



# THE ECONOMIC BASE OF ARIZONA, METROPOLITAN PHOENIX, METROPOLITAN TUCSON, AND THE BALANCE OF THE STATE: UPDATED WITH 2014 DATA

July 2016

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ARIZONA STATE UNIVERSITY

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## **PREFACE: INTRODUCTION TO REGIONAL ECONOMICS**

At a subnational level, a region can be defined in various ways, such as a grouping of states, a single state, a metropolitan area, or a labor market area. Regional economics, sometimes referred to as “spatial economics,” has been described as addressing the question of “what is where, and why — and so what?”<sup>1</sup> Regional economics has three “foundation stones:”

- Natural resource advantages. The unequal distribution of climate, minerals, soil, topography, and most other natural features helps to explain the location of many kinds of economic activity. In economic terms, this is “imperfect factor mobility.” The complete or partial immobility of land and other productive factors is one essential part of any explanation of what is where. Such immobility lies at the heart of the comparative advantage that various regions enjoy for specialization in production and trade.
- Economies of spatial concentration. In economic terms, this is “imperfect divisibility.” Economies of scale can result from the concentration of an economic activity in a particular location. Such concentrations have been described as clusters, discussed later in this paper.
- Costs of transportation and communication. Such costs vary by location. In economic terms, this is “imperfect mobility of goods and services.”

As the distribution of economic activity over space changes, there are important consequences for individuals and for communities. For example, electronics manufacturing used to be a dominant economic activity in the Phoenix area. As it has shrunk in size, at a disproportionate rate relative to the nation, it has had a substantial impact on workers — many of whom have had to move from the Phoenix area to find work — and on the communities in which the manufacturing facilities were located. Empty buildings and reduced consumer consumption put a strain on city finances. The impacts have been especially large due to the high average wage paid by the electronics manufacturers and by the lower wages paid by companies that eventually occupied the empty space.

A key concept in regional economics is the distinction between “traded” economic activities and other economic activities.

### **Traded Economic Activities**

Goods and services sold to customers (individuals or businesses) who are not residents of a region are referred to as “traded” economic activities. Synonyms for “traded” include “tradable,” “export,” and “basic.”<sup>2</sup> The sale of goods and services to customers from outside the region imports money into the regional economy that would otherwise not be present. Importing money into a regional economy is a necessity since “leakages” of money from the regional economy inevitably occur. Since no region produces all of the goods desired by its residents, money leaves the region when purchases of goods manufactured in other regions are made. Expenditures by residents while visiting another region is another form of leakage.

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<sup>1</sup> The discussion in this paragraph is from Edgar M. Hoover and Frank Giarratani, *An Introduction to Regional Economics*, <http://www.rri.wvu.edu/webbook/giarratani/chapterone.htm>.

<sup>2</sup> The definition of “export” in this situation applies to any sale to a customer from outside the region and is not limited to international exports.

Few economic activities sell wholly to customers outside the region or entirely to regional residents, but in many cases, customers are predominantly from either the region or from other regions. Many manufacturing, mining, and agricultural activities have a high percentage of sales made to customers from outside the region. For example, a high percentage of the aerospace goods manufactured in Arizona are sold to customers outside the state. Other activities that import money into a region include tourism and some services, such as call centers of a national company that serve a market area greater than the region.

A few traded activities, such as a copper mine, are location specific but most traded activities can locate anywhere since their customers are spread out across the country or the globe. Traded activities tend to concentrate geographically in relatively few regions. For example, high-technology activities are disproportionately found in a handful of locations, such as the Silicon Valley and Boston. This concentration is due to factors other than customer location, as discussed in the “Introduction to Economic Clusters” section of this paper.

In contrast to traded activities, nontraded (or “local”) economic activities are location specific since they sell their goods and services to regional customers (which consist of local companies as well as individuals). Local economic activities do not display geographic concentrations across the country. Instead, their presence largely is proportional to a region’s size, as defined by purchasing power.

While an integral part of a regional economy, nontraded activities do not import money into the regional economy. Their presence in the region is due to traded activities — the expenditures made locally by companies selling traded goods and services and by the employees of these businesses. In this way, traded activities “drive” the regional economy while nontraded activities respond to the growth occurring in traded activities.

To illustrate the relationship between traded and nontraded activities, consider the extreme case of a community that is wholly dependent on one traded activity. In some mining towns, the output of the mine is the sole traded product. No one lived in the area until the mine began to hire workers. While the mine is operating, a variety of nontraded activities spring up to serve those employed at the mine. When the mine closes, the mine’s employees leave the town to find jobs elsewhere and the businesses engaged in nontraded activities immediately lose many of their customers. A community cannot survive by selling goods and services to each other because of leakages of local monies. Some former mining towns have survived by attracting other traded activities, such as tourism. Otherwise, without a means of importing money into the community to offset the leakages, the nontraded businesses in a former mining town eventually shut down, resulting in a ghost town.

Regional economic development interests do not need to be concerned about attracting companies to serve local residents and businesses. If an unmet demand is present, a company will fill the opening without any intervention from local governments or economic development agencies.<sup>3 4</sup> Regional economic development focuses on traded activities since communities

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<sup>3</sup> This assumes that the unmet demand is large enough to result in a profitable operation. Residents of small communities often have to travel to other communities to make purchases because the unmet demand in the community is inadequate to attract a merchant to the community.

located outside the region — elsewhere in the same state, in other states, or in other nations — are competing to become the home of these traded activities.

### **Discussion**

Every regional economy has both traded and untraded economic activities; each type of activity is integral. For example, in a smaller region, the addition of a specialized retailer “plugs a leak.” That is, consumers of the specialized product can buy it locally, keeping their money within the regional economy. This has the same effect on regional dollars as a traded activity with an equivalent sales volume moving into the region. However, there is a key distinction between traded and untraded activities: the capacity for growth in a regional economy is severely limited unless growth in traded activities occurs. In addition, most traded activities pay considerably higher wages than most nontraded activities, and more generally have a larger “footprint” on the region than a nontraded activity with the same number of employees.

The inherent emphasis in a regional economy on traded activities should not be confused with “mercantilism,” or what more accurately is called “neomercantilism.” Generally associated with national economies rather than regional economies, neomercantilism emphasizes exports (generally, international exports), usually through the use of protectionist policies.

In Arizona, construction and real estate have been misidentified as driving activities. In reality, only a small portion of these activities are traded — construction and real estate largely respond to growth in the traded portion of the economy. Due to the state’s historically high growth rate and the high cyclical nature of the growth rate, growth-related activities such as construction and real estate make up relatively large shares of the economy and are highly cyclical. As long as the state’s traded activities continue to grow at an above-average pace, construction and real estate will remain disproportionately large pieces of the Arizona economy. At times, due to cyclical and artificial booms as in the mid-2000s, construction and real estate temporarily appear to drive the economy, but they should not be considered to be traded activities.

As seen in this paper, Arizona’s economy performed poorly in the decade from 2004 through 2014, which is a period running from the middle of the expansionary phase of one economic cycle to a similar point in the next cycle. Relative to population, Arizona’s employment — in both traded and nontraded activities — fell more than the national average. As a result, the prosperity of the state declined relative to the national average.

During this decade, the state disproportionately lost economic activity in high-paying traded activities such as electronics and gained a lesser number of traded jobs that had a lower average wage. However, the causes of the poor performance in traded activities cannot be determined with any certainty. What is known is that the quality of the workforce is the most important location factor and that Arizona has declined relative to the nation on this measure.<sup>5</sup>

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<sup>4</sup> However, cities within a metropolitan area compete with each other to attract companies serving the local population in order to receive the tax benefits of the economic activity. This competition is unhealthy from the perspective of the metro area.

<sup>5</sup> See the Office of the University Economist report, “Overview of Economic Competitiveness: Business and Individual Location Factors, With a Focus on Arizona,” November 2014, <https://wpcarey.asu.edu/sites/default/files/uploads/center-competitiveness-and-prosperity-research/competitiveness11-14.pdf>.

## SUMMARY

Arizona's economic base in 2014 was reasonably diverse, with four economic clusters of particular importance: aerospace vehicles and defense, financial services, metal mining, and hospitality and tourism. Considerable changes in the economic base occurred between 2004 and 2014. In particular, financial services and insurance services continued to gain in importance, while the high-technology clusters of information technology and analytical instruments and aerospace vehicles and defense contracted. Business services also declined significantly.

“Traded” economic activities — those that import money into a regional economy by selling goods and services to customers outside the region — form the economic base. They “drive” the economy and are responsible for the prosperity of a region. Nontraded activities respond to the growth occurring in traded activities and would not exist if traded activities were not present. Only about one-third of the total employment in 2014 was in traded activities: 33.8 percent nationally and 32.0 percent in Arizona.

The traded activities, which are defined by industry, have been organized into economic clusters by the Institute for Strategy and Competitiveness (ISC) at the Harvard Business School. According to the ISC, “A cluster is a geographic concentration of related companies, organizations, and institutions in a particular field that can be present in a region, state, or nation. Clusters arise because they raise a company's productivity, which is influenced by local assets and the presence of like firms, institutions, and infrastructure that surround it.”

Using a dataset of nonfarm, private-sector wage and salary employment by industry, the ISC has defined 51 traded clusters, with most of these clusters divided into subclusters. In this paper, two additional traded clusters — farming and federal government — are defined, using data from a different dataset. The ISC also defines 16 nontraded (“local”) clusters, to which state and local government has been added.

Employment is used by the ISC and in this paper because it is the only measure available by industry. However, employment is an inferior economic measure since does not take into account the wages paid or the number of hours worked. If data were available, the results of a base study using a dollar-denominated measure such as gross product would be considerably different from the results using employment. For example, a cluster with a low average wage, such as tourism, would be of less importance based on a dollar measure than on employment.

Traded activities of disproportionate size — defined as per capita employment greater than the national average — are of particular importance to a regional economy. Overall economic activity on a per capita basis was 11.5 percent lower than the national average in Arizona in 2014, which contributes to the state's low incomes. This subpar per capita activity is particularly an issue outside the two major metro areas, but even in the Phoenix area per capita activity was 8 percent below the national average in 2014.

“Differential” employment is calculated as the amount that is greater (“excess employment”) or lesser (“employment deficit”) than what would exist if the per capita figure was equal to the U.S. average. Based on excess employment, the clusters driving the economy in Arizona and its subregions are detailed in Table S-1.

**TABLE S-1  
TRADED CLUSTERS WITH EXCESS EMPLOYMENT  
IN ARIZONA AND SUBREGIONS IN 2014, SUMMARY**

	Arizona	Excess Employment		Balance of State
		Metro Phoenix	Metro Tucson	
Aerospace Vehicles & Defense	11,950	5,575	8,035	-
Hospitality & Tourism	9,942	4,065	1,395	4,482
Financial Services	9,523	17,214	-	-
Metal Mining	8,907	329	2,174	6,405
Transportation & Logistics	5,348	11,206	-	-
Electric Power Generation & Transmission	2,034	2,174	-	324
Insurance Services	2,026	6,351	-	-
Medical Devices	892	-	-	2,746
Information Technology & Analytical Instruments	-	3,398	-	-
Communications Equipment & Services	-	1,526	-	-
Furniture	-	183	-	-
Federal Government	-	-	5,827	12,505
Biopharmaceuticals	-	-	517	-
Farming	-	-	-	5,007
Construction Products & Services	-	-	-	1,272
Agricultural Inputs & Services	-	-	-	403
Nonmetal Mining	-	-	-	181
Coal Mining	-	-	-	47

Sources: U.S. Department of Commerce, Census Bureau, *County Business Patterns* (nonfarm, private-sector employment) and U.S. Department of Commerce, Bureau of Economic Analysis (farm and government employment). Cluster definitions are from the Institute for Strategy and Competitiveness, Harvard Business School. Excess employment was calculated using per capita employment. The population estimate for the nation came from the U.S. Department of Commerce, Census Bureau. The population estimates for Arizona and its subregions came from the Arizona Department of Administration, Office of Employment and Population Statistics.

Only eight of 53 traded clusters were of disproportionate size in Arizona in 2014 based on per capita employment. The aerospace vehicles and defense cluster provided the greatest excess employment in Arizona, with excesses in each of its three subclusters: missiles and space vehicles, aircraft, and search and navigation equipment. Excesses were present in each of the two large metro areas.

Excess employment in hospitality and tourism ranked second, disproportionately coming from the accommodation and tourism services subclusters. Each of the subregions provided an excess. However, the average wage in this cluster is far less than in the other leading clusters. Financial services ranked third, with its excess entirely in the credit intermediation subcluster in the Phoenix area. Metal mining ranked fourth, with excess employment in each of the subregions. The excess in the transportation and logistics cluster was predominantly in the air transportation subcluster in the Phoenix area. Lesser amounts of excess employment were present in the electric power generation and transmission, insurance services, and medical devices clusters.

The Phoenix area had excess employment in 10 traded clusters, led by financial services (predominantly in the credit intermediation subcluster). Large excesses also were present in

transportation and logistics (primarily in the air transportation subcluster), insurance services (mostly in the insurance carriers subcluster), and aerospace vehicles and defense (in all three subclusters, but particularly aircraft). Moderate excess employment was present in hospitality and tourism (particularly in tourism services, but also in other subclusters) and information technology and analytical instruments (predominantly in the semiconductors subcluster). Lesser excess employment was present in electric power generation and transmission, communications equipment and services (only in the communications equipment subcluster), metal mining, and furniture clusters.

Only five traded clusters generated excess employment in the Tucson area. Aerospace vehicles and defense provided the greatest excess employment, mostly in the missiles and space vehicles subcluster, but also in the other subclusters. The next highest excess employment was provided by the federal government. Excess employment was lower in metal mining, hospitality and tourism (only in the accommodations subcluster), and biopharmaceuticals (in the diagnostic substances subcluster).

Unlike the metro areas, the balance of the state consists of multiple local economies, with the composition of the economies varying geographically. Most of the local economies are driven by only one or a few economic activities. Taken as a whole, the balance of the state had excess employment in 10 traded clusters, led by the federal government, metal mining, and farming. Excess employment was moderate in hospitality and tourism (in various subclusters but especially accommodation), and medical devices. A lesser amount of excess employment was present in construction products and services, agricultural inputs and services, electric power generation and transmission, nonmetal mining, and coal mining.

Per capita employment in both traded clusters and local clusters declined nationally between 2004 and 2014, with larger decreases in Arizona. Employment in the traded clusters as a share of total employment fell nationally and in Arizona. In addition, significant changes in the composition of Arizona's economic base occurred during these 10 years; the largest changes in differential employment are shown in Table S-2.

The business services cluster had provided excess employment in 2004 but a large employment deficit was present in 2014. Large declines occurred in the corporate headquarters and computer services subclusters. Excess employment decreased in the tourism and hospitality cluster, with the gambling facilities and accommodation subclusters experiencing the largest declines. Excess employment also fell in two high-technology clusters. Most of the subclusters in the information technology and analytical instruments cluster experienced a drop in differential employment. Much of the decline in the aerospace vehicles and defense cluster occurred in the aircraft subcluster, but excess employment in the missiles and space vehicles cluster also decreased. In addition, high-technology subclusters were largely responsible for the drop in the distribution and electronic commerce cluster.

Partially offsetting these declines were gains in differential employment in various traded clusters. The largest increase in Arizona occurred in the education and knowledge creation cluster, but this cluster still had a significant employment deficit in 2014. Public schools are not included in this cluster. Excess employment increased in the financial services cluster (entirely in

**TABLE S-2**  
**CHANGE IN DIFFERENTIAL EMPLOYMENT IN ARIZONA AND SUBREGIONS**  
**BETWEEN 2004 AND 2014, SUMMARY**

	Change in Differential Employment			
	Arizona	Metro Phoenix	Metro Tucson	Balance of State
<b>Top Five Traded Clusters In Each Region</b>				
Education and Knowledge Creation*	8,919	10,278	-1,446	87
Financial Services	7,875	5,012	1,586	1,277
Insurance Services	5,967	2,260	1,357	2,350
Communications Equipment & Services	5,080	4,487	315	279
Metal Mining	4,392	651	1,057	2,684
Transportation & Logistics	3,632	2,862	381	389
Federal Government	-2,652	-5,404	2,692	59
Automotive	2,950	719	1,612	620
Biopharmaceuticals	1,962	721	1,230	11
Construction Products & Services	561	-704	-1,268	2,533
Medical Devices	2,295	60	167	2,068
<b>Bottom Five Traded Clusters In Each Region**</b>				
Business Services	-34,359	-30,655	-4,577	874
Distribution and Electronic Commerce	-9,557	-7,531	-1,838	-189
Hospitality and Tourism	-8,746	-6,190	-3,135	579
Information Technology and Analytical Instruments	-7,899	-6,422	-1,840	363
Oil and Gas Production and Transportation	-7,098	-4,820	-970	-1,307
Federal Government	-2,652	-5,404	2,692	59
Aerospace Vehicles and Defense	-6,645	-2,438	-4,123	-84

Notes:

- Several of these clusters did not provide excess employment in 2014 in one or more of the regions.
- The top five and bottom five differentials in each region are shown in **bold**.

\* The education portion of the cluster includes only the private sector.

\*\* In the balance of the state, only one cluster had a decrease of more than 500.

Sources: U.S. Department of Commerce, Census Bureau, *County Business Patterns* (nonfarm, private-sector employment) and U.S. Department of Commerce, Bureau of Economic Analysis (farm and government employment). Cluster definitions are from the Institute for Strategy and Competitiveness, Harvard Business School. Excess employment was calculated using per capita employment. The population estimate for the nation came from the U.S. Department of Commerce, Census Bureau. The population estimates for Arizona and its subregions came from the Arizona Department of Administration, Office of Employment and Population Statistics.

the credit intermediation subcluster) and in the insurance services cluster (primarily in the insurance carriers subcluster). However, the gains in these two clusters did not offset the losses in the two high-tech clusters, and the average wage in these clusters is less than in the high-tech clusters. A sizable advance also occurred in the communications equipment and services cluster, but a small employment deficit remained in 2014. Metal mining also posted strong growth, but further gains should not be expected in this very cyclical cluster.

The changes over the decade in the economic base in the Phoenix area were similar to those for the state. The decline in the aerospace vehicles and defense cluster was particularly severe in the Tucson area, which did not experience significant gains in the communications equipment and services or education and knowledge creation clusters. Metro Tucson did have a large gain in the federal government cluster — compared to drop in Metro Phoenix — and in the biopharmaceuticals cluster.

The traded clusters fared better over the decade in the balance of the state than in the two large metro areas. Only one cluster had a sizable decline in the balance of the state. The medical devices and construction products and services clusters had the largest gains.

### **Commentary**

Though a relatively small number of traded clusters provide excess employment, Arizona's economy is reasonably diverse. Reports that the economy lacks diversity are primarily based on the relatively large size of growth-related activities such as construction and real estate and the very high cyclical nature of those activities. However, only a small portion of these activities are traded — construction and real estate respond to growth in the traded portion of the economy. They do not drive the economy, except temporarily during an artificial boom as in the mid-2000s. As long as the state's traded activities continue to grow at an above-average pace, construction and real estate will remain disproportionately large pieces of the Arizona economy.

Further diversification of the economy will have little effect on moderating the state's severe economic cycles since most economic activities follow the same cycle. The severity of economic cycles is a common feature of states with rapid overall growth rates. While economic diversification would be of significant benefit to most rural areas, such factors as geographic remoteness, small population size, and limited educational attainment of the residents limit opportunities for diversification in much of rural Arizona.

Instead of concentrating on diversification, the economic development focus in Arizona should be on higher-quality growth — not just job gains in traded sectors that pay well, but gains in higher-wage occupations within such clusters. In a number of clusters, including financial services and insurance services, the average wage in Arizona is far below the national average, suggesting that Arizona's growth has disproportionately consisted of lower-wage occupations. The disproportionately large loss of high-paying high-technology jobs in Arizona is troubling.

Another significant issue is the relatively low number of traded-sector jobs relative both to the number of residents and as a percentage of all jobs. While Arizona's age distribution — somewhat above-average shares of both children and senior citizens — contributes to its below-average number of jobs per capita, the number of jobs is subpar even relative to the working-age population. The state's low labor force participation rate is a significant contributor to the state's low incomes. Low educational attainment across much of the state outside of the two large metro areas and in certain segments of the population even within the Phoenix and Tucson areas likely is a significant contributor to the state's low workforce participation.

## **INTRODUCTION TO ECONOMIC BASE STUDIES**

An economic base study identifies leading economic activities in a region. For this report, base studies were conducted for Arizona and for three geographic subregions of the state: Metropolitan Phoenix (Maricopa and Pinal counties), Metropolitan Tucson (Pima County), and the balance of the state (the sum of the state's other 12 counties). While the balance of the state consists of a number of diverse areas that are in many ways independent of each other, the balance of the state was not further subdivided geographically in this report due to data limitations.

In order to conduct an economic base study, measures of economic activity must be available for components of the overall economy. The North American Industry Classification System (NAICS) hierarchically divides economic activity into sectors, subsectors, industry groups, and industries. While an economic base study can be undertaken using any level of the NAICS, utilizing the most-detailed industry data produces the most precise and useful results.

Any one of several economic measures, such as employment or gross product, conceptually could be used in a base study. Since employment is available by industry for states and counties, it generally is the economic measure used in base studies. However, employment is an inferior measure of economic activity because it does not consider the number of hours worked or the hourly wage. A broader dollar measure such as gross product would be better, but the NAICS detail available for such measures is limited to sectors or subsectors for state and substate areas.

### **Traditional Economic Base Studies**

An economic base study differs from a simple examination of the composition of a regional economy (using employment or another economic measure) by considering the importance of an economic activity in a regional economy relative to its significance in a geographically broader economy — usually the national economy is used for the comparison.

In order to determine the importance of economic activities in a regional economy relative to their significance in a broader economy, a “location quotient” is calculated for each economic activity. Typically, a base study compares the shares of total economic activity by sector, subsector, industry group, and/or industry in a region to those in the nation. A location quotient is calculated by dividing the share in the region by the national share. For example, if a sector's employment makes up 11 percent of the total employment in a region but 10 percent nationally, the location quotient (LQ) is 1.1 (11 divided by 10). If a location quotient is greater than 1, then “excess” — that is, above average — employment exists in that sector in the region.

The standard method of calculating location quotients is less than desirable if the overall level of economic activity in a region is much different from the national average after adjusting for the size differential, as measured by population. In Arizona, overall per capita employment is considerably lower than the national average — by 11 percent based on the broadest measure of employment in 2014. In a case such as this, location quotients based on sectoral shares present a misleading picture of the concentration of an economic activity in a regional economy — an activity's share of the regional economy may be above average but its per capita activity may be below the national average.

Thus, an alternative means of calculating location quotients is to compare per capita economic activity in a region to the national per capita figure. For example, if a sector's employment per 1,000 residents is 10 regionally, but 11 nationally, the location quotient is 0.91 (10 divided by 11). A location quotient less than 1 indicates that economic activity in the region is less than average and that a "deficit" of employment exists in that activity in the region.

The magnitude of the employment "differential" — the excess or deficit — is quantified by subtracting from the region's employment the regional employment divided by the location quotient. The existence of excess employment indicates an unusually strong concentration in that economic activity.

A location quotient greater than 1 can result from an above-average level of sales to customers from outside the region or from local conditions that cause above-average sales to regional residents. In the Arizona desert, for example, activities related to air conditioners (sales, maintenance and repair) have excesses because of climate-induced high levels of expenditures by local residents.

Historically, base studies have focused on employment excesses (economic activities with a location quotient greater than 1) without considering whether an economic activity primarily serves regional residents or primarily sells to customers located outside the region. This serious omission was necessitated by a lack of information regarding the nature of an economic activity's customers. Thus, information relative to the traded portion of economic activities is a key addition to a traditional economic base study. The "Introduction to Economic Clusters" section that follows discusses a source that distinguishes between traded and local economic activities.

