \$s)	<b>Purchases from other Arizona Businesses</b> (in mill \$s)
1985	10,100	307	531
1986	9,300	260	524
1987	8,900	254	608
1988	9,500	375	588
1989	10,400	386	719
1990	11,200	410	997
1991	12,100	430	953
1992	12,100	450	1,122
1993	11,800	472	864
1994	11,700	476	879
1995	12,300	512	1,113
1996	12,600	615	1,292
1997	12,200	558	1,166
1998	11,100	519	1,133
1999	9,800	478	853
2000	7,500	362	731
2001	6,900	350	803
2002	6,200	307	639
2003	5,900	293	657
2004	6,400	317	788
2005	6,900	410	1,038
2006	8,200	481	1,440
2007	10,300	570	2,448
2008	11,200	775	2,839
2009	9,100	683	2,110
2010	10,400	674	2,512
2011	10,600	848	2,733

Source: Western Economic Analysis Center (1985-2010) and L. William Seidman Research Institute (2011)

**Table B 2: State and Local Taxes Paid by Arizona Copper Producers, 1985-2011**

	<b>Property</b>	<b>Severance</b>	<b>Corporate Income</b>	<b>Sales</b>	<b>State Land Payments</b>
1985	20,002	15,566	0	7,533	
1986	19,394	10,737	407	10,267	
1987	18,700	14,244	0	13,023	
1988	24,302	24,816	732	16,572	
1989	30,798	30,813	10,095	17,693	
1990	33,667	30,394	8,702	17,232	
1991	41,444	26,356	2,989	16,161	
1992	48,207	27,625	3,134	21,067	
1993	53,493	21,378	2,684	27,367	
1994	51,233	31,328	3,057	20,143	
1995	50,847	40,698	4,193	21,939	
1996	48,534	29,961	6,398	21,801	
1997	44,497	29,778	5,065	21,660	
1998	40,578	20,539	2,842	17,418	
1999	32,924	15,456	2,743	14,203	
2000	28,508	6,274	0	14,809	
2001	28,979	1,475	0	15,440	552
2002	25,726	1,127	0	13,346	491
2003	24,375	2,402	0	15,972	478
2004	22,745	11,624	7	18,434	1,066
2005	23,379	21,526	137	22,114	344
2006	27,044	41,215	31,334	25,448	1,567
2007	35,967	37,672	13,706	30,763	1,601
2008	55,120	35,892	9,099	40,596	3,813
2009	73,748	18,120	350	26,927	7,637
2010	54,691	32,679	16,079	30,763	35,500
2011	54,929	43,379	4,892	18,889	23,944

Source: Western Economic Analysis Center (1985-2010) and L. William Seidman Research Institute (2011)