An economic activity can be traded but not have an excess or can have an excess but not be traded. The most important activities to a regional economy are those that are traded and have an excess.

### **Economic Data Used in Base Studies**

All economic data produced by the federal government are subject to disclosure restrictions, which are in place to prevent data on a particular company from being released or otherwise ascertained. These restrictions result in considerable data being withheld from publication for subnational geographies and create serious limitations to conducting economic analyses.

Two federal government sources of economic data are discussed in this subsection: the U.S. Department of Commerce's Bureau of Economic Analysis (BEA) and the U.S. Department of Commerce's Census Bureau, which produces *County Business Patterns*.

#### **BEA**

The BEA provides a variety of economic data for the nation, states, metropolitan areas, and counties.<sup>6</sup> However, estimates are provided only to the subsectoral level by state; by county and metropolitan area, the estimates largely are limited to sectors. While this lack of detail is a

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<sup>6</sup> See <http://www.bea.gov/regional/index.htm>.

serious disadvantage from the perspective of economic base studies, the BEA data have some advantages:

- Data are available for all sectors.
- The employment data include proprietors as well as wage and salary workers.
- Several economic measures are available, including gross product, earnings, and employment.

In the BEA's dataset, some estimates by county are not disclosed, even at the sectoral level. Because of numerous withholdings in the less-populous counties, the balance of the state was calculated as the difference between Arizona and the two large metropolitan areas. Still, a few figures had to be estimated. While the subsectoral figures were forced to sum to the sectoral total, and the sectoral figures were controlled to the overall total, the estimated values are subject to considerable error.

Economic base study results using BEA data are presented in Appendix A for Arizona and each of its three subregions. Separate base studies were conducted using total employment, earnings, and gross product.

### ***County Business Patterns***

Because base studies are much more insightful if data are available by industry, most base studies use the data reported in *County Business Patterns* (CBP).<sup>7</sup> The latest version of *County Business Patterns*, released in April 2016, reports data for 2014. CBP provides the number of establishments (physical locations at which work is performed), employment, payroll, and the number of establishments in each of several employment-size categories (less than 5, 5 to 9, 10 to 19, 20 to 49, 50 to 99, 100 to 249, 250 to 499, 500 to 999, and 1,000 or more). These data are available for each level of the NAICS — sector, subsector, industry group, and industry — for counties, metropolitan areas, states, and the nation.

Only wage and salary employees are included in CBP; proprietors are not counted. Employment is expressed as of the week including March 12. No distinction is made between full-time and part-time workers. Payroll is provided for the calendar year and for the first quarter (to better align with the March 12 employment date). Certain economic activities are not within the scope of CBP, including most of the agriculture sector, the government sector, the rail transportation subsector, and the private households subsector.

Some establishments are not assigned to a county in CBP, being placed in a “statewide” category. Thus, the balance of the state includes these geographically unassigned activities as well as the establishments physically located in the 12 counties other than Maricopa, Pima, and Pinal.

More than three-fourths of the geographically unassigned employment in Arizona in 2014 was in one industry: NAICS code 561330, professional employer organizations. Establishments in this industry provide human resource management services to client businesses. Such establishments frequently provide contract workers to the client company, with the workers technically an

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<sup>7</sup> See <http://www.census.gov/econ/cbp/>.

employee of the professional employer organization. It is in this situation when a professional employer organization is not assigned to a county in CBP. In this base study, NAICS industry 561330 was subtracted from the totals in order to compare the totals for Metro Phoenix, Metro Tucson, and the balance of the state.

**Imputation of Withheld Employment Data.** While the number of establishments is not subject to the federal disclosure restriction, much of the employment and payroll data below the national level are withheld from publication in *County Business Patterns*. In some cases, the withheld data can be calculated directly from published values. For example, values may be provided for the industry group and for each of the other industries within the group. The missing value can thus be calculated as the difference between the industry group total and the sum of the other industries. In other cases, the missing data must be estimated. For example, the data may be withheld for more than one industry within an industrial group, or the industry group total may be withheld as well.

Generally, when data are withheld by the federal government, it is not feasible to estimate the missing values with any degree of accuracy. However, when an employment value is withheld in CBP, an employment range (0 to 19; 20 to 99; 100 to 249; 250 to 499; 500 to 999; 1,000 to 2,499; 2,500 to 4,999; etc.) is provided in its place. The availability of this employment range causes most economic base studies to use the employment data from *County Business Patterns*. Most base studies use the midpoint of the range when an employment value is not disclosed.

However, the use of the midpoint results in a biased estimate since on average the missing value is less than the midpoint. For this report, a better estimate of the missing value was calculated using the frequency distribution of establishments by employment size and average employment in each of the employment-size categories by sector. Moreover, the estimated value was controlled to the value for the next higher industrial level — for example, within an industry group, the sum of employment by industry was forced to sum to the industry group total. In addition, the estimated values for Metro Phoenix, Metro Tucson, and the balance of the state were controlled to the state total for every industry. This detailed technique for estimating a withheld employment value — referred to as an imputation in this paper — is quite time consuming.

**Payroll Data.** Because of the conceptual limitations of employment, the payroll data reported in *County Business Patterns* are an attractive alternative to use in a base study. However, even when both employment and payroll are reported in CBP, the calculation of payroll per employee (average wage) is problematic since the two measures are not directly linked. Employment is expressed as of the week of March 12, while payroll is provided for the first quarter and for the calendar year total. Unless employment is stable over time, dividing payroll by employment does not provide an accurate measure of the average wage.

Conceptually, the use of first quarter payroll should provide a more reliable estimate of the average wage than the use of the annual data, since employment on March 12 is likely to be closer to average employment in the first quarter than annual average employment. However, some businesses provide annual bonuses, which generally are included in the payroll figures of either the first quarter or fourth quarter. Depending on whether bonuses were present in the first

quarter and changes in employment before and after March 12, in some industries the calculated average wage is higher using the first quarter figures (with the quarterly payroll annualized by multiplying by four) than the annual payroll. In other industries, the average wage is higher using the annual payroll figure. In some industries, the difference in the two averages is considerable.

The lack of a direct link between the employment and payroll figures is not the greatest shortcoming to using payroll in the base study. The larger problem is the numerous instances in which the payroll data are withheld. Since the Census Bureau does not provide a range for a missing payroll figure as it does for employment, it is not possible to accurately estimate undisclosed payroll data. For this study, an estimate of the average wage, based on first quarter payroll, was made for each industry. These should be viewed as rough estimates. The estimated values were not controlled to the next higher NAICS level; the figure for the balance of the state was calculated as the difference between the Arizona figure and the figures for the two populous metro areas.

## INTRODUCTION TO ECONOMIC CLUSTERS

The Institute for Strategy and Competitiveness (ISC) at the Harvard Business School, directed by Professor Michael Porter, is a leading research unit on economic clusters. According to the ISC, “A cluster is a geographic concentration of related companies, organizations, and institutions in a particular field that can be present in a region, state, or nation. Clusters arise because they raise a company's productivity, which is influenced by local assets and the presence of like firms, institutions, and infrastructure that surround it.”<sup>8</sup> The ISC states that clusters increase productivity and operational efficiency, stimulate and enable innovation, and facilitate commercialization and new business formation.

The U.S. Cluster Mapping Project is a national economic development initiative led by the ISC.<sup>9</sup> According to the ISC, “The U.S. Cluster Mapping Project aims to strengthen U.S. competitiveness by helping clusters and regions understand and improve their economic composition and performance. While much national economic debate has focused on macroeconomic challenges, most of the critical drivers of U.S. competitiveness are regional, and clusters are a central part of this framework.”

While all of the ISC's cluster data are available online, easy access to large quantities of data is not available. Users can access the ISC's cluster data by state, metropolitan/micropolitan area, county, and the BEA's economic areas. In addition, users can specify a custom geography that consists of an aggregation of counties. This custom option was used to create data for Arizona's balance of the state (the 12 counties other than Maricopa, Pima, and Pinal).

*County Business Patterns* is the primary data source used in the U.S. Cluster Mapping Project. When the cluster mapping website was accessed, 2013 data were the latest available. Two significant differences in methodology are present between the Cluster Mapping Project and the base studies discussed in this report:

- In the Cluster Mapping Project, the CBP data are not supplemented by data from the BEA. Thus, the project's data are limited to the private sector, excluding most of the agriculture sector and certain other activities.
- When employment values are not disclosed in CBP, the Cluster Mapping Project simply uses the midpoint of the published range.

On average, use of the midpoint overstates employment; the sum of the cluster estimates made by the ISC in 2013 was between 0.7-and-0.9 percent too high in Arizona, Metro Phoenix, and Metro Tucson relative to the published total in *County Business Patterns*. However, the overstatement in the balance of the state was 10.3 percent. Thus, the ISC's use of the midpoint results in a much more substantial error when data withholdings are numerous, as in the state's less-populous counties.

While overall the use of the midpoint results in an overstatement of employment, an underestimate may occur for any given undisclosed value. The magnitude of the numeric errors

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<sup>8</sup> From <http://www.isc.hbs.edu/competitiveness-economic-development/frameworks-and-key-concepts/Pages/clusters.aspx>.

<sup>9</sup> The Institute's website is <http://www.isc.hbs.edu>. A link to the Cluster Mapping Project is available from this website; the direct address is <http://www.clustermapping.us/>.

resulting from the use of the midpoint generally is small, but significant errors can occur in large industries for which employment is not disclosed. For example, instead of the midpoint of 7,500 employees for an undisclosed value between 5,000 and 9,999 for the guided missile and space vehicle manufacturing industry in Metro Tucson, the imputed value was 8,472 in 2014. On a percentage basis, the difference between the midpoint and the more-detailed imputation can be quite large when the numeric employment value is small. Given the amount of time needed to generate imputed values and the very large number of geographic areas reported by the ISC, it is not feasible to calculate imputed values for the U.S. Cluster Mapping Project.

### **Traded Versus Local Clusters**

There is no definitive way to determine the traded nature of economic activities, as discussed in the next section, “Estimates of Traded Shares.” The ISC categorized each industry as being either traded or local, though it acknowledges that an industry may have both elements. This categorization was made using three criteria, all related to employment specialization and concentration across regions of the United States. If an industry met the requirement for tradability on all three criteria, it was considered to be traded; if it did not meet any of the three requirements, it was designated as nontraded. Further research was conducted on those industries meeting one or two of the criteria.

The ISC recognizes that the methodology it employed is not the only way to distinguish between traded and local industries. Thus, their categorization does not match that of others, as discussed in the next section.

The 2007 version of the NAICS identified 1,088 industries. The ISC categorized 778 industries as being traded and aggregated these traded industries into 51 clusters. Of these 51 clusters, 42 are divided into 207 subclusters. Most of the nine traded clusters that are not subdivided are associated with mining and other natural resources. The remaining 310 industries were organized into 16 nontraded clusters, each of which is divided into subclusters. The total number of nontraded subclusters is 100. Table 1 provides a summary of the number of clusters, subclusters, and industries.

No industry was included in more than one cluster, though an industry may have connections to more than one cluster. The grouping of the industries was based on “co-location patterns and other regional data to find inter-industry linkages.”<sup>10</sup>

While 71.5 percent of the industries are part of a traded cluster, traded clusters accounted for only 36 percent of the nation’s nonfarm private-sector wage and salary employment in 2013. Traded clusters accounted for 50 percent of income since, on average, the traded clusters pay higher wages than nontraded clusters. More than 96 percent of the nation’s patents are associated with a traded cluster.

Nationally, the ISC reported employment of 118.3 million in 2013, of which 42.6 million was in traded clusters. The size of the 51 traded clusters varied considerably, from nearly 11 million employees (in the business services cluster, which was responsible for more than one-fourth of

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<sup>10</sup> “Categorization of Traded and Local Industries in the US Economy,” available from <http://clustermapping.us/content/cluster-mapping-methodology>.

**TABLE 1**  
**NUMBER OF CLUSTERS, SUBCLUSTERS, AND INDUSTRIES**

	Clusters	Sub-clusters	Indus-tries*	Industries Per Cluster		Industries Per Subcluster	
				Average	Range	Average	Range
Total	67	307	1,088	16.2	3 – 62	3.5	1 – 22
Traded	51		778	15.2	3 – 62		
No Subclusters	9		52	5.8	3 – 13		
With Subclusters	42	207	726	17.3	4 – 62	3.5	1 – 15
Nontraded	16	100	310	19.4	5 – 52	3.1	1 – 22

\* Using the 2007 version of the North American Industry Classification System.

Source: Institute for Strategy and Competitiveness, Harvard Business School.

the total of the traded clusters) to less than 15,000. Four clusters accounted for more than half of the traded cluster total, while 27 clusters combined for less than 10 percent of the traded total. Seven subclusters employed more than 1 million nationally in 2013, led by the 3.3 million in business support services.

The national size of the 16 nontraded clusters ranged from 16.6 million employees (in health services) to 500,000 in 2013. Eighteen of the nontraded subclusters employed more than 1 million, led by hospitality establishments at 10.4 million and hospitals at 5.8 million. Employment for each cluster and subcluster is provided in Appendix B.

The U.S. Cluster Mapping Project reports wage data, but these figures are not reliable at a subnational level due to the withholding of wages in a significant number of industries.

## ESTIMATES OF TRADED SHARES

It is not possible to directly estimate the traded portion of economic activity as measured, for example, by sector or industry, since data are not available by company or by industry to indicate the percentage of sales that are made to local residents and companies versus the portion made to out-of-state customers, tourists, and others who are not local residents. The lack of data regarding tradability has resulted in most economic base studies giving little attention to this concept, instead focusing on excess activity and equating the presence of excess activity to export activity. To the extent that tradability is discussed in base studies, it has been limited to the use of judgment to differentiate economic activities as, for example, primarily traded, partially traded, or largely not traded.

The Institute for Strategy and Competitiveness used a more sophisticated means of assigning tradability by industry, using 2009 data, but their designations still were influenced by judgment and resulted in each industry being designated as either wholly traded or entirely nontraded. By aggregating the industry data, an estimate of the traded share by sector was produced (see Table 2).

An earlier effort to determine tradability was published by the Institute for International Economics (IIE).<sup>11</sup> Like the ISC, employment specialization and concentration across regions of the United States was used to determine tradability, but the data and methodology used differed from that of the ISC.

Estimates of traded shares are embedded within economic models. The Regional Economic Models, Inc. (REMI) model for Arizona provides traded shares by sector and for most subsectors. The Minnesota IMPLAN Group (IMPLAN) model for Arizona provides traded shares by sector, for most subsectors, and for selected industry groups and industries. In both models, certain subsectors (and industry groups and industries in IMPLAN) are combined before the traded share is calculated. The traded shares calculated from these economic models are based on a measure of production. In order to be more consistent with the age of the data used by the ISC and IIE, the traded shares from the models discussed in this section are based on data from several years ago.

At the sectoral level, the correlation in the traded shares from the two economic models is high, exceeding 0.8. Still, as seen in Table 2, some notable differences in estimates of traded share exist at the sectoral level, with the extremes in the transportation and warehousing sector and the agriculture sector. Only three sectors in Arizona — the classic export sectors of agriculture, mining, and manufacturing — are considered to be at least 65 percent traded in each model.

The correlations in the traded shares are not as high between the ISC and IIE or between these sources and the two economic models, ranging from 0.58 to 0.76. In several sectors — agriculture, mining, manufacturing, wholesale trade, information, finance and insurance, professional and technical services, and management of companies — the estimated traded shares from ISC and IIE exceed those from the two models.

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<sup>11</sup> J. Bradford Jensen and Lori G. Kletzer, "Tradable Services: Understanding the Scope and Impact of Services Outsourcing," September 2005.

**TABLE 2**  
**ESTIMATES OF TRADED SHARE BY SECTOR**

<b>Sector</b>	<b>ISC</b>	<b>IIE</b>	<b>REMI</b>	<b>IMPLAN</b>
Agriculture	100%*	100%	98%	68%
Mining	100	100	92	82
Utilities	25	19	37	41
Construction	8	0	18	20
Manufacturing	92	86	65	67
Wholesale Trade	71	54	18	37
Retail Trade	4	15	8	29
Transportation and Warehousing	63	70	64	36
Information	53	67	28	39
Finance and Insurance	57	68	42	32
Real Estate and Rental	10	91	14	36
Professional, Scientific and Technical Services	66	86	11	18
Management of Companies	100	100	48	23
Administrative Support and Waste Management	36	40	35	53
Education (Private Sector)	65	1	21	17
Health Care and Social Assistance	0	2	7	12
Arts, Entertainment and Recreation	53	33	17	27
Accommodation and Food Services	16	18	12	25
Other Services	2	20	7	20
Government	NA	28	1	4

\* Includes only a small portion of the agriculture sector.  
NA: not available.

Note: The REMI and IMPLAN figures are specific to Arizona, while the ISC and IIE figures are for the national average of the states.

Sources: Institute for Strategy and Competitiveness, Harvard Business School (ISC); Institute for International Economics (IIE); Regional Economic Models, Inc. (REMI); and Minnesota IMPLAN Group (IMPLAN).

At the subsectoral level, the traded shares from the two models are substantially different with a correlation of just 0.38. For example, the difference in share is 49 percentage points or more in five of the 22 manufacturing subsectors (see Table 3) — that is, one model assumes a subsector is primarily traded while the other assumes it is largely not traded. Similarly large differences are found in subsectors in the transportation and warehousing sector and in the information sector.

The differences in traded share between the two models do not follow a pattern. In some sectors and subsectors, REMI indicates a higher traded share, but in other cases IMPLAN has the higher share. In some subsectors, one model's estimates seem more reasonable, but in other subsectors the other model seems to provide a more likely estimate of the traded share. In other subsectors, neither model provides a seemingly accurate estimate, or the two models provide similar and reasonable estimates.

**TABLE 3**  
**ESTIMATES OF TRADED SHARE BY SUBSECTOR IN ARIZONA**

<b>Sector</b>			
<b>Subsector</b>	<b>REMI</b>	<b>IMPLAN</b>	<b>Difference</b>
Agriculture	98%	68%	-30
Farm	100	70	-30
Forestry, fishing, hunting and trapping	81	57	-24
Support	60	57	-3
Mining	92	82	-10
Oil and gas	67	57	-10
Other mining	93	87	-6
Support	59	73	14
Manufacturing	65	67	2
Food	82	33	-49
Beverages and tobacco	46	80	34
Textile mills	96	76	-20
Textile products	75	99	24
Apparel	28	11	-17
Leather and allied products	55	25	-30
Wood products	30	42	12
Paper	49	98	49
Printing and related	14	75	61
Petroleum and coal products	49	28	-21
Chemicals	56	41	-15
Plastic and rubber products	38	15	-23
Nonmetallic mineral products	40	95	55
Primary metals	72	97	25
Fabricated metal products	32	91	59
Machinery	66	58	-8
Computer and electronic products	74	70	-4
Electrical equipment and appliances	52	63	11
Motor vehicles and parts	36	74	38
Other transportation equipment	87	78	-9
Furniture and related	61	23	-38
Miscellaneous	79	63	-16
Transportation and Warehousing	64	36	-28
Air transportation	66	75	9
Rail transportation	95	31	-64
Water transportation	100	20	-80
Truck transportation; Couriers and messengers	61	10	-51
Transit and ground passenger transportation	31	0	-31
Pipeline transportation	95	2	-93
Scenic and sightseeing transportation; Support	62	30	-32
Warehousing and storage	81	1	-80
Information	28	39	11
Publishing	27	71	44
Motion picture and sound recording	90	1	-89
Data processing; Other information services	3	68	65
Broadcasting; Telecommunications	30	28	-2

(continued)

**TABLE 3 (continued)**

<b>Sector</b>			
<b>Subsector</b>	<b>REMI</b>	<b>IMPLAN</b>	<b>Difference</b>
Finance and Insurance	42%	32%	-10
Credit intermediation; Monetary authorities	39	42	3
Securities and other financial investments	33	17	-16
Insurance	54	33	-21
Real Estate and Rental	14	36	22
Real estate	7	32	25
Rental and leasing; Lessors of intangible assets	50	61	11
Administrative Support and Waste Management	35	53	18
Administrative support	38	55	17
Waste management	5	26	21
Health Care and Social Assistance	7	12	5
Ambulatory health care	7	21	14
Hospitals	4	0	-4
Nursing care	1	0	-1
Social assistance	51	0	-51
Arts, Entertainment and Recreation	17	27	10
Performing arts and spectator sports	16	37	21
Museums and historical sites	1	0	-1
Amusement, gambling and recreation	21	21	0
Accommodation and Food Services	12	25	13
Accommodation	39	42	3
Food services	2	21	19
Other Services	7	20	13
Repair and maintenance	9	30	21
Personal and laundry services	1	9	8
Religious, civic, professional & similar organizations	11	10	-1
Private households	11	0	-11
Government	1	4	3
State and local	1	3	2
Federal civilian	0	8	8
Federal military	0	0	0

Note: No subsectoral detail is available from REMI for the sectors not shown in this table.

Source: Calculated from Regional Economic Models, Inc. (REMI) and Minnesota IMPLAN Group (IMPLAN).

## **ARIZONA DATA FROM THE U.S. CLUSTER MAPPING PROJECT**

This section is based on the data reported by the U.S. Cluster Mapping Project led by Harvard's Institute for Strategy and Competitiveness. Thus, it is limited to private-sector employment excluding most of the agriculture sector and certain other activities and is subject to the inaccuracies caused by the use of the midpoint of the range for undisclosed data. Data for 2014 were not yet available when this paper was completed. The definition of clusters is that of the ISC.

This section focuses on two topics:

- Comparisons of Arizona to other states.
- Changes over time. The ISC provides a time series from 1998 through 2013.

The 2013 figures by cluster and subcluster are summarized in Appendix B. Arizona and its subregions are discussed in more detail in the next section, using data through 2014.

### **Comparison of Arizona to Other States, 2013**

Among the 50 states, Arizona's traded share of 33.5 percent of employment in 2013 ranked 41st. Among 10 western states, the percentage was lower only in New Mexico. Twenty-one states had a share greater than the national figure of 36.0 percent and four states matched the national share. The highest share was in Utah at 43.6 percent; the lowest share was in Montana at 27.4 percent. The traded shares do not follow a strong regional pattern, though five of the 10 western states ranked in the top 11 nationally.

By cluster, the states were ranked on two measures: employment as a share of total employment and per capita employment.<sup>12</sup> Location quotients were calculated based on each measure. Since Arizona's overall employment per capita in 2013 was 12 percent less than the national average, its location quotients were considerably lower based on the per capita measure relative to the measure based on share. In some clusters, Arizona's rank was the same or little different between the two measures, but in other clusters, Arizona's rank was considerably lower based on the per capita measure. The remainder of this discussion is based on the per capita measure.

Arizona's location quotient for total employment in 2013 was 0.88, the fifth lowest in the nation. The overall LQ for traded clusters was 0.81, sixth lowest in the nation, and the overall LQ for nontraded clusters was 0.92, eighth lowest in the nation.

Among the 51 traded clusters, the location quotient in Arizona exceeded 1 in only five and was equal to 1 in one cluster. The LQ exceeded 2 in the metal mining cluster and in the aerospace vehicles and defense cluster; Arizona ranked fourth or fifth in each. The LQ was between 1.1 and 1.2 in the transportation and logistics; financial services; and hospitality and tourism clusters, with the state ranking between 13th and 16th on each. The LQ was 1.00 in the medical devices cluster, ranking 17th.

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<sup>12</sup> The Census Bureau's population estimate for July 1, 2013 was used to calculate per capita employment. Thus, Arizona's location quotients and excess employment reported in this subsection are slightly different from those elsewhere in this report, which are based on the population estimate of the Arizona Department of Administration, Office of Employment and Population Statistics.

Arizona's location quotient was quite low in many of the traded clusters. It was less than 0.25 in 11, between 0.25 and 0.49 in 17, and between 0.50 and 0.74 in six. The state ranked among the bottom 10 states in 14 traded clusters and between 31st and 40th in 18 traded clusters. Arizona's employment and location quotient are shown in Table 4 for the nation's 15 largest traded clusters. Of the three clusters with a LQ greater than 1, the national average wage was very low in hospitality and tourism, very high in financial services, and below average in transportation and logistics.

Among the 16 nontraded clusters, Arizona's location quotient exceeded 1 in three, was between 0.90 and 0.99 in five, was between 0.80 and 0.89 in seven, and was less than 0.80 in one. Arizona ranked in the bottom 10 in four nontraded clusters, between 31st and 40th in six, and between 21st and 30th in six.

### Change Between 1998 and 2013 in Arizona

Between 1998 and 2013, the traded share of Arizona's nonfarm private-sector employment was as high as 36.2 percent in 1998 and 2000, and as low as 32.9 percent in 2009. The share has been a little lower since 2004 than in earlier years.

Based on per capita employment, the overall location quotient was between 0.91 and 0.93 in each year from 1998 through 2005. It was higher in 2006 and 2007 at 0.96, but was 0.89 or 0.90 in four of the years between 2009 and 2013. This pattern was reflected in the overall LQ for

**TABLE 4  
EMPLOYMENT IN ARIZONA IN THE NATION'S 15 LARGEST TRADED CLUSTERS  
IN 2013**

	Employment	Location Quotient	Rank*
Business Services	212,613	0.93	19
Distribution & e-Commerce	91,962	0.79	35
Hospitality & Tourism	73,164	1.14	16
Education & Knowledge Creation**	51,903	0.84	25
Financial Services	46,181	1.16	13
Transportation & Logistics	40,417	1.17	16
Insurance Services	31,263	0.99	21
Marketing, Design & Publishing	15,593	0.59	31
Information Tech & Analytical Instruments	17,821	0.79	21
Production Technology & Heavy Machinery	7,650	0.37	44
Food Processing & Manufacturing	9,548	0.47	44
Automotive	4,492	0.24	34
Construction Products & Services	14,257	0.85	29
Oil and Gas Production & Transportation	702	0.05	44
Plastics	5,925	0.43	43

\* Rank of the location quotient among the 50 states, with the highest LQ assigned a rank of 1.

\*\* The education portion of the cluster includes only the private sector.

Sources: Institute for Strategy and Competitiveness, Harvard Business School (employment). The location quotients were calculated using per capita employment, based on the population estimates for the nation and for the states produced by the U.S. Department of Commerce, Census Bureau.

nontraded clusters, which was 1.01 in 2006 and 2007 and 0.92 or 0.93 from 2010 through 2013. The overall LQ for traded clusters between 1998 and 2013 generally was in a narrow range from 0.85 to 0.89, but was only 0.83 in 2009 and 2013.

Many of the traded clusters did not experience a large change in location quotient over the 1998-to-2013 period. Some of those with a noticeable change had little effect on the Arizona economy since their employment level is so low. Focusing on the 11 traded clusters that employed more than 10,000 in Arizona in 2013, three became more important to the state's economy over this period, while the significance of three declined.

The most significant change in Arizona's economic base was the sharp drop in the location quotient in the high-paying information technology and analytical instruments cluster, from around 1.5 before 2002 to only 0.81 in 2013. Employment dropped by more than half, with large declines in the semiconductors and electronic components subclusters. In the business services cluster, by far the largest in Arizona and which has an above-average wage nationally, the location quotient exceeded 1 through 2008, but has been lower since, including 0.93 in 2013. A decline also occurred in the transportation and logistics cluster, which has an average wage nationally below the traded cluster norm. This cluster had a location quotient of 1.4 or higher through 2003, but the LQ has been around 1.2 in the last few years.

Largely offsetting these declines were gains in three traded clusters in Arizona. The location quotient in the financial services cluster — the highest-paying cluster nationally — in recent years has been about 1.2, up from about 1 earlier in the 1998-to-2013 period. Insurance services, which also pays well nationally, has experienced a larger increase, but the location quotient in 2013 was only 1.00. An even larger increase in the location quotient has occurred in the education and knowledge creation cluster, rising from 0.35 to around 0.9.<sup>13</sup> However, the average wage in this cluster is below the traded cluster norm and it is not clear that this cluster has a strong traded component — the Institute for Strategy and Competitiveness placed the traded share of the education services sector at 65 percent, compared to estimates of between 1-and-21 percent by the other three sources discussed in the “Estimates of Traded Shares” section.

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<sup>13</sup> The education portion of this cluster includes only private-sector operations; public K-12 schools and public institutions of higher education are not included.

## 2014 ECONOMIC BASE STUDY

### Methodology

This base study largely uses data from the 2014 version of *County Business Patterns*. The actual and imputed employment figures are transformed into per capita employment using the mid-2014 population estimates produced by the Census Bureau for the United States and by the Arizona Department of Administration's Office of Employment and Population Statistics for Arizona, Metro Phoenix, Metro Tucson, and the balance of the state. Industries are organized into the 51 traded clusters and 16 local clusters defined by the ISC.

The CBP data are supplemented with BEA data for the government sector and the farm subsector. As seen in the "Estimates of Traded Shares" section, three of the four sources of estimates of the traded share indicate the figure in the agriculture sector to be at least 98 percent. The agriculture sector is split into two subsectors in the BEA data: (1) farm and (2) fishing, forestry, and agricultural services. Since the second component is partially available from *County Business Patterns* and is subdivided and included in three traded clusters by the Institute for Strategy and Competitiveness — fishing and fishing products, forestry, and agricultural inputs and services — the BEA data for this subsector are not used. The farm subsector, which is missing from *County Business Patterns*, is considered to be a traded cluster in addition to the 51 defined by the ISC.<sup>14</sup>

The BEA provides data for four subsectors within the government sector: federal civilian, military, state, and local. According to the REMI and IMPLAN models, the traded share of state and local governments is between 1-and-3 percent — presumably nonzero due to the receipt of certain federal funds. In this paper, state and local governments are classified as nontraded and combined into one local cluster.

At a substate level, however, state government might be considered to be traded. For example, state prisons in small communities, as well as Northern Arizona University and the University of Arizona, are strong driving activities in their local communities. State government is examined separately in this paper as a traded activity in the state's subregions.

Nationally, the federal government should be considered to be nontraded. Regionally, the federal government could be categorized as traded. Though the REMI and IMPLAN models for Arizona assume that hardly any of the federal government subsector is traded, the traded share of the overall government sector was estimated to be 28 percent by the Institute for International Economics study. This share roughly coincides with the federal government's share of the government sector. Indeed, there is some competition among regions for the siting of certain federal facilities and regions compete to prevent military bases from being closed. In this base study, the federal government is considered to be traded. Since much of the federal civilian

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<sup>14</sup> The BEA provides wage and salary employment and total employment by sector and subsector for the nation and states, but only total employment by sector and subsector for substate areas. In order to be consistent with the wage and salary employment figures reported in CBP, farm wage and salary employment in the state's subregions was estimated using the wage and salary proportion of total employment for Arizona's farm subsector.

employment is associated with military bases, all of federal government is combined into one traded cluster at the subnational level.

In this base study, a total of 53 traded clusters and 17 nontraded clusters are examined.

### **Payroll**

The magnitude of withheld payroll data in Arizona and its subregions is so great that the average wage could be directly calculated in only a small minority of the 51 traded clusters that are based on CBP data: 11 in Arizona, eight in Metro Phoenix, four in Metro Tucson, and one in the balance of the state. Undisclosed data were not as common in nontraded industries, but an average wage could be calculated directly in less than half of the nontraded clusters in the Tucson area and the balance of the state.

Nationally, undisclosed payroll figures are not an issue. In 2014, including government and farming, the overall payroll per employee (average wage) was \$56,244, after annualizing the payroll figure for the first quarter. Among the traded clusters, the overall average was \$72,289 — 89 percent higher than the overall average of \$38,291 among the local clusters.

The average wage varied widely nationally in 2014 across the 53 traded clusters. It exceeded \$100,000 in seven clusters, including a figure of \$190,346 in financial services. In contrast, the average wage was less than \$40,000 in 12 clusters; it was lowest in the apparel cluster at \$25,893.

In most of the traded clusters, the average wage was relatively consistent across the subclusters, but within some clusters a large variation existed. For example, in the business services cluster, the average wage by subcluster ranged from about \$28,000 to \$125,000. The variation in the average wage across subclusters was greater in the nontraded clusters. In most of these clusters, the average wage was very low in at least one of the subclusters, while the average in one or more subclusters was average to above average.

### **Arizona**

Based on estimates of the payroll when the actual figure was not disclosed, the overall average wage in Arizona in 2014 was 14 percent less than the national average. The differential was 16 percent in the traded clusters but only 5 percent in the nontraded clusters.

There are a number of reasons why the average wage in Arizona is less than the national average. First, the cost of living in Arizona is slightly less than the national average — the differential was 2.9 percent in 2013, the latest data on regional price parities reported by the BEA. Even after adjusting for living costs, the average wage in Arizona was 11 percent below the U.S. average overall, with differentials of 13 percent in traded clusters and 3 percent in nontraded clusters.

Second, since the average wage does not reflect the number of hours worked, above-average shares of part-time and/or seasonal workers may lower Arizona's average wage, though the limited available data on hours worked indicates that this factor does not have much effect in explaining Arizona's average wage shortfall. Third, the mix of jobs can be a significant factor, since the average wage varies widely by industry and by occupation. Earlier studies of job

quality indicated that Arizona's industrial mix and occupational mix lowered the average wage by a few percent.

Even after adjusting for these factors, the average wage in Arizona is considerably below the national average. This suggests that workers in Arizona are willing to accept a lower wage than they would elsewhere, presumably due to factors such as climate and lifestyle.

While Arizona's unadjusted average wage in 2014 was 16 percent below the national average for the traded clusters as a whole, the differential ranged widely by traded cluster. In some clusters, the average wage was above the national average, suggesting that the industrial and/or occupational mix within the cluster in Arizona was considerably different from the national average. In other traded clusters, the average wage in Arizona was considerably below the national average, with the figure in a few clusters just half of the U.S. average. The range across the nontraded clusters was much less, with Arizona's average wage generally close to the national average.

### **Arizona's Subregions**

The average wage in the Phoenix area was considerably higher than in the rest of the state, even after adjusting for the cost of living. Overall, the adjusted figure in the Phoenix area was 7 percent below average. It was 20 percent below average in the Tucson area, and 26 percent below average in the balance of the state. In each of the subregions, the average wage in the local clusters was closer to the national average than in the traded clusters. In the traded clusters, the shortfall from the national average was 7 percent in Metro Phoenix, 16 percent in Metro Tucson, and 32 percent in the balance of the state. In the nontraded clusters, the average wage in the Phoenix area was equal to the U.S. average, while the figures were 10 percent lower in the Tucson area and the balance of the state.

### **Overall Base Study Results**

Including all of the CBP data plus the BEA data for farming and government, employment per 1,000 residents was 404.7 in 2014 in Arizona, 11.5 percent less than the national figure of 457.5; the location quotient was 0.885. There was a deficit of 352,128 jobs.

The traded cluster share of total employment in 2014 was 33.8 percent nationally but only 32.0 percent in Arizona. The traded cluster location quotient for Arizona was only 0.838. The local cluster LQ was higher at 0.908. Local clusters accounted for 53 percent of the overall employment deficit, compared to nearly two-thirds of total employment.

In order to compare the state's three geographic subregions, industry 561330 (professional employer organizations) was excluded from the 2014 data, since most of this industry's employment was included in the "statewide" designation in CBP. The adjusted totals are shown in Table 5. The traded share in each of the state's three subregions was less than the national average, with a particularly low share in the Tucson area. The overall location quotients and the LQs for the traded cluster subtotal were far below 1 in each of the subregions. The LQs for the local cluster subtotal were not as far below 1 in the Phoenix and Tucson areas, but the local cluster LQ for the balance of the state was quite low.

**TABLE 5  
BASE STUDY TOTALS IN 2014\***

	<b>United States</b>	<b>Arizona</b>	<b>Metro Phoenix</b>	<b>Metro Tucson</b>	<b>Balance of State</b>
<b>Employment Per 1,000 Residents:</b>					
Total	450.4	393.6	412.8	389.9	329.3
Traded	147.5	118.6	127.5	103.2	99.5
Local	302.9	275.1	285.3	286.7	229.8
<b>Traded Share (%)</b>					
	32.8	30.1	30.9	26.5	30.2
<b>Location Quotient:</b>					
Total		0.874	0.917	0.866	0.731
Traded		0.804	0.864	0.699	0.674
Local		0.908	0.942	0.946	0.759
<b>Employment Excess or Deficit:</b>					
Total		-378,690	-165,661	-60,997	-152,033
Traded		-193,080	-88,114	-44,670	-60,297
Local		-185,610	-77,547	-16,327	-91,736

\* Industry 561330 (professional employer organizations) is excluded. However, the balance of the state still includes some activities placed in the “statewide” designation in *County Business Patterns*. Since employment in these activities is distributed throughout the state, the figures in the table are slightly overstated for the balance of the state and slightly understated for the Phoenix and Tucson metropolitan areas.

Sources: U.S. Department of Commerce, Census Bureau, *County Business Patterns* (nonfarm, private-sector employment) and U.S. Department of Commerce, Bureau of Economic Analysis (farm and government employment). Cluster definitions are from the Institute for Strategy and Competitiveness, Harvard Business School. Location quotients and excess employment were calculated using per capita employment. The population estimate for the nation came from the U.S. Department of Commerce, Census Bureau. The population estimates for Arizona and its subregions came from the Arizona Department of Administration, Office of Employment and Population Statistics.

### **Traded Clusters and Subclusters**

The largest traded clusters in 2014 are shown in Table 6. Any cluster that was among the 10 largest in any of the displayed geographies is included in the table. In Arizona and in Metro Phoenix, the top 10 listing is similar to that for the nation. Differences in the ranking compared to the national ranks are more numerous in the Tucson area and in the balance of the state. National payroll per employee by cluster is included in the table. The largest clusters ranged from among the lowest paying (hospitality and tourism and education and knowledge creation) to the highest paying, with three of the 10 largest clusters nationally having an average wage in excess of \$100,000.

The largest traded subclusters in 2014 are shown in Table 7. Any subcluster that was among the 10 largest in any of the displayed geographies is included in the table. Of the nation’s 10 largest subclusters, nine are among the top 10 in Arizona and Metro Phoenix; seven are among the top 10 in Metro Tucson and in the balance of the state. The lowest rank of any of the nation’s 10 largest subclusters in Arizona or its subregions is 22nd. Most of the 10 largest subclusters nationally had an average wage above the traded cluster average, but the average wage in three was considerably below average.

All traded clusters with a location quotient greater than 1 in Arizona or in any of the state's subregions in 2014 are included in Table 8, listed by excess employment in the state, then by excess employment in the subregions. Arizona had excess employment in only eight traded clusters. In seven of these eight clusters, payroll per employee in Arizona was at or above the state's average for traded clusters, but the figure for the hospitality and tourism cluster was considerably below average. Metro Phoenix had an excess in 10 traded clusters, but Metro Tucson had an excess in only five traded clusters. In the balance of the state, there was an excess in 10 traded clusters, though the amount was slight, and the average wage was low, in several of these clusters.

Of the eight traded clusters with excess employment in Arizona in 2014, two had excess employment in each of the state's three subregions: hospitality and tourism, the second-largest cluster based on excess employment but with a low average wage, and metal mining, which ranked fourth in the state and had a high average wage. Aerospace vehicles and defense, which provided the greatest excess employment in Arizona and was one of the highest-paying clusters in the state, had excess employment in the Phoenix area and in the Tucson area. Electrical power generation and transmission, another high-paying cluster, had an excess in the Phoenix area and in the balance of the state. The other four clusters had an excess in only one of the state's subregions.

Among the other clusters listed in Table 8, only the federal government had an excess in more than one of the subregions. In Arizona and each of its subregions, most of the clusters with excess employment in Table 8 were among the largest clusters based on total employment in Table 6.

Based on estimated excess payroll, calculated by multiplying the estimate of payroll per employee by the number of excess employees, the aerospace vehicles and defense cluster was the largest traded cluster in Arizona by a significant margin. Financial services and metal mining also provided substantial excess payroll. In Metro Phoenix, financial services provided more than twice as much excess payroll as any other traded cluster. Other significant clusters were transportation and logistics, aerospace vehicles and defense, and insurance services. In Metro Tucson, aerospace vehicles and defense was by far the largest cluster based on excess payroll. The federal government ranked second, followed by metal mining. In the balance of the state, the federal government provided the most excess payroll, followed by metal mining.

A more detailed listing of the state's most important economic activities can be obtained by looking at traded subclusters instead of clusters. Table 9 lists the top 10 traded subclusters for the state based on excess employment and also displays other subclusters that rank in the top 10 in one of the state's subregions.

Of the 207 traded subclusters, Arizona had excess employment in 31 in 2014, distributed among 22 clusters. The Phoenix area had an excess in 43 subclusters spread across 20 clusters, but Metro Tucson had an excess in only 19 subclusters in 15 clusters. In the balance of the state, 28 subclusters in 17 clusters had an excess, but the number of excess employees was only slight to moderate in most of these subclusters.

**TABLE 6**  
**LARGEST TRADED CLUSTERS BASED ON EMPLOYMENT IN 2014**

Cluster (U.S. Payroll Per Employee in Thousands of Dollars)	United States		Arizona		Metro Phoenix		Metro Tucson		Balance of AZ	
	Employment	Rank	Employment	Rank	Employment	Rank	Employment	Rank	Employment	Rank
Business Services* (83)	9,322,230	1	165,846	1	126,600	1	21,754	1	17,492	2
Distribution & Electronic Commerce (68)	5,616,869	2	90,345	2	74,808	2	6,186	5	9,351	4
Federal Government (64)	4,772,000	3	87,378	3	35,193	6	20,898	2	31,287	1
Hospitality and Tourism (32)	3,106,368	4	74,885	4	46,972	3	11,205	3	16,708	3
Education and Knowledge Creation** (38)	3,046,194	5	43,671	6	36,086	5	3,622	7	3,963	8
Financial Services (190)	1,893,024	6	49,100	5	43,361	4	4,088	6	1,651	13
Transportation and Logistics (52)	1,616,726	7	39,148	7	33,537	7	2,668	10	2,943	11
Insurance Services (112)	1,511,440	8	33,625	8	27,228	8	3,357	8	3,040	10
Marketing, Design and Publishing (86)	1,322,741	9	17,001	11	14,614	10	1,668	12	719	18
Info Tech & Analytical Instruments (105)	1,057,686	10	21,565	10	18,007	9	3,024	9	534	22
Aerospace Vehicles and Defense (96)	532,330	18	23,079	9	12,928	11	9,716	4	435	25
Farming (33)	802,000	15	12,345	13	3,646	22	535	22	8,164	5
Metal Mining (99)	45,716	47	9,863	15	960	36	2,318	11	6,585	6
Construction Products and Services (59)	807,294	14	15,354	12	9,797	12	1,108	15	4,449	7
Medical Devices (70)	254,115	31	6,205	19	1,760	29	699	21	3,746	9
Total of Traded Clusters (72)	44,047,453		790,518		561,726		103,914		124,878	
Overall Total (56)	143,643,440		2,624,393		1,818,405		392,653		413,335	

\* Excludes NAICS 561330, professional employer organizations.

\*\* The education portion of the cluster includes only the private sector.

Note: Rank is among 53 clusters. Each cluster ranked among the top 10 on employment in any one of the geographic areas shown in the table is listed.

Sources: U.S. Department of Commerce, Census Bureau, *County Business Patterns* (nonfarm, private-sector employment) and U.S. Department of Commerce, Bureau of Economic Analysis (farm and government employment). Cluster definitions are from the Institute for Strategy and Competitiveness, Harvard Business School.

**TABLE 7**  
**LARGEST TRADED SUBCLUSTERS BASED ON EMPLOYMENT IN 2014**

Subcluster (U.S. Payroll Per Employee in Thousands of Dollars)	United States		Arizona		Metro Phoenix		Metro Tucson		Balance of AZ	
	Employment	Rank	Employment	Rank	Employment	Rank	Employment	Rank	Employment	Rank
Corporate Headquarters (125)	3,235,958	1	47,891	2	41,383	1	4,920	4	1,588	10
Computer Services (94)	2,169,326	2	34,523	5	28,741	3	1,947	9	3,835	3
Accommodations & Related Services (26)	1,985,437	3	49,312	1	28,042	4	9,119	2	12,151	1
Colleges, Universities & Prof. Schools* (38)	1,927,394	4	25,884	7	22,414	7	696	22	2,774	8
Business Support Services** (45)	1,462,415	5	41,430	3	24,046	6	10,193	1	7,189	2
Insurance Carriers (111)	1,424,674	6	32,087	6	25,913	5	3,188	5	2,986	7
Engineering Services (88)	1,021,273	7	20,642	8	14,887	9	2,619	7	3,136	6
Credit Intermediation (89)	919,170	8	34,589	4	30,695	2	2,775	6	1,119	18
Consulting Services (79)	882,925	9	14,668	11	12,160	11	1,245	13	1,263	15
Warehousing & Storage (42)	754,269	10	15,610	10	13,428	10	966	14	1,216	16
Air Transportation (62)	570,797	14	19,561	9	17,809	8	1,427	10	325	44
Missiles & Space Vehicles (106)	59,913	119	10,256	18	1,784	55	8,472	3	0	175
Software Publishers (140)	442,246	23	5,061	31	2,734	38	2,104	8	223	57
Surgical & Dental Instruments & Supplies (70)	214,202	44	5,951	25	1,694	58	541	28	3,716	4
Construction (62)	545,782	15	11,375	13	7,105	22	647	24	3,623	5
Specialty Foods and Ingredients (42)	178,840	52	3,061	45	1,230	72	176	69	1,655	9

\* Only the private sector is included in this subcluster.

\*\* Excludes NAICS 561330, professional employer organizations.

Note: Rank is among 207 subclusters. Each subcluster ranked among the top 10 on employment in any one of the geographic areas shown in the table is listed.

Sources: U.S. Department of Commerce, Census Bureau, *County Business Patterns* (employment). Subcluster definitions are from the Institute for Strategy and Competitiveness, Harvard Business School.

**TABLE 8**  
**LEADING TRADED CLUSTERS BASED ON EXCESS EMPLOYMENT IN ARIZONA AND SUBREGIONS IN 2014**

Cluster (Arizona Payroll Per Employee in Thousands of Dollars)	Arizona		Metro Phoenix		Metro Tucson		Balance of AZ	
	Excess Employment	Location Quotient						
Aerospace Vehicles and Defense (104)	11,950	2.07	5,575	1.76	8,035	5.78	-1,660	0.21
Hospitality and Tourism (36)	9,942	1.15	4,065	1.10	1,395	1.14	4,482	1.37
Financial Services (85)	9,523	1.24	17,214	1.66	-1,890	0.68	-5,800	0.22
Metal Mining (87)	8,907	10.32	329	1.52	2,174	16.06	6,405	36.60
Transportation and Logistics (60)	5,348	1.16	11,206	1.50	-2,438	0.52	-3,420	0.46
Electric Power Generation & Transmission (141)	2,034	1.65	2,174	2.05	-464	0.02	324	1.55
Insurance Services (77)	2,026	1.06	6,351	1.30	-1,416	0.70	-2,909	0.51
Medical Devices (62)	892	1.17	-1,750	0.50	-104	0.87	2,746	3.75
Information Tech & Analytical Instruments (98)	-548	0.98	3,398	1.23	-316	0.91	-3,629	0.13
Communications Equipment and Services (87)	-526	0.94	1,526	1.26	-889	0.34	-1,164	0.30
Furniture (28)	-1,378	0.80	183	1.04	-913	0.12	-648	0.50
Federal Government (61)	-12,404	0.88	-30,730	0.53	5,825	1.39	12,502	1.67
Biopharmaceuticals (124)	-1,735	0.65	-1,355	0.58	517	1.69	-896	0.04
Farming (42)	-4,422	0.74	-7,432	0.33	-1,998	0.21	5,007	2.59
Construction Products and Services (57)	-1,524	0.91	-1,354	0.88	-1,442	0.44	1,272	1.40
Agricultural Inputs and Services (37)	-557	0.73	-844	0.37	-117	0.62	403	2.05
Nonmetal Mining (44)	-380	0.78	-487	0.57	-75	0.71	181	1.56
Coal Mining (89)	-1,359	0.22	-1,146	0.00	-260	0.01	47	1.14

Note: Each cluster with a location quotient greater than 1 in any one of the geographic areas shown in the table is listed.

Sources: U.S. Department of Commerce, Census Bureau, *County Business Patterns* (nonfarm, private-sector employment) and U.S. Department of Commerce, Bureau of Economic Analysis (farm and government employment). Cluster definitions are from the Institute for Strategy and Competitiveness, Harvard Business School. The location quotients and excess employment were calculated using per capita employment. The population estimate for the nation came from the U.S. Department of Commerce, Census Bureau. The population estimates for Arizona and its subregions came from the Arizona Department of Administration, Office of Employment and Population Statistics.

**TABLE 9  
LEADING TRADED SUBCLUSTERS BASED ON EXCESS EMPLOYMENT IN ARIZONA AND SUBREGIONS IN 2014**

Subcluster (Arizona Payroll Per Employee in Thousands of Dollars)	Arizona		Metro Phoenix		Metro Tucson		Balance of AZ	
	Excess Employment	Location Quotient						
Credit Intermediation (74)	15,372	1.80	17,999	2.42	-128	0.96	-2,499	0.31
Business Support Services (33)	10,856	1.36	3,846	1.19	5,576	2.21	1,433	1.25
Missiles and Space Vehicles (119)	9,003	8.19	956	2.16	8,283	44.77	-236	0.00
Semiconductors (125)	7,982	4.21	8,657	6.27	-207	0.45	-468	0.00
Accommodations and Related Services (27)	7,803	1.19	618	1.02	2,849	1.45	4,336	1.56
Air Transportation (79)	7,628	1.64	9,925	2.26	-376	0.79	-1,922	0.15
Tourism-Related Services (65)	4,869	1.91	5,031	2.42	-471	0.42	309	1.31
Fossil Fuel Electric Power (131)	3,403	3.13	3,092	3.93	-241	0.00	552	2.84
Insurance Carriers (78)	2,302	1.08	6,235	1.32	-1,311	0.58	-2,621	0.53
Search and Navigation Equipment (94)	2,068	1.79	1,780	2.02	547	2.38	-259	0.48
Warehousing and Storage (42)	-159	0.99	3,010	1.29	-1,416	0.41	-1,753	0.41
Electronic and Catalog Shopping (68)	923	1.11	2,870	1.52	-857	0.32	-1,089	0.31
Aircraft (91)	878	1.82	2,838	1.59	-795	0.27	-1,165	0.25
Diagnostic Substances (191)	732	2.38	-351	0.00	1,180	15.69	-96	0.04
Software Publishers (95)	-4,185	0.55	-3,374	0.45	707	1.51	-1,518	0.13
Professional Organizations (78)	-191	0.89	-429	0.64	552	3.04	-314	0.47
Wholesale of Construction & Mining Equip. (70)	713	1.38	391	1.32	303	2.07	19	1.06
Sporting and Athletic Goods (52)	824	2.06	481	1.94	274	3.34	69	1.47
Soft Drinks and Ice (48)	432	1.31	435	1.48	207	2.00	-210	0.19
Surgical and Dental Instruments & Supplies (61)	1,473	1.33	1,265	0.57	-135	0.80	2,873	4.41
Construction (59)	-35	1.00	-434	0.94	-1,077	0.38	1,475	1.69
Specialty Foods and Ingredients (33)	-678	0.82	-1,240	0.50	-389	0.31	951	2.35
Gambling Facilities (39)	1,904	1.59	1,466	1.69	-127	0.94	564	1.93
Other Tourism Attractions (17)	-1,252	0.75	-1,475	0.56	-237	0.69	460	1.49
Ammunition (64)	603	1.66	174	1.29	-21	0.85	451	3.61
Agricultural Services (32)	-259	0.82	-581	0.38	-25	0.89	347	2.30

Note: Each subcluster ranked among the top 10 on excess employment in any one of the geographic areas shown in the table is listed.

Sources: U.S. Department of Commerce, Census Bureau, *County Business Patterns* (employment). Cluster definitions are from the Institute for Strategy and Competitiveness, Harvard Business School. The location quotients and excess employment were calculated using per capita employment. The population estimate for the nation came from the U.S. Department of Commerce, Census Bureau. The population estimates for Arizona and its subregions came from the Arizona Department of Administration, Office of Employment and Population Statistics.

Among the subclusters, credit intermediation had the largest excess employment in Arizona and in Metro Phoenix. An excess was present only in the Phoenix area. The only other financial services subcluster with an excess was securities brokers in the Phoenix area.

Business support services provided the second-most excess employment among the subclusters in Arizona, with excess employment ranking in the top 10 in each of the subregions. The only other business services subclusters with a significant excess was engineering services in the Phoenix area.

The missiles and space vehicles subcluster had the third-greatest excess employment in Arizona, with an excess in each of the two large metro areas, particularly the Tucson area, where it ranked first. Search and navigation equipment, another subcluster of the aerospace vehicles and defense cluster, had the 10th-greatest excess in Arizona, including the seventh-largest excess in the Tucson area and an excess in the Phoenix area. The other subcluster within this cluster, aircraft, provided an excess in Arizona, with only the Phoenix area having an excess (10th greatest).

The semiconductors subcluster ranked fourth in Arizona and third in the Phoenix area on excess employment. Software publishers, another information technology and analytical instruments subcluster, ranked fifth in the Tucson area.

The accommodation subcluster ranked fifth in the state, with an excess in each of the subregions, including the highest figure in the balance of the state and the third-highest in the Tucson area. Other subclusters of the hospitality and tourism cluster also contributed excess employment. Gambling facilities provided excesses in Arizona, Metro Phoenix, and the balance of the state (ranked sixth). Tourism services had an excess in Metro Phoenix (the fifth highest) and in the balance of the state. Tourism attractions ranked eighth in the balance of the state.

Air transportation ranked sixth in Arizona and second in Metro Phoenix, the only subregion with an excess. Other transportation and logistics subclusters provided much smaller excesses, including trucking in the Phoenix area and bus transportation in Arizona and in the two large metro areas.

The fossil fuel electric power subcluster ranked eighth in Arizona and seventh in the Phoenix area and in the balance of the state, the only significant excesses in the electric power generation and transmission cluster. Insurance carriers ranked ninth, with an excess only in the Phoenix area (fourth highest). Reinsurance carriers, another insurance services subcluster, provided much less excess employment in Arizona and in Metro Phoenix. Several subclusters in other clusters were among the top 10 on excess employment in the Tucson area or in the balance of the state.

The order of importance of the subclusters was somewhat different based on estimated excess payroll. Credit intermediation ranked first in Arizona, followed by missiles and space vehicles, semiconductors, and air transportation. In the Phoenix area, credit intermediation also ranked first, followed by semiconductors, air transportation, and insurance carriers. In the Tucson area, excess payroll was by far the highest in the missiles and space vehicles subcluster, followed by diagnostic substances. In the balance of the state, none of the subclusters provided a large amount of excess payroll; the largest figure was in surgical and dental instruments and supplies.

### **Nontraded Clusters and Subclusters**

Employment in each of the nontraded clusters is displayed in Table 10. The location quotient also is shown. The overall nontraded LQ was below 1 in Arizona and in each of its subregions. These low figures largely relate to the low average incomes present in Arizona — residents have less income than the average American with which to spend on goods and services. Within Arizona, the overall nontraded LQ was considerably higher in Metro Phoenix and Metro Tucson than in the balance of the state. The differences in these subregional LQs partially reflect the differences in average income, but the LQs also are a function of residents of the balance of the state traveling to the state's larger metro areas to purchase some goods and services.

In most nontraded clusters, the location quotient in the balance of the state was considerably less than in the two large metro areas. An exception was the motor vehicle products and services cluster, in large part due to the gasoline stations subcluster. Rural residents drive greater distances than urban residents; tourists also have an impact on gasoline stations in the balance of the state. The state and local government cluster's LQ exceeded 1 in the balance of the state and in the Tucson area, well above the figure in the Phoenix area.

In some nontraded clusters, the location quotient in the Phoenix area was considerably higher than in the Tucson area, including commercial services, industrial products and services, and financial services. In such clusters, some degree of centralization leads to the Phoenix area serving the Tucson area as well as the balance of the state. The LQ in the Tucson area was considerably higher than in the Phoenix area in two clusters: education and training, and state and local government.

The largest nontraded subclusters are shown in Table 11. The location quotients for these subclusters generally were below 1. The primary exceptions were the specialty contractors and deposit-taking institutions subclusters in the Phoenix area and gasoline stations in the balance of the state.

### **Arizona**

Only eight of the 53 traded clusters had a location quotient of more than 1 in Arizona in 2014. Those clusters are displayed in Table 12, along with the subclusters within these clusters with a location quotient of more than 1. Employment, location quotients, and excess employment varied widely across these eight clusters. Other than the aerospace cluster, each of the clusters included in Table 12 had subclusters with location quotients below 1 (an employment deficit). Thus, the excess employment in the displayed subclusters sums to more than the cluster total.

The aerospace vehicles and defense cluster was the state's most important economic activity in 2014, contributing the most excess employment and excess payroll. It also had a LQ in excess of 2. Each of its three subclusters contributed excesses, with missiles and space vehicles ranking third on excess employment and second on excess payroll. Significant excess employment in this cluster was present in the Tucson metro area, predominantly in the missiles and space vehicles subcluster. The Phoenix area also had excess employment, spread across the three subclusters.

The hospitality and tourism cluster provided the second-greatest amount of excess employment, but ranked fourth on excess payroll. Excesses were present in three of its seven subclusters, with

**TABLE 10  
NONTRADED CLUSTERS IN 2014**

Cluster (U.S. Payroll Per Employee in Thousands of Dollars)	United States	Employment			Balance of State	Location Quotient			Balance of State
		Arizona	Metro Phoenix	Metro Tucson		Arizona	Metro Phoenix	Metro Tucson	
State and Local Government (47)	19,258,000	357,431	211,214	68,064	78,153	0.89	0.79	1.12	1.03
Local Health Services (47)	16,764,526	287,614	191,245	49,197	47,172	0.82	0.83	0.93	0.72
Local Hospitality Establishments (15)	12,054,252	251,520	176,595	38,041	36,884	1.00	1.06	1.00	0.78
Local Commercial Services (38)	8,510,992	155,070	120,721	17,903	16,446	0.87	1.03	0.67	0.49
Local Real Estate, Construct & Dev (46)	8,334,506	184,040	135,775	25,305	22,960	1.06	1.18	0.96	0.70
Local Retailing of Genl Merchandise (20)	4,809,082	101,220	69,024	14,966	17,230	1.01	1.04	0.99	0.91
Local Community & Civic Organiz (26)	4,396,923	72,317	31,356	12,056	8,905	0.79	0.85	0.87	0.52
Local Motor Vehicle Prods & Servs (34)	4,172,603	86,567	57,731	12,700	16,136	0.99	1.00	0.96	0.98
Local Food & Bev Processing & Distr (27)	4,145,331	72,877	49,574	10,791	12,512	0.84	0.87	0.82	0.77
Local Financial Services (75)	3,020,268	62,553	50,760	6,682	5,111	0.99	1.22	0.70	0.43
Local Personal (Nonmedical) Servs (21)	2,563,032	45,564	33,391	7,598	4,575	0.85	0.94	0.94	0.45
Local Logistical Services (39)	2,152,794	35,442	25,199	4,917	5,326	0.79	0.85	0.72	0.63
Local Household Goods & Services (28)	1,567,120	34,778	25,285	5,482	4,011	1.06	1.17	1.11	0.65
Local Education and Training* (29)	1,471,116	30,419	19,103	6,433	4,883	0.99	0.94	1.39	0.84
Local Entertainment and Media (31)	1,437,728	27,396	18,972	4,423	4,001	0.91	0.96	0.97	0.71
Local Utilities (93)	1,394,550	19,522	13,061	3,158	3,303	0.67	0.68	0.72	0.60
Local Industrial Products and Servs (45)	543,164	9,545	7,673	1,023	849	0.84	1.02	0.60	0.40
Total of Nontraded Clusters (38)	96,515,987	1,833,875	1,256,679	288,739	288,457	0.91	0.94	0.95	0.76

\* The education portion of the cluster includes only the private sector.

Sources: U.S. Department of Commerce, Census Bureau, *County Business Patterns* (nonfarm, private-sector employment) and U.S. Department of Commerce, Bureau of Economic Analysis (farm and government employment). Cluster definitions are from the Institute for Strategy and Competitiveness, Harvard Business School. The location quotients and excess employment were calculated using per capita employment. The population estimate for the nation came from the U.S. Department of Commerce, Census Bureau. The population estimates for Arizona and its subregions came from the Arizona Department of Administration, Office of Employment and Population Statistics.

**TABLE 11**  
**LARGEST NONTRADED SUBCLUSTERS BASED ON EMPLOYMENT IN 2014**

Subcluster (U.S. Payroll Per Employee in Thousands of Dollars)	United States	Employment			Balance of State	Location Quotient			Balance of State
		Arizona	Metro Phoenix	Metro Tucson		Arizona	Metro Phoenix	Metro Tucson	
Hospitality Establishments (15)	10,782,570	222,789	155,256	33,625	33,908	0.99	1.04	0.99	0.80
Hospitals (57)	5,775,571	96,347	61,633	16,352	18,362	0.80	0.77	0.90	0.81
Professional Services (44)	5,650,250	100,409	76,889	11,131	12,389	0.85	0.99	0.62	0.56
Healthcare Provider Offices (57)	4,999,083	99,043	66,945	17,229	14,869	0.95	0.97	1.09	0.76
Home & Residential Care (26)	4,742,061	68,955	44,988	12,391	11,576	0.70	0.69	0.83	0.62
Specialty Contractors (45)	3,786,323	89,929	68,513	11,855	9,561	1.14	1.31	0.99	0.64
General Merchandise Retailing (22)	3,030,304	67,364	44,922	9,001	13,441	1.06	1.07	0.94	1.13
Retail Food Stores (21)	2,901,512	52,076	33,746	8,658	9,672	0.86	0.84	0.95	0.85
Social Service Organizations (25)	2,344,459	47,495	34,285	7,737	5,473	0.97	1.06	1.05	0.59
Deposit-Taking Institutions (89)	1,835,679	38,557	31,491	3,824	3,242	1.01	1.24	0.66	0.45
Apparel Retailing (16)	1,605,029	30,512	21,878	5,382	3,252	0.91	0.99	1.06	0.52
Gasoline Stations (18)	904,084	18,084	10,249	2,225	5,610	0.96	0.82	0.78	1.58

Note: Each subcluster ranked among the 10 largest on employment in any one of the geographic areas shown in the table is listed.

Sources: U.S. Department of Commerce, Census Bureau, *County Business Patterns* (employment). Cluster definitions are from the Institute for Strategy and Competitiveness, Harvard Business School. The location quotients and excess employment were calculated using per capita employment. The population estimate for the nation came from the U.S. Department of Commerce, Census Bureau. The population estimates for Arizona and its subregions came from the Arizona Department of Administration, Office of Employment and Population Statistics.

**TABLE 12**  
**TRADED CLUSTERS WITH EXCESS EMPLOYMENT IN ARIZONA IN 2014**

Cluster Subcluster	Payroll Per Employee (000)	Employ- ment	Location Quotient	Excess Employ- ment
<b>Aerospace Vehicles and Defense</b>	<b>\$104</b>	<b>23,079</b>	<b>2.07</b>	<b>11,950</b>
Missiles and Space Vehicles	119	10,256	8.19	9,003
Search and Navigation Equipment	94	4,700	1.79	2,068
Aircraft	91	8,123	1.12	878
<b>Hospitality and Tourism</b>	<b>36</b>	<b>74,885</b>	<b>1.15</b>	<b>9,942</b>
Accommodation and Related Services	27	49,312	1.19	7,803
Tourism-Related Services	65	10,218	1.91	4,869
Gambling Facilities	39	5,111	1.59	1,904
<b>Financial Services</b>	<b>85</b>	<b>49,100</b>	<b>1.24</b>	<b>9,523</b>
Credit Intermediation	74	34,589	1.80	15,372
<b>Metal Mining*</b>	<b>87</b>	<b>9,863</b>	<b>10.32</b>	<b>8,907</b>
<b>Transportation and Logistics</b>	<b>60</b>	<b>39,148</b>	<b>1.16</b>	<b>5,348</b>
Air Transportation	79	19,561	1.64	7,628
Bus Transportation	28	1,611	1.64	630
Specialty Air Transportation	56	765	1.10	67
<b>Electrical Power Generation &amp; Transmission</b>	<b>141</b>	<b>5,178</b>	<b>1.65</b>	<b>2,034</b>
Fossil Fuel Electric Power	142	5,000	3.13	3,403
<b>Insurance Services</b>	<b>77</b>	<b>33,625</b>	<b>1.06</b>	<b>2,026</b>
Insurance Carriers	78	32,087	1.08	2,302
Reinsurance Carriers	62	509	1.73	214
<b>Medical Devices</b>	<b>62</b>	<b>6,205</b>	<b>1.17</b>	<b>892</b>
Surgical and Dental Instruments and Supplies	61	5,951	1.33	1,473

Note: Only those subclusters with excess employment are shown. Thus, employment and excess employment in the displayed subclusters may not sum to the cluster total.

\* This cluster does not have any subclusters.

Sources: U.S. Department of Commerce, Census Bureau, *County Business Patterns* (nonfarm, private-sector employment) and U.S. Department of Commerce, Bureau of Economic Analysis (farm and government employment). Cluster definitions are from the Institute for Strategy and Competitiveness, Harvard Business School. The location quotients and excess employment were calculated using per capita employment. The population estimate for the nation came from the U.S. Department of Commerce, Census Bureau. The population estimates for Arizona and its subregions came from the Arizona Department of Administration, Office of Employment and Population Statistics.

the accommodation and related services subcluster and the tourism-related services subcluster each ranking among the top 10 subclusters on both excess employment and excess payroll. The rank of the cluster's excess employment was not as high in any of the state's three geographic subregions, but excess employment was present in each of these geographic areas.

The financial services cluster provided nearly as much excess employment as hospitality and tourism. It ranked second on excess payroll. All of the excess came from just one of its five subclusters; credit intermediation provided the most excess employment and excess payroll of any subcluster. An excess was present only in the Phoenix area.

Metal mining ranked fourth on excess employment and had a very high location quotient. Its excess payroll ranked third. Each of the three geographic subdivisions contributed excess metal mining employment; the excess in the Phoenix area resulted from the presence of mining company offices rather than an operating mine.

In the transportation and logistics cluster — ranked fifth on both excess employment and excess payroll — most of the excess employment resulted from the air transportation subcluster, though an excess was present in three of the five subclusters. The air transportation subcluster provided the fourth-highest excess payroll and ranked sixth on excess employment. Only the Phoenix area had excess employment in either the cluster or the air transportation subcluster.

Excess employment was not as great in the electrical power generation and transmission cluster. All of the excess was in one of the three subclusters: fossil fuel electric power. An excess was present in both the Phoenix area and the balance of the state.

The location quotient in the insurance services cluster was only 1.06, but excess employment exceeded 2,000. Most of the excess was in the insurance carriers subcluster. Only the Phoenix area had excess employment in this subcluster and cluster. The excess in the medical devices cluster was entirely in one subcluster and only in the balance of the state, primarily due to one establishment in Coconino County.

A number of subclusters other than those shown in Table 12 had excess employment in Arizona, but this excess was more than offset by deficit employment in the other subclusters within the cluster. Of the 207 subclusters, only 31 had excess employment in Arizona in 2014. Other than the subclusters displayed in Table 12, the greatest excess employment was in three subclusters:

- Business support services, part of the very large business services cluster, had excess employment of 10,856 (second highest) and a LQ of 1.36; excess payroll only ranked sixth.<sup>15</sup>
- Semiconductors, part of the information technology and analytical instruments cluster, had excess employment of 7,982 (fourth highest) with a LQ of 4.21; excess payroll ranked third.
- Communications equipment, part of the communications equipment and services cluster, had excess employment of 1,191 and a LQ of 1.58.

Of the 45 traded clusters with an employment deficit in 2014, the deficit exceeded 10,000 in eight clusters: business services; distribution and electronic commerce; education and knowledge creation; oil and gas production and transportation; automotive; production technology and heavy machinery; federal government; and marketing, design and publishing.

### **Metropolitan Phoenix**

Only 10 of the 53 traded clusters had a location quotient of more than 1 in Metropolitan Phoenix in 2014. Those clusters are displayed in Table 13, along with the subclusters within these clusters with a location quotient of more than 1.

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<sup>15</sup> These figures exclude industry 561330, Professional Employer Organizations. Including this industry, the subcluster's location quotient was 1.48 and the excess employment was 37,418.

**TABLE 13**  
**TRADED CLUSTERS WITH EXCESS EMPLOYMENT IN METROPOLITAN PHOENIX**  
**IN 2014**

Cluster	Payroll Per Employee (000)	Employ- ment	Location Quotient	Excess Employ- ment
<b>Financial Services</b>	<b>\$86</b>	<b>43,361</b>	<b>1.66</b>	<b>17,214</b>
Credit Intermediation	76	30,695	2.42	17,999
Securities Brokers, Dealers, and Exchanges	118	7,171	1.17	1,029
<b>Transportation and Logistics</b>	<b>63</b>	<b>33,537</b>	<b>1.50</b>	<b>11,206</b>
Air Transportation	82	17,809	2.26	9,925
Trucking	41	11,132	1.26	2,284
Bus Transportation	28	1,280	1.97	632
Specialty Air Transportation	59	468	1.01	7
<b>Insurance Services</b>	<b>79</b>	<b>27,228</b>	<b>1.30</b>	<b>6,351</b>
Insurance Carriers	80	25,913	1.32	6,235
Reinsurance Carriers	62	505	2.60	310
<b>Aerospace Vehicles and Defense</b>	<b>103</b>	<b>12,928</b>	<b>1.76</b>	<b>5,575</b>
Aircraft	95	7,625	1.59	2,838
Search and Navigation Equipment	102	3,519	2.02	1,780
Missiles and Space Vehicles	142	1,784	2.16	956
<b>Hospitality and Tourism</b>	<b>44</b>	<b>46,972</b>	<b>1.10</b>	<b>4,065</b>
Tourism-Related Services	72	3,565	2.42	5,031
Gambling Facilities	45	3,585	1.69	1,466
Accommodation and Related Services	29	28,042	1.02	618
Spectator Sports	203	1,917	1.09	151
<b>Information Technology &amp; Analytical Instruments</b>	<b>103</b>	<b>18,007</b>	<b>1.23</b>	<b>3,398</b>
Semiconductors	127	10,300	6.27	8,657
Electronic Components	43	2,530	1.10	224
Computers and Peripherals	68	732	1.09	63
<b>Electrical Power Generation and Transmission</b>	<b>141</b>	<b>4,251</b>	<b>2.05</b>	<b>2,174</b>
Fossil Fuel Electric Power	142	4,147	3.93	3,092
<b>Communications Equipment and Services</b>	<b>91</b>	<b>7,371</b>	<b>1.26</b>	<b>1,526</b>
Communications Equipment	99	3,120	2.30	1,761
<b>Metal Mining*</b>	<b>79</b>	<b>960</b>	<b>1.52</b>	<b>329</b>
<b>Furniture</b>	<b>28</b>	<b>4,717</b>	<b>1.04</b>	<b>183</b>
Household Furniture	26	2,141	1.26	438
Mobile Homes	28	864	2.79	554

Note: Only those subclusters with excess employment are shown. Thus, employment and excess employment in the displayed subclusters may not sum to the cluster total.

\* This cluster does not have any subclusters.

Sources: U.S. Department of Commerce, Census Bureau, *County Business Patterns* (nonfarm, private-sector employment) and U.S. Department of Commerce, Bureau of Economic Analysis (farm and government employment). Cluster definitions are from the Institute for Strategy and Competitiveness, Harvard Business School. The location quotients and excess employment were calculated using per capita employment. The population estimate for the nation came from the U.S. Department of Commerce, Census Bureau. The population estimates for Arizona and its subregions came from the Arizona Department of Administration, Office of Employment and Population Statistics.

The financial services cluster provided the most excess employment and excess payroll in the Phoenix area in 2014. Most of the excess was in the credit intermediation subcluster, which ranked first among subclusters on both excess employment and excess payroll. A relatively large deficit was present in the financial investment activities subcluster.

The next-highest excess employment and excess payroll was in the transportation and logistics cluster, with most of the excess in the air transportation subcluster, which ranked second on excess employment and third on excess payroll. An excess also was present in three of the other four subclusters, but a relatively large deficit was present in the ground transportation support activities subcluster.

Insurance services provided the third-highest amount of excess employment and ranked fourth on excess payroll, mostly due to the insurance carriers subcluster, which ranked fourth on both excess employment and excess payroll. A small excess also was present in the reinsurance carriers subcluster.

The aerospace vehicles and defense cluster ranked fourth on excess employment and third on excess payroll, with each of its three subclusters contributing excesses. The aircraft and search and navigation equipment subclusters each ranked among the top 10 on excess payroll.

The hospitality and tourism cluster ranked fifth on excess employment and sixth on excess payroll. An excess was present in four of its seven subclusters, led by tourism-related services, which ranked in the top 10 on both excess employment and excess payroll. Relatively large deficits were present in the other tourism attractions and amusement parks and arcades subclusters.

Information technology and analytical instruments ranked sixth on excess employment and fifth on excess payroll. Three of its eight subclusters had an excess, but most of the excess was in the semiconductors subcluster, which had a high location quotient and ranked third on excess employment and second on excess payroll. Sizable employment deficits existed in the software publishing and process and laboratory instruments subclusters.

As seen in Table 13, lesser amounts of excess employment were present in the electrical power generation and transmission; communications equipment and services; metal mining; and furniture clusters. The only cluster with an employment deficit exceeding 10,000 was federal government.

A number of subclusters other than those shown in Table 13 provided excess employment, but the excess was more than offset by deficit employment in the other subclusters within the cluster. Of the 207 subclusters, 43 had excess employment in Metro Phoenix in 2014. Other than the subclusters displayed in Table 13, the greatest excess employment was in three subclusters:

- Business support services, excluding professional employer organizations, had a LQ of 1.19 and excess employment of 3,839, sixth highest. It is part of the large business services cluster.
- Warehousing and storage had a LQ of 1.29 and excess employment of 3,010, eighth highest. It is one of many subclusters in the distribution and electronic commerce cluster.

- Electronic and catalog shopping had a LQ of 1.52 and excess employment of 2,870, 10th highest. It ranked eighth on excess payroll. It too is part of the distribution and electronic commerce cluster.

### Metropolitan Tucson

Only five of the 53 traded clusters had a location quotient of more than 1 in Metropolitan Tucson in 2014. Those clusters are displayed in Table 14, along with the subclusters within these clusters with a location quotient of more than 1.

The aerospace vehicles and defense cluster was Metro Tucson's most important economic activity in 2014, contributing the most excess employment and excess payroll, and having a high location quotient. Two of its three subclusters contributed excess employment, though most of it was in missiles and space vehicles, which had an extremely high LQ and provided the most excess employment and excess payroll of any subcluster. Search and navigation equipment ranked in the top 10 on both excesses.

The federal government provided the second-most excess employment and excess payroll, followed by metal mining, which had a very high LQ. The hospitality and tourism cluster ranked fourth on excess employment and fifth on excess payroll. All of its excess was in just one of its seven subclusters, accommodation and related services, which ranked third on excess

**TABLE 14  
TRADED CLUSTERS WITH EXCESS EMPLOYMENT IN METROPOLITAN TUCSON  
IN 2014**

Cluster Subcluster	Payroll Per Employee (000)	Employ- ment	Location Quotient	Excess Employ- ment
<b>Aerospace Vehicles and Defense</b>	<b>\$108</b>	<b>9,716</b>	<b>5.78</b>	<b>8,035</b>
Missiles and Space Vehicles	114	8,472	44.77	8,283
Search and Navigation Equipment	66	945	2.38	547
<b>Federal Government*</b>	<b>64</b>	<b>20,898</b>	<b>1.39</b>	<b>5,827</b>
<b>Metal Mining*</b>	<b>78</b>	<b>2,318</b>	<b>16.06</b>	<b>2,174</b>
<b>Hospitality and Tourism</b>	<b>26</b>	<b>11,205</b>	<b>1.14</b>	<b>1,395</b>
Accommodation and Related Services	26	9,119	1.45	2,849
<b>Biopharmaceuticals</b>	<b>192</b>	<b>1,262</b>	<b>1.69</b>	<b>517</b>
Diagnostic Substances	192	1,260	15.69	1,180

Note: Only those subclusters with excess employment are shown. Thus, employment and excess employment in the displayed subclusters may not sum to the cluster total.

\* This cluster does not have any subclusters.

Sources: U.S. Department of Commerce, Census Bureau, *County Business Patterns* (nonfarm, private-sector employment) and U.S. Department of Commerce, Bureau of Economic Analysis (farm and government employment). Cluster definitions are from the Institute for Strategy and Competitiveness, Harvard Business School. The location quotients and excess employment were calculated using per capita employment. The population estimate for the nation came from the U.S. Department of Commerce, Census Bureau. The population estimates for Arizona and its subregions came from the Arizona Department of Administration, Office of Employment and Population Statistics.

employment and fourth on excess payroll. The biopharmaceuticals cluster also provided excess employment, entirely in one of its three subclusters. The diagnostic substances subcluster had a very high location quotient and ranked fourth on excess employment and second on excess payroll.

Three clusters had an employment deficit of more than 5,000: distribution and electronic commerce; business services; and education and knowledge creation.

Subclusters other than those shown in Table 14 had excess employment, but this excess was more than offset by deficit employment in the other subclusters within the cluster. Of the 207 subclusters, only 19 had excess employment in Metro Tucson in 2014. Other than the subclusters displayed in Table 14, the greatest excess employment was in three subclusters:

- Business support services, excluding professional employer organizations, had a LQ of 2.21 and excess employment of 5,576, second highest. It ranked third on excess payroll.
- Software publishing, part of the information technology and analytical instruments cluster, had a LQ of 1.51 and excess employment of 707. It ranked fifth on both excess employment and excess payroll.
- Professional organizations, part of the education and knowledge creation cluster, had a LQ of 3.04 and excess employment of 552, sixth highest. It ranked seventh on excess payroll.

State government, though not categorized as a traded activity in this study, also is an important driver of the Tucson area economy, in large part related to the University of Arizona. The location quotient for state government was 1.68 in 2014, with excess employment of 11,355.

### **Balance of the State**

Only 10 of the 53 traded clusters had a location quotient of more than 1 in the balance of Arizona in 2014. Those clusters are displayed in Table 15, along with the subclusters within these clusters with a location quotient of more than 1.

The federal government cluster provided the most excess employment and excess payroll in the balance of the state in 2014. Metal mining ranked second on each measure, with an extremely high location quotient. Farming ranked third on excess employment and fourth on excess payroll. Hospitality and tourism ranked fourth on excess employment and fifth on excess payroll, with excesses in four of the seven subclusters. The accommodation and related services subcluster — which had the most excess employment among subclusters and ranked second on excess payroll — was responsible for most of the cluster's excess.

The medical devices cluster, which had a high LQ, provided the fifth-most excess employment and ranked third on excess payroll, with its surgical and dental instruments and supplies subcluster placing second on excess employment and first on excess payroll. The excesses were smaller in the construction products and services cluster, with excesses in two of the five subclusters. The construction subcluster ranked third on excess employment and fourth on excess payroll. Lesser excesses were present in the agricultural inputs and services; electrical power generation and transmission; nonmetal mining; and coal mining clusters. The fossil fuel electric power subcluster ranked third on excess payroll but only seventh on excess employment.

**TABLE 15  
TRADED CLUSTERS WITH EXCESS EMPLOYMENT  
IN THE BALANCE OF ARIZONA IN 2014**

Cluster Subcluster	Payroll Per Employee (000)	Employ- ment	Location Quotient	Excess Employ- ment
<b>Federal Government*</b>	<b>\$64</b>	<b>31,287</b>	<b>1.67</b>	<b>12,505</b>
<b>Farm*</b>	<b>28</b>	<b>20,567</b>	<b>1.98</b>	<b>10,164</b>
<b>Metal Mining*</b>	<b>91</b>	<b>6,585</b>	<b>36.60</b>	<b>6,405</b>
<b>Hospitality and Tourism</b>	<b>21</b>	<b>16,708</b>	<b>1.37</b>	<b>4,482</b>
Accommodation and Related Services	21	12,151	1.56	4,336
Gambling Facilities	24	1,168	1.93	564
Other Tourism Attractions	18	1,410	1.49	460
Tourism-Related Services	28	1,316	1.31	309
<b>Medical Devices</b>	<b>65</b>	<b>3,746</b>	<b>3.75</b>	<b>2,746</b>
Surgical and Dental Instruments and Supplies	65	3,716	4.41	2,873
<b>Construction Products and Services</b>	<b>48</b>	<b>4,449</b>	<b>1.40</b>	<b>1,272</b>
Construction	50	3,623	1.69	1,475
Water, Sewage and Other Systems	39	479	3.36	336
<b>Agricultural Inputs and Services</b>	<b>42</b>	<b>787</b>	<b>2.05</b>	<b>403</b>
Agricultural Services	35	615	2.30	347
Fertilizers	84	114	2.19	62
<b>Electrical Power Generation and Transmission</b>	<b>138</b>	<b>916</b>	<b>1.55</b>	<b>324</b>
Fossil Fuel Electric Power	138	853	2.84	552
Electric Power Transmission	141	53	1.04	2
<b>Nonmetal Mining*</b>	<b>40</b>	<b>504</b>	<b>1.56</b>	<b>181</b>
<b>Coal Mining*</b>	<b>89</b>	<b>373</b>	<b>1.14</b>	<b>47</b>

Note: Only those subclusters with excess employment are shown. Thus, employment and excess employment in the displayed subclusters may not sum to the cluster total.

\* This cluster does not have any subclusters.

Sources: U.S. Department of Commerce, Census Bureau, *County Business Patterns* (nonfarm, private-sector employment) and U.S. Department of Commerce, Bureau of Economic Analysis (farm and government employment). Cluster definitions are from the Institute for Strategy and Competitiveness, Harvard Business School. The location quotients and excess employment were calculated using per capita employment. The population estimate for the nation came from the U.S. Department of Commerce, Census Bureau. The population estimates for Arizona and its subregions came from the Arizona Department of Administration, Office of Employment and Population Statistics.

Four clusters had an employment deficit of more than 5,000: business services; distribution and electronic commerce; education and knowledge creation; and financial services.

A number of subclusters other than those shown in Table 15 had excess employment, but this excess was more than offset by deficit employment in the other subclusters within the cluster. Of the 207 subclusters, 28 had excess employment in the balance of the state in 2014. Other than the subclusters displayed in Table 15, the greatest excess employment was in business support services, excluding professional employer organizations, which had a LQ of 1.25 and ranked

fourth on excess employment and fifth on excess payroll. The specialty foods and ingredients subcluster, part of the food processing and manufacturing cluster, had a LQ of 2.34 and ranked fifth on excess employment and sixth on excess payroll.

The balance of the state consists of a multitude of local economies, the structure of which varies substantially. For example, nearly all of the activity in the medical devices cluster is located in Flagstaff. Metal mining is restricted to certain locations, where it generally is the dominant economic activity. In some communities, farming is the dominant activity, while in other locales farming may hardly be present. Some of the other leading clusters in the balance of the state, such as hospitality and tourism, are more widespread, but still may range from barely present to being the dominant activity.

## CHANGES IN THE ECONOMIC BASE BETWEEN 2004 AND 2014

Economic base studies for the state and counties previously were produced by the Seidman Research Institute for the Arizona Department of Commerce using 1999 and 2004 data. For Arizona, data also are available for 2001, when base studies by community were produced. In addition, a base study using 2009 data was produced for Arizona, Metro Phoenix, Metro Tucson, and the balance of the state.<sup>16</sup> Because some industries are highly cyclical, analyses of the change in the economic base over time are best performed using comparable years of two economic cycles. 2004 provides the best comparison to 2014: each was an expansionary year, coming before the peak growth rates of each economic cycle.

Employment growth between 2004 and 2014 was relatively modest, negatively affected by the deep and long recession that lasted from the end of 2007 into 2010. Based on the BEA's figures for wage and salary employment, the 10-year increase was only 5.3 percent nationally. Arizona and Metro Phoenix outpaced the nation, though by relatively small differentials. The percent changes in Metro Tucson and the balance of the state were less than the national average.

In the rest of this section, the change in employment is not examined. Instead, the emphasis is on the change in excess employment, calculated from per capita employment in Arizona and the nation.

Including all economic activities, employment per 1,000 residents declined between 2004 and 2014 in Arizona and in the nation. The decrease in Arizona was greater, with the location quotient falling from 0.909 to 0.885. The deficit in employment went from -247,000 to -352,000.

The traded cluster share of total employment rose marginally in Arizona between 2004 and 2014, from 31.8-to-32.0 percent, while the national share dropped a bit from 34.3-to-33.8 percent. The traded cluster location quotient for Arizona slipped a little, from 0.843 to 0.838, while the local cluster LQ dropped from 0.944 to 0.908. The employment deficit enlarged by 13 percent in the traded clusters but burgeoned 85 percent in the local clusters.

In order to compare the state's three geographic subregions, industry 561330 (professional employer organizations) was excluded from the 2014 and 2004 data. The totals are shown in Table 16. Arizona's two large metropolitan areas fared worse than the nation between 2004 and 2014, with declines in the total and traded cluster location quotients and a larger decrease in the traded cluster share of total employment. In contrast, in the balance of Arizona, the traded cluster strengthened, with an increase in the traded sector location quotient and a gain in the traded cluster share of employment. The share in the balance of state went from below the shares for the two large metro areas in 2004 to above the Metro Tucson share, and close to the Metro Phoenix share, in 2014.

Between 2004 and 2014, the composition of the traded clusters shifted considerably in Arizona. Declines in some traded clusters were mostly offset by gains in other traded clusters.

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<sup>16</sup> See the June 2012 report "The Economic Base of Arizona, Metropolitan Phoenix, Metropolitan Tucson, the Balance of the State, and Chandler" at <https://wpcarey.asu.edu/sites/default/files/uploads/center-competitiveness-and-prosperity-research/basestudy6-12.pdf>.

**TABLE 16**  
**CHANGE IN BASE STUDY TOTALS BETWEEN 2004 AND 2014\***

	<b>United States</b>	<b>Arizona</b>	<b>Metro Phoenix</b>	<b>Metro Tucson</b>	<b>Balance of State</b>
<b>Employment Per 1,000 Residents</b>					
Total	-21.1	-32.4	-41.1	-36.2	-5.3
Traded	-10.8	-11.7	-17.4	-17.5	9.3
Local	-10.3	-20.6	-23.7	-18.6	-14.6
<b>Traded Share (%)</b>	-0.8	-0.5	-1.0	-1.8	3.2
<b>Location Quotient</b>					
Total		-0.029	-0.046	-0.038	0.021
Traded		-0.019	-0.051	-0.064	0.104
Local		-0.036	-0.045	-0.029	-0.021
<b>Excess or Deficit Employment</b>					
Total		-118,043	-100,707	-19,428	2,090
Traded		-32,600	-38,682	-10,324	16,405
Local		-85,444	-62,025	-9,104	-14,315

\* Industry 561330 (professional employer organizations) is excluded. However, the balance of the state still includes some activities placed in the “statewide” designation in *County Business Patterns*.

Sources: U.S. Department of Commerce, Census Bureau, *County Business Patterns* (nonfarm, private-sector employment) and U.S. Department of Commerce, Bureau of Economic Analysis (farm and government employment). Cluster definitions are from the Institute for Strategy and Competitiveness, Harvard Business School. The location quotients and excess employment were calculated using per capita employment. The population estimate for the nation came from the U.S. Department of Commerce, Census Bureau. The population estimates for Arizona and its subregions came from the Arizona Department of Administration, Office of Employment and Population Statistics.

### **Arizona**

Among the state’s largest traded clusters as measured by employment, significant decreases in location quotients occurred between 2004 and 2014 in two high-technology clusters: aerospace vehicles and defense, and information technology and analytical instruments. The hospitality and tourism cluster had the next-largest decline, but it was much smaller in magnitude. The largest gains in location quotients occurred in education and knowledge creation (which still had a LQ considerably below 1 in 2014), financial services, and insurance services.

The traded clusters with the largest changes in excess employment in Arizona between 2004 and 2014 are shown in Table 17. The listing is not restricted to clusters with excess employment (location quotients greater than 1). For example, the largest increase in the excess employment figure was a shrinking of the employment deficit in the education and knowledge creation cluster, which still had a sizable employment deficit in 2014.<sup>17</sup> The employment deficit narrowed considerably in two of the five subclusters, with nearly all of the improvement occurring in the Phoenix area. The cluster’s improvement in excess payroll ranked second.

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<sup>17</sup> The education portion of this cluster — NAICS sector 61, educational services — only includes private-sector educational institutions.

**TABLE 17**  
**EXCESS OR DEFICIT EMPLOYMENT IN TRADED CLUSTERS**  
**WITH LARGE CHANGES IN ARIZONA BETWEEN 2004 AND 2014**

Cluster Subcluster	2004	2014	Change, 2004 to 2014	2014 Payroll Per Employee (000)
<b>Gains</b>				
<b>Education and Knowledge Creation</b>	<b>-28,933</b>	<b>-20,014</b>	<b>8,919</b>	<b>\$67</b>
Colleges, Universities, & Professional Schools	-19,422	-14,411	5,011	42
Research Organizations	-7,739	-3,333	4,406	146
<b>Financial Services</b>	<b>1,649</b>	<b>9,523</b>	<b>7,875</b>	<b>85</b>
Credit Intermediation	3,831	15,372	11,541	74
<b>Insurance Services</b>	<b>-3,941</b>	<b>2,026</b>	<b>5,967</b>	<b>77</b>
Insurance Carriers	-3,192	2,302	5,494	78
<b>Communications Equipment and Services</b>	<b>-5,607</b>	<b>-526</b>	<b>5,080</b>	<b>87</b>
Communications Equipment	-1,883	1,191	3,075	97
Communications Services	-3,547	-1,594	1,953	81
<b>Metal Mining*</b>	<b>4,515</b>	<b>8,907</b>	<b>4,392</b>	<b>87</b>
<b>Transportation and Logistics</b>	<b>1,716</b>	<b>5,348</b>	<b>3,632</b>	<b>60</b>
Trucking	-4,776	-355	4,421	40
<b>Textile Manufacturing**</b>	<b>-6,335</b>	<b>-3,099</b>	<b>3,236</b>	<b>28</b>
<b>Automotive</b>	<b>-16,890</b>	<b>-13,940</b>	<b>2,950</b>	<b>54</b>
Automotive Parts	-6,720	-5,086	1,635	55
<b>Apparel**</b>	<b>-4,496</b>	<b>-1,943</b>	<b>2,554</b>	<b>25</b>
<b>Medical Devices</b>	<b>-1,403</b>	<b>892</b>	<b>2,295</b>	<b>62</b>
Surgical and Dental Instruments and Supplies	-792	1,473	2,264	61
<b>Losses</b>				
<b>Business Services***</b>	<b>5,309</b>	<b>-29,049</b>	<b>-34,358</b>	<b>57</b>
Corporate Headquarters	3,556	-19,762	-23,318	89
Computer Services	-3,282	-10,830	-7,548	80
Employment Placement Services	46	-3,731	-3,777	50
Architectural and Drafting Services	723	-835	-1,558	57
<b>Distribution and Electronic Commerce</b>	<b>-17,527</b>	<b>-27,084</b>	<b>-9,557</b>	<b>61</b>
Wholesale of Prof Equipment & Supplies	723	-2,760	-3,483	78
Wholesale of Electrical and Electronic Goods	1,597	-409	-2,006	85
<b>Hospitality and Tourism</b>	<b>18,688</b>	<b>9,942</b>	<b>-8,746</b>	<b>36</b>
Gambling Facilities	5,800	1,904	-3,896	39
Accommodation and Related Services	10,268	7,803	-2,465	29
<b>Information Tech &amp; Analytical Instruments</b>	<b>7,352</b>	<b>-548</b>	<b>-7,899</b>	<b>98</b>
Electronic Components	2,617	-719	-3,336	42
Software Publishers	-1,221	-4,185	-2,964	95
Process and Laboratory Instruments	-347	-2,270	-1,924	58
<b>Oil and Gas Production and Transportation</b>	<b>-7,383</b>	<b>-14,481</b>	<b>-7,098</b>	<b>98</b>
Support Activities for Oil and Gas Operations	-2,482	-6,536	-4,054	58
<b>Aerospace Vehicles and Defense</b>	<b>18,595</b>	<b>11,950</b>	<b>-6,645</b>	<b>104</b>
Aircraft	5,475	878	-4,597	91
Missiles and Space Vehicles	10,970	9,003	-1,966	119
<b>Federal Government*</b>	<b>-9,736</b>	<b>-12,388</b>	<b>-2,652</b>	<b>61</b>
<b>Performing Arts</b>	<b>225</b>	<b>-2,317</b>	<b>-2,542</b>	<b>23</b>
Promoters and Managers	913	-1,414	-2,327	21
<b>Video Production and Distribution*</b>	<b>-2,462</b>	<b>-4,631</b>	<b>-2,169</b>	<b>40</b>

(continued)

## TABLE 17 (continued)

Note: Only those subclusters with large changes in excess employment are shown. Thus, excess employment in the displayed subclusters may not sum to the cluster total.

\* This cluster does not have any subclusters.

\*\* None of the subclusters experienced a large change.

\*\*\* Industry 561330, professional employer organizations, is excluded.

Sources: U.S. Department of Commerce, Census Bureau, *County Business Patterns* (nonfarm, private-sector employment) and U.S. Department of Commerce, Bureau of Economic Analysis (farm and government employment). Cluster definitions are from the Institute for Strategy and Competitiveness, Harvard Business School. The location quotients and excess employment were calculated using per capita employment. The population estimate for the nation came from the U.S. Department of Commerce, Census Bureau. The population estimates for Arizona and its subregions came from the Arizona Department of Administration, Office of Employment and Population Statistics.

Of those clusters with excess employment in 2014, the largest gains occurred in financial services, which ranked second overall on the improvement in excess employment and first on excess payroll. The gain was entirely in the credit intermediation subcluster, which posted an especially large increase. Each of the three subregions experienced a sizable gain, though only the Phoenix area had excess employment in 2014. In contrast, the deficit enlarged in the financial investments activity subcluster in each of the subregions; the deficit in the securities subcluster also grew due to a reduction in excess employment in the Phoenix area.

In the insurance services cluster, an employment deficit in 2004 became an employment excess in 2014. The improvement in both excess employment and excess payroll ranked third, predominantly due to the insurance carriers subcluster. Gains occurred in each of the three subregions, though only the Phoenix area had excess employment in 2014.

The gain in the communications equipment and services cluster, which ranked fourth on both excess employment and excess payroll, largely occurred in the Phoenix area. An employment deficit swung to an employment excess in the communications equipment subcluster; the deficit narrowed in communications services.

The improvement in both excess employment and excess payroll between 2004 and 2014 in the metal mining cluster ranked fifth. Each of the three subregions experienced a gain in metal mining, with an especially large increase in the balance of the state. However, the metal mining cluster historically has been highly erratic over time, so continued gains should not be expected. In fact, according to the monthly employment estimates from the U.S. Bureau of Labor Statistics, metal mining employment dropped 13 percent in Arizona and the nation between March 2014 and March 2016.

Excess employment and excess payroll improved in the transportation and logistics cluster, with each measure ranking sixth, primarily due to gains in the Phoenix area. The cluster's gain resulted from a significant narrowing of the deficit in the trucking subcluster. The largest subcluster of air transportation experienced a reduction in its excesses. The deficit widened in the ground transportation subcluster.

In the medical devices cluster, an employment deficit in 2004 became an employment excess in 2014. The gain — 10th on excess employment and eighth on excess payroll — was predominantly in the surgical instruments subcluster in the balance of the state.

Other clusters with a large gain in the employment differential measure did so by narrowing the employment deficit. The decrease in the size of the employment deficits in the textile manufacturing, automotive, and apparel clusters occurred throughout the state. Of the various subclusters within these clusters, the largest gain occurred in automotive parts in the Tucson area.

Significant decreases in the excess employment figure occurred in several clusters in Arizona between 2004 and 2014. The business services cluster had the largest drop in excess employment and excess payroll, going from an excess to a significant deficit in Arizona and in Metro Phoenix. The deficit widened considerably in the Tucson area. Several of the subclusters experienced significant declines, especially corporate headquarters and computer services. Excess employment hardly changed in the business support services subcluster, as a large decline in the Phoenix area was offset by gains in the rest of the state.

The information technology and analytical instruments cluster also went from an excess in 2004 to a deficit in 2014. It had the second-largest decline in excess payroll and fourth-largest in excess employment. The excess in the Phoenix area dropped considerably while an excess changed to a deficit in the Tucson area. Declines occurred in most of the subclusters, though the deficit in the computer and peripherals subcluster narrowed. The decrease in the semiconductors subcluster was relatively small.

Other high-technology activities also experienced declines in the excess in Arizona between 2004 and 2014. In the aerospace vehicles and defense cluster — whose decline was fourth largest on excess payroll and sixth largest on excess employment — each of the subclusters, particularly aircraft, experienced a decrease in its excess. The declines were more significant in the Tucson area than in the Phoenix area. The two largest subcluster declines in the distribution and electronic commerce cluster — which had the second-largest drop in excess employment and fifth largest in excess payroll — were in the high-tech subclusters of the wholesale of electronic goods and the wholesale of professional equipment. These decreases occurred largely in the Phoenix area.

The hospitality and tourism cluster also experienced a large decline in its excesses: third largest in excess employment and sixth largest in excess payroll. All seven subclusters declined. The losses occurred in the Phoenix area and in the Tucson area. The deficits in the oil and gas production and transportation cluster became much larger, with declines in each of the subclusters. Decreases occurred across the state. Lesser declines occurred in the federal government, performing arts, and video production and distribution clusters. In the two latter clusters, losses occurred across the state, while the decline in federal government was strictly in the Phoenix area.

Considering only the clusters with large changes between 2004 and 2014 in excess employment — those shown in Table 17 — the losses in excess employment and excess payroll were

considerably greater than the gains. However, estimated payroll per employee was slightly higher in the clusters with gains than in the clusters with losses.

High-paying high-technology activities began to be significant drivers of the Arizona economy in the 1950s. While these activities — most notably reflected in the information technology and analytical instrument cluster and in the aerospace vehicles and defense cluster — remain significant parts of the Arizona economy, they are shrinking in size. Despite these declines, the traded share of the economy has dropped only a little, as gains have been realized in other traded activities. Of the traded activities that are sizable and growing rapidly in Arizona, two stand out: financial services and insurance services. Financial services and insurance services pay well in Arizona, but not as well as the two high-tech clusters. Payroll per employee in each cluster in Arizona is well below the national average, in each of the subclusters in each cluster. In addition, a disproportionate share of the activity in Arizona in the financial services cluster is in the credit intermediation subcluster, the lowest-paying of the five subclusters. In addition to the wage differential between the high-tech clusters and these two services clusters, job gains between 2004 and 2014 — measured both as total employment and excess employment — in financial services and insurance services were smaller in magnitude than the job losses in the two high-tech clusters.

### **Metropolitan Phoenix**

The traded clusters with the largest changes in excess employment in Metro Phoenix between 2004 and 2014 are shown in Table 18. The largest gain in both excess employment and excess payroll was in the education and knowledge creation cluster. The deficit narrowed considerably in two of the five subclusters.

Large gains occurred in several clusters with excess employment in 2014. In the financial services cluster — second in the improvement in both excess employment and excess payroll — the gain was entirely in the credit intermediation subcluster; the excess in the securities subcluster narrowed. In the communications equipment and services cluster and in the communications equipment subcluster, an employment deficit turned into an employment excess. The deficit narrowed in communications services. The 10-year change in the cluster ranked third on both excess employment and excess payroll.

Excess employment increased between 2004 and 2014 in the transportation and logistics cluster, with the gains ranking third in both excess employment and excess payroll. An employment deficit in the trucking subcluster became an excess. However, the air transportation and ground transportation subclusters experienced losses.

In the insurance services cluster, the excesses rose, with the gain fifth on excess employment and sixth on excess payroll, primarily due to the insurance carriers subcluster. The excesses also increased in the electric power generation and transmission cluster. The increase in excess employment ranked seventh and the gain in excess payroll placed fourth.

Other clusters with a large gain in the employment differential measure did so by narrowing the employment deficit. Employment deficits became smaller in the textile manufacturing and apparel clusters, with small-to-moderate gains in each of the subclusters.

**TABLE 18**  
**EXCESS OR DEFICIT EMPLOYMENT IN TRADED CLUSTERS**  
**WITH LARGE CHANGES IN METROPOLITAN PHOENIX BETWEEN 2004 AND 2014**

Cluster Subcluster	2004	2014	Change, 2004 to 2014	2014 Payroll Per Employee (000)
<b>Gains</b>				
<b>Education and Knowledge Creation</b>	<b>-16,267</b>	<b>-5,989</b>	<b>10,278</b>	<b>\$72</b>
Colleges, Universities, and Professional Schools	-10,802	-4,208	6,594	44
Research Organizations	-4,969	-680	4,289	162
<b>Financial Services</b>	<b>12,201</b>	<b>17,214</b>	<b>5,012</b>	<b>86</b>
Credit Intermediation	9,597	17,999	8,402	76
Securities Brokers, Dealers, and Exchanges	3,166	1,029	-2,137	118
<b>Communications Equipment and Services</b>	<b>-2,961</b>	<b>1,526</b>	<b>4,487</b>	<b>91</b>
Communications Equipment	-920	1,761	2,681	99
Communications Services	-1,927	-154	1,773	84
<b>Transportation and Logistics</b>	<b>8,344</b>	<b>11,206</b>	<b>2,862</b>	<b>63</b>
Trucking	-1,874	2,284	4,159	41
<b>Insurance Services</b>	<b>4,091</b>	<b>6,351</b>	<b>2,260</b>	<b>79</b>
Insurance Carriers	4,488	6,235	1,747	80
<b>Textile Manufacturing**</b>	<b>-4,292</b>	<b>-2,178</b>	<b>2,114</b>	<b>30</b>
<b>Electric Power Generation and Transmission</b>	<b>545</b>	<b>2,174</b>	<b>1,629</b>	<b>142</b>
Fossil Fuel Electric Power	1,192	3,092	1,900	142
<b>Apparel**</b>	<b>-2,734</b>	<b>-1,107</b>	<b>1,627</b>	<b>25</b>
<b>Losses</b>				
<b>Business Services***</b>	<b>28,493</b>	<b>-2,163</b>	<b>-30,656</b>	<b>71</b>
Corporate Headquarters	15,926	-3,313	-19,240	91
Computer Services	2,019	-1,223	-3,241	83
Employment Placement Services	1,104	-2,056	-3,160	47
Business Support Services***	10,189	3,846	-6,343	37
<b>Distribution and Electronic Commerce</b>	<b>4,756</b>	<b>-2,775</b>	<b>-7,531</b>	<b>61</b>
Wholesale of Professional Equipment & Supplies	4,493	598	-3,895	78
Wholesale of Electrical and Electronic Goods	3,839	2,388	-1,551	86
Electronic and Catalog Shopping	1,074	2,870	1,796	71
<b>Information Technology &amp; Analytical Instruments</b>	<b>9,820</b>	<b>3,398</b>	<b>-6,422</b>	<b>103</b>
Software Publishers	-722	-3,374	-2,652	104
Electronic Components	3,631	224	-3,407	43
<b>Hospitality and Tourism</b>	<b>10,256</b>	<b>4,065</b>	<b>-6,190</b>	<b>44</b>
Accommodation and Related Services	3,962	618	-3,343	29
Gambling Facilities	3,043	1,466	-1,577	45
<b>Federal Government*</b>	<b>-25,316</b>	<b>-30,720</b>	<b>-5,404</b>	<b>56</b>
<b>Oil and Gas Production and Transportation</b>	<b>-4,908</b>	<b>-9,729</b>	<b>-4,820</b>	<b>84</b>
Support Activities for Oil and Gas Operations	-1,613	-4,327	-2,714	48
<b>Farm*</b>	<b>-4,862</b>	<b>-7,432</b>	<b>-2,570</b>	<b>72</b>
<b>Aerospace Vehicles and Defense</b>	<b>8,014</b>	<b>5,575</b>	<b>-2,438</b>	<b>103</b>
Aircraft	5,457	2,838	-2,619	95
<b>Performing Arts</b>	<b>982</b>	<b>-1,045</b>	<b>-2,027</b>	<b>24</b>
Promoters and Managers	1,384	-491	-1,874	22
<b>Wood Products**</b>	<b>-643</b>	<b>-2,358</b>	<b>-1,715</b>	<b>33</b>

(continued)

## TABLE 18 (continued)

Note: Only those subclusters with large changes in excess employment are shown. Thus, excess employment in the displayed subclusters may not sum to the cluster total.

\* This cluster does not have any subclusters.

\*\* None of the subclusters experienced a large change.

\*\*\* Industry 561330, professional employer organizations, is excluded.

Sources: U.S. Department of Commerce, Census Bureau, *County Business Patterns* (nonfarm, private-sector employment) and U.S. Department of Commerce, Bureau of Economic Analysis (farm and government employment). Cluster definitions are from the Institute for Strategy and Competitiveness, Harvard Business School. The location quotients and excess employment were calculated using per capita employment. The population estimate for the nation came from the U.S. Department of Commerce, Census Bureau. The population estimates for Arizona and its subregions came from the Arizona Department of Administration, Office of Employment and Population Statistics.

Significant decreases in the employment differential figure occurred in several clusters in Metro Phoenix between 2004 and 2014. The business services cluster experienced a very large drop, going from substantial excess employment to an employment deficit. It had the largest drop in both excess employment and excess payroll. Five of the eight subclusters experienced significant declines, especially corporate headquarters and business support services.

The information technology and analytical instruments cluster also experienced a sharp drop in its excesses between 2004 and 2014, with the third largest on excess employment and the second largest on excess payroll. Declines occurred in six of the eight subclusters, with the largest losses in electronic components and software publishing.

Other high-technology activities also experienced declines in their excesses in Metro Phoenix between 2004 and 2014. The two largest subcluster declines in the distribution and electronic commerce cluster — which had the second-largest loss in excess employment and the third-largest decline in excess payroll — were in the high-tech subclusters of the wholesale of electronic goods and the wholesale of professional equipment. In the aerospace vehicles and defense cluster (eighth-largest loss in excess employment and seventh-largest in excess payroll), a large loss occurred in the aircraft subcluster, with a smaller drop in search and navigation instruments.

Hospitality and tourism also lost ground, with the fourth-largest loss in excess employment and the sixth largest in excess payroll. A large decline in excess employment occurred in the accommodation and gambling facilities subclusters; six of the seven subclusters declined.

The employment deficit in the oil and gas production and transportation cluster became much larger, with declines in each of the subclusters. A sizable decrease also was recorded in the federal government cluster. Lesser declines occurred in the farm, performing arts, and wood products clusters.

Considering only the clusters with large changes between 2004 and 2014 in excess employment — those shown in Table 18 — the losses in excess employment and excess payroll were

considerably greater than the gains. However, estimated payroll per employee was higher in the clusters with gains than in the clusters with losses.

The comparison of the two high-tech clusters to the financial services and insurance services clusters that was included in the Arizona discussion is relevant to Metro Phoenix. Not only do the two services clusters pay lower wages than the high-tech clusters, job gains between 2004 and 2014 — measured both as total employment and excess employment — in financial services and insurance services were smaller in magnitude than the job losses in the two high-tech clusters.

### **Metropolitan Tucson**

The traded clusters with the largest changes in excess employment in Metro Tucson between 2004 and 2014 are shown in Table 19. The largest gain was in the federal government cluster, which had the second-largest increase in excess payroll. The excesses also increased in metal mining (sixth on the gain in excess employment and fifth on excess payroll). An employment deficit became an employment excess in the biopharmaceuticals cluster, which had the greatest gain in excess payroll and ranked fifth on excess employment.

Each of the other clusters with a large improvement in the employment differential measure still had an employment deficit in 2014. The improvement in the financial services cluster (third on both excess employment and excess payroll) was entirely in the credit intermediation subcluster, while the gain in insurance services — fourth on excess employment and sixth on excess payroll — was predominantly in the insurance carriers subcluster. In the automotive cluster (second on excess employment and fourth on excess payroll), much of the gain was in the automotive parts subcluster.

Significant decreases in the excess employment figure occurred in several clusters in Metro Tucson between 2004 and 2014. The excesses fell considerably in the aerospace vehicles and defense cluster (the largest decrease on excess payroll and second largest on excess employment), with losses in the aircraft subcluster and in the missiles and space vehicles subcluster. Excess employment also dropped in the hospitality and tourism cluster — third-largest decline in excess employment and sixth largest on excess payroll. Six of the seven subclusters declined, with the largest drops in gambling facilities and tourism services. Excess employment in 2004 became an employment deficit in 2014 in the information technology and analytical instruments cluster — the decline was fourth largest in excess employment and third largest in excess payroll — and in four of its subclusters, including medical apparatus, process and laboratory instruments, and semiconductors.

Each of the other clusters with a large loss in the excess employment figure experienced a widening of the employment deficit. The business services cluster experienced a large drop (the largest in excess employment and second largest in excess payroll), with declines in six of eight subclusters. In contrast, excess employment increased in the business support services subcluster. The other clusters are shown in Table 19.

Considering only the clusters with large changes between 2004 and 2014 in excess employment — those shown in Table 19 — the losses in excess employment and excess payroll were

**TABLE 19**  
**EXCESS OR DEFICIT EMPLOYMENT IN TRADED CLUSTERS**  
**WITH LARGE CHANGES IN METROPOLITAN TUCSON BETWEEN 2004 AND 2014**

Cluster Subcluster	2004	2014	Change, 2004 to 2014	2014 Payroll Per Employee (000)
<b>Gains</b>				
<b>Federal Government*</b>	<b>3,135</b>	<b>5,827</b>	<b>2,692</b>	<b>\$64</b>
<b>Automotive</b>	<b>-3,514</b>	<b>-1,902</b>	<b>1,612</b>	<b>67</b>
Automotive Parts	-1,485	-418	1,067	70
<b>Financial Services</b>	<b>-3,476</b>	<b>-1,890</b>	<b>1,586</b>	<b>72</b>
Credit Intermediation	-2,094	-128	1,966	49
<b>Insurance Services</b>	<b>-2,773</b>	<b>-1,416</b>	<b>1,357</b>	<b>54</b>
Insurance Carriers	-2,703	-1,311	1,747	56
<b>Biopharmaceuticals</b>	<b>-714</b>	<b>517</b>	<b>1,230</b>	<b>192</b>
Diagnostic Substances	-80	1,180	1,260	192
<b>Metal Mining*</b>	<b>1,116</b>	<b>2,174</b>	<b>1,057</b>	<b>78</b>
<b>Textile Manufacturing**</b>	<b>-1,134</b>	<b>-576</b>	<b>558</b>	<b>30</b>
<b>Farm*</b>	<b>-7,502</b>	<b>-6,998</b>	<b>504</b>	<b>51</b>
<b>Losses</b>				
<b>Business Services***</b>	<b>-3,110</b>	<b>-7,687</b>	<b>-4,577</b>	<b>50</b>
Computer Services	-1,625	-4,904	-3,279	65
Corporate Headquarters	-2,772	-5,300	-2,528	78
Engineering Services	632	-606	-1,239	94
Business Support Services***	2,344	5,576	3,232	27
<b>Aerospace Vehicles and Defense</b>	<b>12,158</b>	<b>8,035</b>	<b>-4,123</b>	<b>108</b>
Missiles and Space Vehicles	10,975	8,283	-2,692	114
Aircraft	970	-795	-1,765	49
<b>Hospitality and Tourism</b>	<b>4,529</b>	<b>1,395</b>	<b>-3,135</b>	<b>26</b>
Gambling Facilities	2,010	-127	-2,137	30
Tourism-Related Services	411	-471	-882	39
<b>Information Technology &amp; Analytical Instruments</b>	<b>1,523</b>	<b>-316</b>	<b>-1,840</b>	<b>74</b>
Medical Apparatus	521	-166	-687	66
Process and Laboratory Instruments	559	-73	-633	56
Semiconductors	371	-207	-578	51
<b>Distribution and Electronic Commerce</b>	<b>-9,715</b>	<b>-11,553</b>	<b>-1,838</b>	<b>56</b>
Electronic and Catalog Shopping	-133	-857	-724	24
<b>Construction Products and Services</b>	<b>-174</b>	<b>-1,442</b>	<b>-1,268</b>	<b>50</b>
Construction	-494	-1,077	-583	51
<b>Marketing, Design and Publishing**</b>	<b>-1,416</b>	<b>-2,509</b>	<b>-1,094</b>	<b>43</b>
<b>Oil and Gas Production and Transportation</b>	<b>-1,203</b>	<b>-2,173</b>	<b>-970</b>	<b>115</b>
Support Activities for Oil and Gas Operations	-392	-978	-587	70
<b>Upstream Metal Manufacturing</b>	<b>-169</b>	<b>-1,085</b>	<b>-916</b>	<b>49</b>
Metal Processing	649	-314	-963	52

(continued)

## TABLE 19 (continued)

Note: Only those subclusters with large changes in excess employment are shown. Thus, excess employment in the displayed subclusters may not sum to the cluster total.

\* This cluster does not have any subclusters.

\*\* None of the subclusters experienced a large change.

\*\*\* Industry 561330, professional employer organizations, is excluded.

Sources: U.S. Department of Commerce, Census Bureau, *County Business Patterns* (nonfarm, private-sector employment) and U.S. Department of Commerce, Bureau of Economic Analysis (farm and government employment). Cluster definitions are from the Institute for Strategy and Competitiveness, Harvard Business School. The location quotients and excess employment were calculated using per capita employment. The population estimate for the nation came from the U.S. Department of Commerce, Census Bureau. The population estimates for Arizona and its subregions came from the Arizona Department of Administration, Office of Employment and Population Statistics.

considerably greater than the gains. However, estimated payroll per employee was quite a bit higher in the clusters with gains than in the clusters with losses.

The comparison of the two high-tech clusters to the financial services and insurance services clusters that was included in the Arizona discussion is relevant to Metro Tucson. Not only do the two services clusters pay lower wages than the high-tech clusters, job gains between 2004 and 2014 — measured both as total employment and excess employment — in financial services and insurance services were considerably smaller in magnitude than the job losses in the two high-tech clusters. Neither of these services clusters is nearly as important in the Tucson area as in the Phoenix area.

### Balance of Arizona

Unlike the two large metro areas, the traded share of the balance of Arizona economy increased between 2004 and 2014, with increases in the location quotient and excess employment of the traded clusters as a whole. The differentiation between the balance of the state and the large metro areas came not from disproportionately large gains in some clusters in the balance of the state but from an avoidance of large losses. The only cluster with a significant loss was oil and gas production and transportation. The traded clusters with the largest changes in excess employment in the balance of the state between 2004 and 2014 are shown in Table 20.

Four clusters with excess employment in 2004 had a greater excess in 2014: metal mining (which had the largest gain in both excess employment and excess payroll), medical devices (the change in excess employment ranked fourth and the gain in excess payroll ranked third), farm (ranked sixth on both measures), and hospitality and tourism. In the latter cluster, three of the seven subclusters experienced a moderate gain, with the other four experiencing smaller losses. A deficit in 2004 became an excess in 2014 in the construction products and services cluster. Its gain in excess employment ranked second while its increase in excess payroll was fourth.

Each of the other clusters with a significant improvement in the excess employment measure still had an employment deficit in 2014. The improvement in the insurance services cluster (third on excess employment and second on excess payroll) was due to the insurance carriers subcluster.

**TABLE 20**  
**EXCESS OR DEFICIT EMPLOYMENT IN TRADED CLUSTERS WITH LARGE**  
**CHANGES IN THE BALANCE OF ARIZONA BETWEEN 2004 AND 2014**

Cluster Subcluster	2004	2014	Change, 2004 to 2014	2014 Payroll Per Employee (000)
<b>Gains</b>				
<b>Metal Mining*</b>	<b>3,721</b>	<b>6,405</b>	<b>2,684</b>	<b>91</b>
<b>Construction Products and Services</b>	<b>-1,261</b>	<b>1,272</b>	<b>2,533</b>	<b>48</b>
Construction	-1,145	1,475	2,620	50
<b>Insurance Services</b>	<b>-5,258</b>	<b>-2,909</b>	<b>2,350</b>	<b>88</b>
Insurance Carriers	-4,978	-2,621	2,357	89
<b>Medical Devices</b>	<b>678</b>	<b>2,746</b>	<b>2,068</b>	<b>65</b>
Surgical and Dental Instruments and Supplies	821	2,873	2,052	65
<b>Financial Services</b>	<b>-7,077</b>	<b>-5,800</b>	<b>1,277</b>	<b>90</b>
Credit Intermediation	-3,672	-2,499	1,173	79
Securities Brokers, Dealers, and Exchanges	-2,044	-1,412	632	115
Financial Investment Activities	-1,227	-1,743	-516	102
<b>Farm*</b>	<b>3,757</b>	<b>5,007</b>	<b>1,250</b>	<b>\$28</b>
<b>Business Services***</b>	<b>-20,073</b>	<b>-19,199</b>	<b>874</b>	<b>36</b>
Business Support Services***	-1,990	1,433	3,423	32
Engineering Services	-1,694	-884	810	68
Corporate Headquarters	-9,598	-11,148	-1,550	61
Computer Services	-3,676	-4,703	-1,028	71
Consulting Services	-1,708	-2,212	-504	56
<b>Downstream Metal Products**</b>	<b>-1,593</b>	<b>-834</b>	<b>759</b>	<b>44</b>
<b>Printing Services</b>	<b>-2,043</b>	<b>-1,377</b>	<b>666</b>	<b>30</b>
Printing Services	-1,745	-1,170	575	31
<b>Automotive**</b>	<b>-3,772</b>	<b>-3,153</b>	<b>620</b>	<b>32</b>
<b>Hospitality and Tourism**</b>	<b>3,903</b>	<b>4,482</b>	<b>579</b>	<b>21</b>
<b>Textile Manufacturing**</b>	<b>-908</b>	<b>-344</b>	<b>564</b>	<b>26</b>
<b>Apparel**</b>	<b>-1,006</b>	<b>-454</b>	<b>552</b>	<b>24</b>
<b>Losses</b>				
<b>Oil and Gas Production and Transportation</b>	<b>-1,273</b>	<b>-2,580</b>	<b>-1,307</b>	<b>107</b>
Support Activities for Oil and Gas Operations	-477	-1,231	-754	75

Note: Only those subclusters with large changes in excess employment are shown. Thus, excess employment in the displayed subclusters may not sum to the cluster total.

\* This cluster does not have any subclusters.

\*\* None of the subclusters experienced a large change.

\*\*\* Industry 561330, professional employer organizations, is excluded.

Sources: U.S. Department of Commerce, Census Bureau, *County Business Patterns*, and Bureau of Economic Analysis (employment). The location quotients and excess employment were calculated using per capita employment, based on the population estimates produced by the Census Bureau for the United States and by the Arizona Department of Administration, Office of Employment and Population Statistics for Arizona. Cluster definitions are from the Institute for Strategy and Competitiveness, Harvard Business School.

In the financial services cluster, which ranked fifth on the gains in both excess employment and excess payroll, gains occurred in the credit intermediation and securities subclusters. The changes in the business services cluster were mixed, with a large gain in business support services and a smaller gain in engineering services offsetting losses in the other subclusters.

## **APPENDIX A:**

### **ECONOMIC BASE STUDY BASED ON BUREAU OF ECONOMIC ANALYSIS DATA**

Using the NAICS, the BEA provides employment data by sector and by county for 2001 through 2014; subsectoral data are available by state. Earnings data are available by sector and subsector by county for 2001 through 2014, though much of the subsectoral data are withheld. Gross domestic product (GDP) data are available by sector and subsector by state and by metropolitan area for 2001 through 2014, but subsectoral data are not available for 2014.

Because of the various limitations and the focus on state and substate data for 2014, the base study using the BEA time series was limited to sectoral data except for some detail in the agriculture and government sectors. The agriculture sector consists of two components: farming; and fishing, forestry, and agricultural services. The government sector consists of four components — federal civilian, military, state, and local — but state and local governments are combined in the GDP series.

The per capita figures for Arizona, Metro Phoenix, Metro Tucson, and the balance of the state are calculated using the population estimates issued by the Arizona Department of Administration, Office of Employment and Population Statistics. The national per capita figures are calculated using the population estimate of the U.S. Census Bureau.

### **Employment**

In 2014, the overall location quotient for total employment, which consists of wage and salary employees plus proprietors, was only 0.89 in Arizona. It was highest in Metro Phoenix at 0.95 and lowest in the balance of the state at 0.70. The LQ in Metro Tucson was 0.85. In most sectors, the LQ was highest in the Phoenix area and lowest in the balance of the state. The exceptions include agriculture and mining, with the highest LQs in the balance of the state, and government, with the LQs similarly high in Metro Tucson and the balance of the state.

In each of the geographic areas, the location quotient exceeded 1 in only between three and five of the 20 sectors, as seen in Table A-1. The LQ was not greater than 1 in all three substate areas in any sector.

The highest location quotient in Arizona was in the real estate and rental sector, with a very high figure in the Phoenix area and a figure greater than 1 in the Tucson area. The next-highest LQ in Arizona was in the administrative support and waste management sector, again with a high figure in the Phoenix area and a figure greater than 1 in the Tucson area. Arizona's LQ exceeded 1 in the finance and insurance sector due to a high figure in the Phoenix area. The state's LQ was barely greater than 1 in the utilities sector, with figures slightly above 1 in each of the populous metro areas. The only other sectors with a location quotient greater than 1 were retail trade in the Phoenix area, government in the Tucson area and in the balance of the state, and agriculture and mining in the balance of the state.

In each government subsector, the location quotient in the Phoenix area was considerably below 1, keeping the state's LQ below 1 in each subsector. The LQ for state government was only 0.65 in Metro Phoenix, despite the presence of the state capital and Arizona State University.

**TABLE A-1**  
**LOCATION QUOTIENTS BY SECTOR BASED ON BEA EMPLOYMENT IN ARIZONA AND SUBREGIONS**

Sector	2014				2004-to-2014 Change			
	Arizona	Metro Phoenix	Metro Tucson	Balance of State	Arizona	Metro Phoenix	Metro Tucson	Balance of State
TOTAL	0.89	0.95	0.85	0.70	-0.04	-0.04	-0.04	-0.04
Agriculture	0.62	0.25	0.16	2.31	0.04	-0.05	0.04	0.38
Mining	0.67	0.42	0.91	1.35	-0.09	0.01	0.08	-0.48
Utilities	1.01	1.01	1.08	0.97	-0.02	-0.09	-0.02	0.17
Construction	0.88	0.98	0.74	0.65	-0.21	-0.34	-0.22	-0.35
Manufacturing	0.63	0.71	0.61	0.37	-0.02	-0.04	-0.05	0.05
Wholesale Trade	0.80	0.98	0.47	0.42	-0.08	-0.13	-0.03	-0.01
Retail Trade	0.97	1.03	0.89	0.82	-0.02	-0.02	-0.02	-0.03
Transportation and Warehousing	0.78	0.89	0.58	0.55	-0.03	-0.06	0.04	0.00
Information	0.79	0.95	0.57	0.43	-0.02	0.01	-0.24	0.00
Finance and Insurance	1.06	1.34	0.69	0.33	0.02	-0.01	0.04	0.01
Real Estate and Rental	1.30	1.50	1.07	0.77	-0.07	0.01	-0.32	-0.19
Professional, Scientific and Technical Services	0.81	0.92	0.82	0.40	-0.07	-0.09	-0.06	-0.04
Management of Companies	0.71	0.94	0.37	0.19	0.02	0.02	-0.04	0.02
Administrative Support and Waste Management	1.16	1.39	1.03	0.49	-0.09	-0.15	-0.01	-0.02
Education (Private Sector)	0.80	0.92	0.65	0.47	0.12	0.17	0.07	-0.02
Health Care and Social Assistance	0.86	0.89	0.97	0.65	0.04	0.07	-0.02	-0.02
Arts, Entertainment and Recreation	0.86	0.94	0.87	0.60	-0.02	0.03	-0.17	-0.08
Accommodation and Food Services	0.94	0.97	0.92	0.85	-0.07	-0.06	-0.09	-0.01
Other Services	0.81	0.85	0.85	0.63	-0.00	0.01	-0.02	-0.05
Government	0.89	0.74	1.17	1.16	-0.04	-0.05	0.06	-0.02

Sources: U.S. Department of Commerce, Bureau of Economic Analysis (employment); U.S. Department of Commerce, Census Bureau (U.S. population); and Arizona Department of Administration, Office of Employment and Population Statistics (Arizona population).

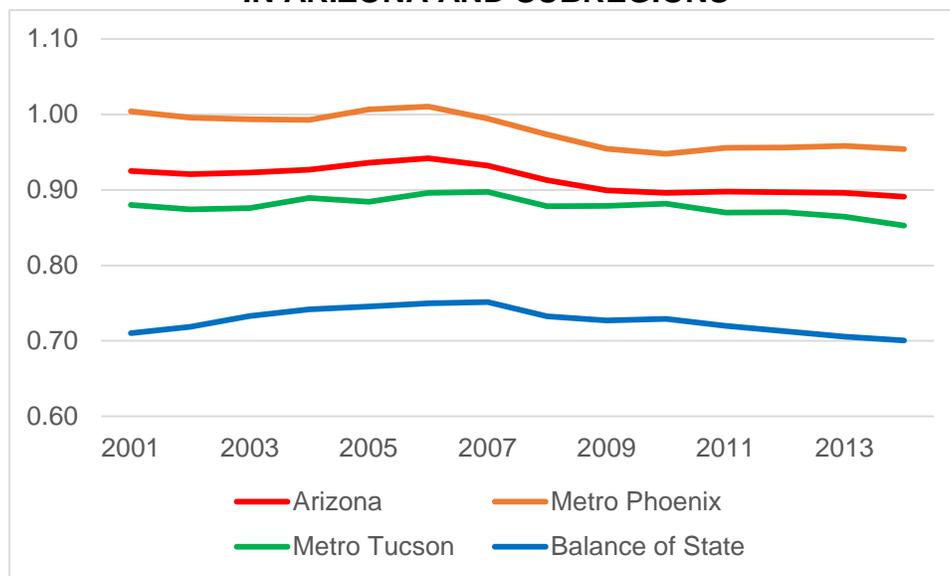
In contrast, in the federal civilian and military subsectors, the location quotient was about 1.4 in the Tucson area; the LQ was nearly 1.7 in the state government subsector. The high state government figure largely can be traced to the University of Arizona. Davis-Monthan Air Force Base contributes heavily to the federal government’s presence. Thus, both the federal government and state government are important drivers of the Tucson area economy.

The location quotients in the two federal government subsectors also were high in the balance of the state at 1.9 for the federal civilian subsector and 1.4 for the military subsector. However, the LQ for state government was below 0.7. Thus, the federal government, but not state government, is an important driver of the economy in the balance of the state as a whole.

In each component of the agriculture sector, the location quotient was quite low (less than 0.3) in the two large metro areas; the figures were considerably below 1 for the state. In the balance of the state, the LQ was 2 in the farming component and 3.2 in fishing, forestry, and agricultural services. According to the ISC’s data for the balance of the state, the LQ exceeded 2.5 in the agricultural inputs and services cluster in 2013 and was close to 1 in the forestry cluster. The BEA data indicate that farming is another important traded cluster in the balance of the state.

As seen in Chart A-1, the overall location quotient did not change substantially in any of the geographic areas between 2001 and 2014. However, the 2014 figure was the lowest of the time series in Metro Tucson and the balance of the state and nearly the lowest in the Phoenix area. As seen in Table A-1, the overall LQ dropped between 2004 and 2014 by an equal amount in each of the geographic areas.

**CHART A-1  
OVERALL LOCATION QUOTIENTS BASED ON BEA EMPLOYMENT  
IN ARIZONA AND SUBREGIONS**



Sources: U.S. Department of Commerce, Bureau of Economic Analysis (employment); U.S. Department of Commerce, Census Bureau (U.S. population); and Arizona Department of Administration, Office of Employment and Population Statistics (Arizona population).

Between 2004 and 2014, the location quotient dropped in 15 of 20 sectors in Arizona and in between 12 and 15 sectors in each of the three subregions. The largest decrease in Arizona was in the construction sector, with large drops in all three subregions. Mining experienced a relatively large decline, entirely in the balance of the state. The administrative support and wholesale trade sectors also experienced relatively large decreases, mostly in the Phoenix area. In contrast, educational services experienced a sizable gain in its location quotient, with increases in each of the large metro areas.

Sizable declines in the location quotient of the real estate and rental sector occurred in the Tucson area and in the balance of the state between 2004 and 2014, but the figure was steady in the Phoenix area. An increase in the LQ for the agriculture sector occurred in the balance of the state, with the gain focused in the farming component.

### **Excess/Deficit Employment**

The size of the excess or deficit in employment depends on both the location quotient and the magnitude of total employment. For example, while total employment in the balance of the state is far lower than in the Phoenix area, the very low location quotient in the balance of the state causes its employment deficit to be much larger than in Metro Phoenix.

Differences in the relative use of part-time employees can distort relationships in excess/deficit employment across sectors and across geographic areas. Variations in the average wage or other per employee measures can provide insight into disproportionate use of part-time employees. This is seen in the real estate and rental sector, which provided the most excess employment in Arizona in 2014. However, its earnings per employee figure was far below the national average, suggesting that the large excess may in part reflect a disproportionately high number of part-time workers.

Excess employment was next largest in the administrative support and waste management sector, followed by finance and insurance. The largest employment deficit was in manufacturing. Sizable deficits also occurred in the health care and social assistance, government, professional and technical services, and other services sectors.

In Metro Phoenix, substantial excess employment occurred in the administrative support and waste management, real estate and rental, and finance and insurance sectors. The largest deficit was in government, followed by manufacturing, agriculture, health care and social assistance, and other services.

Government was the only sector to provide significant excess employment in Metro Tucson, with state government providing most of the excess. Small amounts of excess employment were present in the real estate and rental sector and in the administrative support and waste management sector. The largest deficit was in manufacturing, followed by wholesale trade, agriculture, finance and insurance, and transportation and warehousing.

In the balance of the state, the agriculture and government sectors provided substantial excess employment; a smaller excess was present in mining. The excess in agriculture was nearly evenly split between the two components, while the federal government provided the majority of

the excess in the government sector. The largest deficit was in manufacturing, followed by professional and technical services, health care and social assistance, finance and insurance, and administrative support and waste management.

### **Comparison of Results Across the Three Economic Measures**

Overall in Arizona, the location quotient based on employment was higher than the LQs based on earnings and GDP, a result of the state's below-average earnings per employee and GDP per employee. The higher overall LQ based on employment relative to the two dollar measures largely results from a much higher employment LQ in five sectors: information, finance and insurance, real estate and rental, professional and technical services, and management of companies. In contrast, in most sectors, the location quotients were similar for the employment, earnings, and gross product measures.

The BEA's employment data for farming and government were used in the main base study discussed in the body of this report. The same data were used for this appendix, except for total employment being used rather than wage and salary employment for farming. Farming and federal government — civilian plus military — are assumed to be traded activities at state and substate levels, while state and local governments are assumed to be nontraded, though state government at a substate level could be considered to be traded. The base study results for these activities based on employment can vary considerably from those based on the earnings and gross product measures.

#### **Arizona**

The overall location quotient in 2014 was 0.89 based on employment but only 0.79 to 0.80 based on earnings and GDP. Between 2004 and 2014, the overall LQ fell by between 0.04 and 0.06 on each measure, with the 2014 figure the lowest of the 2001-through-2014 period on each measure.

The location quotient for the administrative support and waste management sector was between 1.15 and 1.18 based on each of the three economic measures in 2014. The LQ slightly exceeded 1 for retail trade based on earnings and GDP. While the LQ based on employment was considerably greater than 1 for the real estate and rental sector and was slightly above 1 for the utilities sector and for the finance and insurance sector, the LQs based on earnings and GDP were less than 1 in each of these sectors, by a considerable amount in the finance and insurance and real estate and rental sectors.

In most sectors, the location quotient fell slightly between 2004 and 2014 based on each of the three economic measures. The largest drop was for construction. In contrast, the LQ rose for the educational services and health care and social assistance sectors based on each measure. In a few sectors, the change between 2004 and 2014 was inconsistent across the three economic measures. A slight increase based on employment was measured in agriculture, but this sector's LQ declined based on the two dollar measures. The inconsistency was in the farming component. Mining's LQ dropped based on employment and earnings, but rose based on gross product. While the real estate and rental LQ fell based on each measure, the decline was much larger based on earnings.

Based on each measure, the location quotients for farming were low in 2014: 0.56 based on employment and 0.49 based on both earnings and gross product. The change in the farm LQs between 2004 and 2014 varied substantially by measure, from an increase of 0.12 based on employment to a decrease of 0.26 based on GDP.

In the federal government subsector, the LQ for the civilian segment was higher than for the military based on earnings and employment, but the military LQ was higher based on GDP. The LQs were less than 1 based on each measure for both the civilian and military components. Based on each measure, the civilian LQs hardly changed between 2004 and 2014; the military LQ hardly changed based on gross product but fell based on employment and earnings.

### **Metropolitan Phoenix**

The difference across the three economic measures in the overall location quotient in 2014 was not as great as in the state's other subregions, but the LQ of 0.95 based on employment still was higher than the 0.90 figures based on earnings and GDP. Between 2004 and 2014, the overall LQ fell by 0.04 based on employment, 0.06 based on earnings, and 0.10 based on GDP, with the 2014 figure the lowest of the 2001-through-2014 period based on earnings and GDP and nearly the lowest based on employment.

The location quotient for the administrative support and waste management sector was between 1.39 and 1.51 based on each of the three economic measures in 2014. Based on all three measures, the LQ also exceeded 1 in three other sectors: finance and insurance, real estate and rental, and retail trade. The employment LQ was considerably higher than the earnings and GDP LQs in the finance and insurance and real estate and rental sectors but was lower in retail trade. Other sectoral LQs greater than 1 included utilities based on employment and earnings; construction based on GDP; wholesale trade based on earnings; arts, entertainment and recreation based on earnings and GDP; and accommodation and food services based on earnings and GDP.

In most sectors, the location quotient fell slightly between 2004 and 2014 based on each of the three economic measures. The largest drop was for construction. In contrast, each LQ rose for the educational services, health care and social assistance sectors, and (by a lesser amount) arts, entertainment and recreation. In a few sectors, the change between 2004 and 2014 was inconsistent across the three economic measures. An increase based on earnings but a decrease based on GDP occurred in finance and insurance. A large decrease in real estate and rental based on earnings contrasted with little change based on employment.

Based on each measure, the location quotients for farming were very low in 2014, ranging from 0.25 based on employment to 0.40 based on earnings. The change in the farm LQs between 2004 and 2014 varied substantially by measure, from a decrease of 0.03 based on employment to a decrease of 0.26 based on GDP.

In the federal government subsector, the LQs also were quite low, ranging from 0.48 based on GDP to 0.56 based on employment for the civilian segment, and from 0.35 based on earnings to 0.50 based on employment for the military component. Based on each measure, both the civilian

and military LQs fell between 2004 and 2014. The state government LQ also was considerably below 1 in 2014 and dropped between 2004 and 2014.

### **Metropolitan Tucson**

The overall location quotient in 2014 was 0.85 based on employment but only between 0.65 and 0.69 based on earnings and GDP. Between 2004 and 2014, the overall LQ fell by 0.04 or 0.05 based on each economic measure. The 2014 LQ was the lowest of the 2001-through-2014 period based on each measure.

The location quotients for the government and utilities sectors were greater than 1 based on each of the three economic measures in 2014, the only two sectors above 1 based on the two dollar measures. Based on employment, the LQs slightly exceeded 1 for the real estate and rental and administrative support and waste management sectors.

In most sectors, the location quotient fell slightly between 2004 and 2014 based on each of the three economic measures. The largest decreases were for the information, construction, real estate and rental, and arts, entertainment and recreation sectors. In contrast, each LQ rose for the mining, educational services, and government sectors.

Based on each measure, the location quotients for farming were extremely low in 2014, ranging from 0.16 based on employment to 0.05 based on gross product. The change in the farm LQs between 2004 and 2014 varied by measure, from an increase of 0.05 based on employment to a decrease of 0.08 based on GDP.

In the federal government subsector, the LQs were above 1, ranging from 1.25 based on GDP to 1.42 based on employment for the civilian segment, and from 1.35 based on employment to 1.84 based on GDP for the military component. Based on each measure, the civilian LQs rose considerably between 2004 and 2014. The military LQ rose by a similar amount based on GDP but hardly changed based on the other two measures. The state government LQ also was considerably above 1 in 2014 and increased between 2004 and 2014.

### **Balance of Arizona**

The overall location quotient in 2014 was only 0.70 based on employment and even lower at between 0.49 and 0.51 based on earnings and GDP. Between 2004 and 2014, the overall LQ fell by between 0.02 and 0.04 based on each measure, with the 2014 LQ the lowest of the 2001-through-2014 period based on each measure.

Only three sectors had location quotients greater than 1 in 2014. The LQ for agriculture ranged from 1.45 based on GDP to 2.31 based on employment. The LQ for government ranged from 1.02 based on earnings to 1.16 based on employment. In the mining sector, the LQs were 1.4 based on GDP and employment but only 0.8 based on earnings.

In most sectors, the location quotient did not change much between 2004 and 2014 based on each of the three economic measures. Large declines occurred for the construction, real estate and rental, and mining sectors based on each measure. The LQ based on each measure rose for utilities and manufacturing.

Based on each measure, the location quotients for farming were exceeded 1 in 2014, ranging widely from 1.10 based on earnings to 1.98 based on employment. The change in the farm LQs between 2004 and 2014 varied significantly by measure, from a large increase based on employment to large decreases based on earnings and GDP.

In the federal government subsector, the LQs were considerably above 1, ranging from 1.68 based on GDP to 1.89 based on employment for the civilian segment, and from 1.36 based on employment to 1.70 based on GDP for the military component. Based on each measure, the civilian LQs rose between 2004 and 2014. The military LQ rose based on GDP but dropped based on employment. The state government LQ was considerably below 1 in 2014, though it increased between 2004 and 2014.

### **Considering the Cost of Living in the Base Study**

Part of the reason that the location quotients based on earnings and gross product are so low in Arizona is that the state's cost of living is below average. However, according to the regional price parity figures from the BEA,<sup>18</sup> the difference from the national average in living costs is not that great: 2.9 percent in Arizona, 1.4 percent in Metro Phoenix, 2.7 percent in Metro Tucson, and 6.9 percent in the balance of the state. Thus, the overall location quotients based on earnings and gross product still are considerably below 1 after adjusting for the cost of living, as seen in Table A-2.

Even after adjusting for living costs, the overall location quotients for earnings and gross product are less than the employment LQ, especially in Metro Tucson and the balance of the state (see Chart A-2). Compared to the national average after adjusting for the cost of living, overall earnings per employee in 2014 was 8 percent lower in Arizona, 5 percent lower in the Phoenix area, 17 percent lower in the Tucson area, and 21 percent lower in the balance of the state. For Arizona and Metro Phoenix, the differentials from the national average on adjusted GDP per employee were similar to those for earnings per employee. In Metro Tucson, GDP per employee was 21 percent below the U.S. average; the differential in the balance of the state was 25 percent.

Earnings per employee and GDP per employee vary widely by sector in each of the geographic areas. The variation by sector differs by geographic area, resulting in wide differences in the ratio to the national average across Arizona and its three subregions in each sector. Much of this variation is due to differing industry/occupation mixes within a sector in Arizona and its subregions relative to the national average. In addition, some of the variation may be due to labor market conditions that cause a particular occupation/industry to pay more or less than the national norm even after considering the cost of living.

In Arizona, the earnings-per-employee figure in 2014 after adjustment for the cost of living was greater than the national average in eight of 20 sectors, by as much as 9 percent in retail trade and manufacturing. The higher figure in manufacturing largely is due to a disproportionate share of Arizona's manufacturing jobs being in certain high-paying industries, such as aerospace. Among the 12 sectors with a lower earnings-per-employee figure in Arizona, the differential

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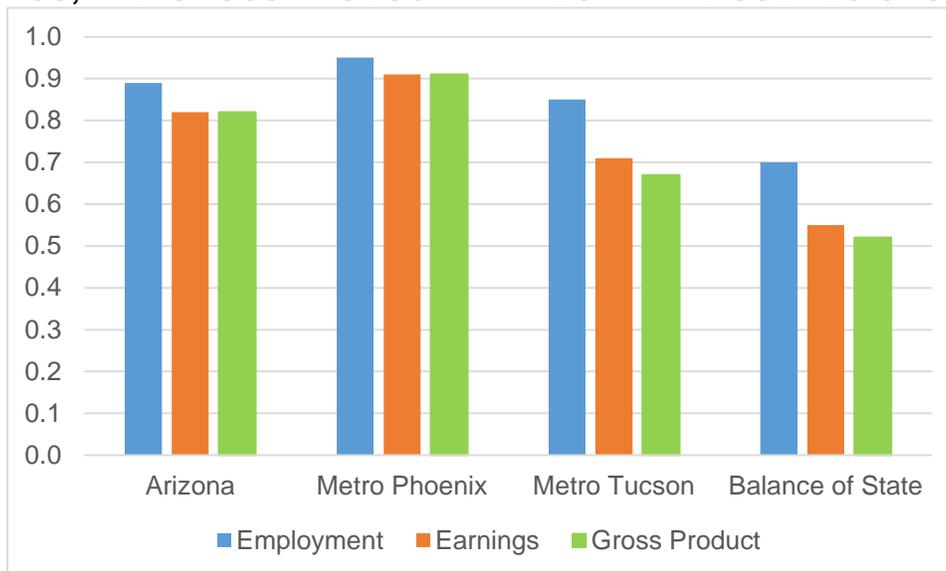
<sup>18</sup> The regional price parity figures are currently available only for the 2008-through-2013 period. The 2013 figures were used to adjust the 2014 earnings and gross product figures.

**TABLE A-2**  
**LOCATION QUOTIENTS BY SECTOR BASED ON EARNINGS AND GROSS PRODUCT**  
**ADJUSTED FOR THE COST OF LIVING IN ARIZONA AND SUBREGIONS IN 2014**

Sector	Earnings				Gross Product			
	Arizona	Metro Phoenix	Metro Tucson	Balance of State	Arizona	Metro Phoenix	Metro Tucson	Balance of State
TOTAL	0.82	0.91	0.71	0.55	0.82	0.91	0.67	0.52
Agriculture	0.57	0.37	0.13	1.67	0.37	0.34	0.06	1.56
Mining	0.38	0.20	0.54	0.89	0.68	0.35	0.91	1.55
Utilities	1.00	1.05	1.11	0.70	0.98	0.99	1.09	0.67
Construction	0.84	1.00	0.57	0.46	1.00	1.14	0.65	0.53
Manufacturing	0.68	0.77	0.74	0.29	0.56	0.64	0.55	0.26
Wholesale Trade	0.80	1.03	0.35	0.29	0.76	0.98	0.33	0.28
Retail Trade	1.05	1.18	0.82	0.75	1.08	1.21	0.84	0.78
Transportation and Warehousing	0.74	0.87	0.46	0.50	0.83	0.93	0.53	0.62
Information	0.52	0.65	0.34	0.21	0.49	0.58	0.37	0.22
Finance and Insurance	0.89	1.20	0.39	0.14	0.83	1.10	0.35	0.13
Real Estate and Rental	0.86	1.05	0.56	0.40	0.95	1.15	0.57	0.24
Professional, Scientific and Technical Services	0.65	0.78	0.58	0.22	0.64	0.76	0.56	0.21
Management of Companies	0.55	0.76	0.19	0.05	0.55	0.78	0.19	0.05
Administrative Support and Waste Management	1.22	1.53	0.81	0.37	1.18	1.48	0.79	0.37
Education (Private Sector)	0.83	1.01	0.49	0.43	0.83	1.02	0.50	0.44
Health Care and Social Assistance	0.92	0.98	0.96	0.66	0.92	0.98	0.96	0.66
Arts, Entertainment and Recreation	0.90	1.14	0.44	0.34	0.86	1.07	0.43	0.34
Accommodation and Food Services	0.99	1.05	0.88	0.82	0.98	1.05	0.88	0.83
Other Services	0.83	0.89	0.89	0.56	0.79	0.84	0.83	0.54
Government	0.84	0.70	1.08	1.10	0.90	0.75	1.19	1.22

Sources: U.S. Department of Commerce, Bureau of Economic Analysis (earnings, gross product, and cost of living); U.S. Department of Commerce, Census Bureau (U.S. population); and Arizona Department of Administration, Office of Employment and Population Statistics (Arizona population).

**CHART A-2  
COMPARISON OF OVERALL LOCATION QUOTIENTS BASED ON EMPLOYMENT,  
EARNINGS, AND GROSS PRODUCT IN ARIZONA AND SUBREGIONS IN 2014**



Note: Earnings and gross product are adjusted by the cost of living.

Sources: U.S. Department of Commerce, Bureau of Economic Analysis (employment, earnings, gross product, and cost of living); U.S. Department of Commerce, Census Bureau (U.S. population); and Arizona Department of Administration, Office of Employment and Population Statistics (Arizona population).

from the national average was quite large in several sectors, exceeding 30 percent in the mining, information, and real estate and rental sectors.

The adjusted earnings-per-employee figure in Metro Phoenix was greater than the national average in 12 of the 20 sectors, yet the overall figure was 5 percent below average. The average was lower in the Phoenix area by 30 percent or more in the mining, information, and real estate and rental sectors, and by more than 10 percent in finance and insurance, professional and technical services, and management of companies.

In the Tucson area, the adjusted earnings-per-employee figures were greater than the U.S. average in just three sectors: manufacturing, utilities, and other services. In the balance of the state, the figure was above the national average only in the health care and social assistance sector.

Fluctuations in the GDP-per-employee ratios to the national average differed somewhat from the earnings-per-employee ratios, but the patterns were similar.

Earnings per employee varied from high to low in the sectors in which Arizona had excess employment in 2014. The largest employment excess was in the real estate and rental sector, which had an earnings-per-employee figure just 37 percent of the overall figure. Administrative

support and waste management had the second-highest employment excess, but also had a below average earnings-per-employee figure (27 percent below average). In contrast, the finance and insurance sector also had excess employment and its earnings-per-employee figure was 21 percent higher than the overall figure.

The situation was similar in Metro Phoenix, with the largest employment excesses in the administrative support and waste management and real estate and rental sectors, which had well below-average earnings per employee. Retail trade also had excess employment and low earnings per employee, but the excess in finance and insurance was associated with high earnings per employee.

In Metro Tucson, government had by far the largest employment excess; its earnings-per-employee figure was 45 percent above the overall figure. Lesser excesses occurred in the low earnings-per-employee sectors of real estate and rental and administrative support and waste management.

The largest employment excess in the balance of the state was in agriculture, which had an earnings-per-employee figure 36 percent below the overall figure. However, the other sectors with excess employment — government and mining — had above average earnings per employee.

**APPENDIX B:  
CLUSTERS AND SUBCLUSTERS DEFINED BY  
THE INSTITUTE FOR STRATEGY AND COMPETITIVENESS**

CLUSTER Subcluster	Employment in 2013		Arizona	
	United States	Arizona	Location Quotient	Excess Employment
<b>OVERALL TOTAL</b>	118,301,188	2,188,770	0.89	-271,112
<b>TOTAL OF TRADED CLUSTERS</b>	42,581,547	733,769	0.83	-151,645
<b>AEROSPACE VEHICLES &amp; DEFENSE</b>	531,777	26,928	2.44	15,871
Aircraft	341,208	12,881	1.82	5,786
Search and Navigation Equipment	131,900	4,787	1.75	2,044
Missiles and Space Vehicles	58,669	9,260	7.59	8,040
<b>AGRICULTURAL INPUTS &amp; SERVICES</b>	94,516	1,486	0.76	-479
Agricultural Services	67,594	1,068	0.76	-338
Farm Management and Labor Services	13,993	187	0.64	-104
Fertilizers	12,929	231	0.86	-38
<b>APPAREL</b>	133,870	748	0.27	-2,036
Accessories and Specialty Apparel	50,962	641	0.60	-419
Apparel Contractors	45,212	60	0.06	-880
Women's Clothing	25,574	37	0.07	-495
Men's Clothing	12,122	10	0.04	-242
<b>AUTOMOTIVE</b>	859,412	4,492	0.25	-13,378
Automotive Parts	371,566	2,703	0.35	-5,023
Motor Vehicles	286,483	550	0.09	-5,407
Metal Mills and Foundries	125,332	836	0.32	-1,770
Gasoline Engines and Engine Parts	53,444	175	0.16	-936
Small Vehicles	13,591	53	0.19	-230
Military Vehicles and Tanks	8,996	175	0.94	-12
<b>BIOPHARMACEUTICALS</b>	231,368	2,033	0.42	-2,778
Biopharmaceutical Products	167,019	1,913	0.55	-1,560
Biological Products	38,830	60	0.07	-747
Diagnostic Substances	25,519	60	0.11	-471
<b>BUSINESS SERVICES</b>	10,968,828	212,613	0.93	-15,466
Business Support Services	3,343,965	93,725	1.35	24,193
Corporate Headquarters	3,098,762	46,176	0.72	-18,258
Computer Services	2,075,211	36,524	0.85	-6,627
Engineering Services	1,028,083	18,330	0.86	-3,047
Consulting Services	826,194	11,805	0.69	-5,374
Employment Placement Services	317,041	1,447	0.22	-5,145
Architectural and Drafting Services	180,833	2,933	0.78	-827
Ground Passenger Transportation	98,739	1,673	0.81	-380
<b>COAL MINING</b>	91,177	395	0.21	-1,501
<b>COMMUNICATIONS EQUIPMENT &amp; SERVICES</b>	465,153	9,306	0.96	-366
Communications Services	355,005	4,796	0.65	-2,586
Communications Equipment	103,352	4,510	2.10	2,361
Communications Equipment Components	6,796	0	0.00	-470

(continued)

	Employment in 2013		Arizona	Excess Employment
	United States	Arizona	Location Quotient	
CONSTRUCTION PRODUCTS & SERVICES	784,308	14,257	0.87	-2,051
Construction	532,129	10,454	0.94	-611
Construction Components	97,835	1,661	0.82	-373
Construction Products	96,455	238	0.12	-1,768
Water, Sewage, and Other Systems	35,801	1,596	2.14	852
Construction Materials	22,088	308	0.67	-151
DISTRIBUTION & E-COMMERCE	5,523,604	91,962	0.80	-22,892
Warehousing and Storage	714,684	13,850	0.93	-1,011
Wholesale of Prof & Comm'l Equipment & Suppl	661,309	11,365	0.83	-2,386
Wholesale of Electrical and Electronic Goods	527,875	15,130	1.38	4,154
Wholesale of Industrial Machinery & Equipment	457,522	4,964	0.52	-4,549
Electronic and Catalog Shopping	385,212	7,583	0.95	-427
Wholesale Trade Agents and Brokers	297,424	5,329	0.86	-855
Wholesale of Drugs and Druggists' Sundries	295,038	3,203	0.52	-2,932
Wholesale of Food Products	256,557	5,826	1.09	491
Wholesale of Apparel and Accessories	199,396	812	0.20	-3,334
Wholesale of Farm Products and Supplies	199,376	2,962	0.71	-1,184
Rental and Leasing	171,907	3,355	0.94	-220
Wholesale of Metals and Minerals	154,301	1,456	0.45	-1,752
Wholesale of Chemical and Allied Products	152,487	1,760	0.56	-1,411
Wholesale of Paper and Paper Products	147,849	1,882	0.61	-1,192
Wholesale of Furniture and Home Furnishing	143,614	2,296	0.77	-690
Wholesale of Farm & Garden Machinery & Equip	104,219	841	0.39	-1,326
Wholesale of Petroleum and Petroleum Products	102,091	1,103	0.52	-1,020
Support Services	98,962	712	0.35	-1,346
Wholesale of Other Merchandise	96,925	1,649	0.82	-366
Wholesale of Construction & Mining Machinery	86,018	2,712	1.52	923
Wholesale of Sporting Goods & Supplies	58,077	877	0.73	-331
Wholesale of Jewelry & Precious Stones & Metals	51,084	394	0.37	-668
Wholesale of Books, Periodicals, & Newspapers	47,614	215	0.22	-775
Wholesale of Service Establishment Equipment	46,101	692	0.72	-267
Wholesale of Transportation Equipment & Suppl	35,857	767	1.03	21
Wholesale of Toy and Hobby Goods and Supplies	32,105	227	0.34	-441
DOWNSTREAM CHEMICAL PRODUCTS	238,714	2,142	0.43	-2,822
Personal Care and Cleaning Products	93,981	721	0.37	-1,233
Processed Chemical Products	80,830	775	0.46	-906
Dyes, Pigments and Coating	46,104	235	0.25	-724
Lubricating Oils and Greases	11,746	36	0.15	-208
Explosives	6,053	375	2.98	249
DOWNSTREAM METAL PRODUCTS	390,451	6,862	0.85	-1,257
Metal Products	208,597	3,023	0.70	-1,314
Fabricated Metal Structures	113,258	1,798	0.76	-557
Ammunition	39,179	1,806	2.22	991
Metal Containers	29,417	235	0.38	-377

(continued)

	Employment in 2013		Arizona	
	United States	Arizona	Location Quotient	Excess Employment
EDUCATION & KNOWLEDGE CREATION	2,970,559	51,903	0.84	-9,865
Colleges, Universities, and Professional Schools	1,908,049	38,556	0.97	-1,119
Research Organizations	607,576	5,436	0.43	-7,198
Training Programs	268,111	4,965	0.89	-610
Educational Support Services	101,390	1,345	0.64	-763
Professional Organizations	85,433	1,601	0.90	-175
ELECTRIC POWER GENERATION & TRANSMIS	149,036	1,065	0.34	-2,034
Fossil Fuel Electric Power	72,760	750	0.50	-763
Alternative Electric Power	62,655	255	0.20	-1,048
Electric Power Transmission	13,621	60	0.21	-223
ENVIRONMENTAL SERVICES	86,082	1,109	0.62	-681
Waste Processing	58,685	847	0.69	-373
Waste Collection	16,203	133	0.39	-204
Other Waste Management Services	11,194	129	0.55	-104
FINANCIAL SERVICES	1,890,950	46,181	1.17	6,862
Credit Intermediation	922,719	31,273	1.63	12,087
Financial Investment Activities	471,016	6,231	0.64	-3,563
Securities Brokers, Dealers, and Exchanges	458,635	8,519	0.89	-1,018
Credit Bureaus	20,074	98	0.23	-319
Monetary Authorities - Central Bank	18,506	60	0.16	-325
FISHING & FISHING PRODUCTS	37,380	10	0.01	-767
FOOD PROCESSING & MANUFACTURING	941,440	9,548	0.49	-10,028
Specialty Foods and Ingredients	174,367	2,099	0.58	-1,527
Baked Goods	153,285	2,150	0.67	-1,037
Dairy Products	135,194	1,616	0.57	-1,195
Packaged Fruit and Vegetables	105,113	339	0.16	-1,847
Soft Drinks and Ice	66,532	2,009	1.45	626
Candy and Chocolate	58,025	122	0.10	-1,085
Farm Wholesalers	49,777	175	0.17	-860
Animal Foods	45,632	508	0.54	-441
Wineries	40,341	87	0.10	-752
Malt Beverages	32,612	394	0.58	-284
Milling and Refining of Cereals and Oilseeds	28,199	10	0.02	-576
Coffee and Tea	16,327	39	0.11	-300
Glass Containers	14,706	0	0.00	-1,017
Milling and Refining of Sugar	13,477	0	0.00	-932
Distilleries	7,853	0	0.00	-543
FOOTWEAR	15,270	70	0.22	-248
Footwear	11,657	60	0.25	-182
Footwear Components	3,613	10	0.13	-65
FORESTRY	65,445	184	0.14	-1,177

(continued)

	Employment in 2013		Arizona	
	United States	Arizona	Location Quotient	Excess Employment
FURNITURE	316,833	4,834	0.73	-1,754
Household Furniture	119,207	2,134	0.86	-345
Wood Cabinets and Woodwork	113,660	1,761	0.75	-602
Office Furniture	34,595	120	0.17	-599
Institutional Furniture	25,849	69	0.13	-468
Mobile Homes	23,522	750	1.53	261
HOSPITALITY & TOURISM	3,055,126	73,164	1.15	9,638
Accommodations and Related Services	1,950,303	48,722	1.20	8,169
Tourism Related Services	247,182	10,432	2.03	5,292
Other Tourism Attractions	236,674	3,383	0.69	-1,538
Amusement Parks and Arcades	172,577	1,672	0.47	-1,916
Gambling Facilities	164,250	4,125	1.21	710
Cultural and Educational Entertainment	156,427	2,510	0.77	-743
Spectator Sports	127,713	2,320	0.87	-336
INFO TECH & ANALYTICAL INSTRUMENTS	1,055,955	17,821	0.81	-4,136
Software Publishers	428,030	5,223	0.59	-3,677
Process and Laboratory Instruments	178,159	2,979	0.80	-726
Electronic Components	174,379	3,112	0.86	-514
Semiconductors	103,783	4,507	2.09	2,349
Medical Apparatus	79,222	962	0.58	-685
Computers and Peripherals	69,782	945	0.65	-506
Software Reproducing	14,072	10	0.03	-283
Audio and Video Equipment	8,528	83	0.47	-94
INSURANCE SERVICES	1,506,052	31,263	1.00	-53
Insurance Carriers	1,430,386	30,537	1.03	794
Insurance Related Services	62,661	716	0.55	-587
Reinsurance Carriers	13,005	10	0.04	-260
JEWELRY & PRECIOUS METALS PRODUCTS	25,010	143	0.27	-377
LEATHER & RELATED PRODUCTS	30,560	313	0.49	-322
Textile Bags and Canvas Products	20,115	260	0.62	-158
Personal Leather Goods and Luggage	8,804	53	0.29	-130
Women's Handbags and Purses	1,641	0	0.00	-113
LIGHTING & ELECTRICAL EQUIPMENT	281,970	2,207	0.38	-3,656
Electrical Equipment	115,704	670	0.28	-1,736
Electrical Components	104,506	1,130	0.52	-1,043
Lighting Fixtures and Parts	42,816	347	0.39	-543
Storage Batteries	18,944	60	0.15	-334
LIVESTOCK PROCESSING	484,145	2,017	0.20	-8,050
Meat Processing	478,532	1,957	0.20	-7,993
Livestock Merchant Wholesalers	5,613	60	0.51	-57
MARKETING, DESIGN & PUBLISHING	1,265,721	15,593	0.59	-10,726
Publishing	425,309	3,176	0.36	-5,668
Advertising Related Services	377,550	4,144	0.53	-3,707
Other Marketing Related Services	352,838	6,837	0.93	-500
Design Services	110,024	1,436	0.63	-852

(continued)

	Employment in 2013		Arizona	Excess Employ- ment
	United States	Arizona	Location Quotient	
MEDICAL DEVICES	258,516	5,561	1.03	186
Surgical and Dental Instruments and Supplies	217,839	5,283	1.17	753
Optical Instruments and Ophthalmic Goods	40,677	278	0.33	-568
METAL MINING	46,469	8,139	8.42	7,173
METALWORKING	484,283	4,500	0.45	-5,570
Metal Processing	174,803	1,460	0.40	-2,175
Fasteners	139,759	1,724	0.59	-1,182
Metalworking Machinery	106,835	874	0.39	-1,347
Machine Tools and Accessories	55,300	432	0.38	-718
Hand Tools	7,586	10	0.06	-148
MUSIC & SOUND RECORDING	22,957	134	0.28	-343
NONMETAL MINING	80,455	1,490	0.89	-183
OIL & GAS PRODUCTION & TRANSPORT	695,109	702	0.05	-13,752
Support Activities for Oil and Gas Operations	299,011	183	0.03	-6,034
Oil and Gas Extraction	131,789	70	0.03	-2,670
Drilling Wells	95,947	144	0.07	-1,851
Petroleum Processing	63,640	0	0.00	-4,401
Oil and Gas Machinery	52,701	10	0.01	-1,086
Pipeline Transportation	52,021	295	0.27	-787
PAPER & PACKAGING	354,735	2,335	0.32	-5,041
Packaging	191,586	1,092	0.27	-2,892
Paper Mills	107,309	143	0.06	-2,088
Paper Products	55,840	1,100	0.95	-61
PERFORMING ARTS	327,427	5,629	0.83	-1,179
Promoters and Managers	166,627	2,917	0.84	-548
Performing Artists	160,800	2,712	0.81	-632
PLASTICS	657,703	5,925	0.43	-7,751
Plastic Products	490,126	4,500	0.44	-5,691
Plastic Materials and Resins	167,577	1,425	0.41	-2,059
PRINTING SERVICES	488,962	5,214	0.51	-4,953
Printing Services	434,819	4,453	0.49	-4,588
Support Activities for Printing	27,684	691	1.20	115
Greeting Card Printing and Publishing	15,113	10	0.03	-304
Printing Inputs	11,346	60	0.25	-176
PRODUCTION TECH & HEAVY MACHINERY	969,760	7,650	0.38	-12,515
Agricultural and Construction Machinery	295,393	2,209	0.36	-3,933
Process Equipment and Components	254,187	2,765	0.52	-2,520
Industrial Machinery	153,481	867	0.27	-2,324
Air Handling Equipment	129,839	880	0.33	-1,820
Moving and Material Handling Equipment	81,289	326	0.19	-1,364
Commercial and Service Industry Machinery	55,571	603	0.52	-553

(continued)

	Employment in 2013		Arizona	Excess Employ- ment
	United States	Arizona	Location Quotient	
RECREATIONAL & SMALL ELECTRIC GOODS	154,234	2,862	0.89	-345
Recreational and Decorative Goods	79,600	1,048	0.63	-607
Sporting and Athletic Goods	37,405	1,602	2.06	824
Motorcycles and Bicycles	10,860	65	0.29	-161
Office Supplies	10,653	41	0.19	-181
Electric Housewares	9,178	60	0.31	-131
Games, Toys, and Children's Vehicles	6,538	46	0.34	-90
TEXTILE MANUFACTURING	190,186	1,053	0.27	-2,902
Household Textile Products	53,318	193	0.17	-916
Fabric Mills	50,437	70	0.07	-979
Textile and Fabric Finishing	29,722	120	0.19	-498
Yarn and Thread Mills	24,674	375	0.73	-138
Fibers	14,046	60	0.21	-232
Knitting Mills	12,109	175	0.70	-77
Other Textile Products	5,880	60	0.49	-62
TOBACCO	14,355	10	0.03	-288
TRAILERS, MOTOR HOMES & APPLIANCES	117,925	796	0.32	-1,656
Trailers and Motor Homes	79,632	347	0.21	-1,309
Household Appliances	34,254	389	0.55	-323
Burial Caskets	4,039	60	0.71	-24
TRANSPORTATION & LOGISTICS	1,591,465	40,417	1.22	7,325
Trucking	634,178	12,512	0.95	-675
Air Transportation	558,960	21,774	1.87	10,151
Ground Transportation Support Activities	314,358	3,963	0.61	-2,574
Bus Transportation	49,825	1,699	1.64	663
Specialty Air Transportation	34,144	469	0.66	-241
UPSTREAM CHEMICAL PRODUCTS	174,713	685	0.19	-2,948
Organic Chemicals	106,803	505	0.23	-1,716
Inorganic Chemicals	39,233	60	0.07	-756
Agricultural Chemicals	16,269	60	0.18	-278
Industrial Gas	12,408	60	0.23	-198
UPSTREAM METAL MANUFACTURING	399,182	3,235	0.39	-5,065
Metal Processing	132,502	2,115	0.77	-640
Iron and Steel Mills and Forging	125,162	134	0.05	-2,469
Metal Products	88,338	605	0.33	-1,232
Wires and Springs	53,180	381	0.34	-725
VIDEO PRODUCTION & DISTRIBUTION	195,285	499	0.12	-3,562
VULCANIZED & FIRED MATERIALS	238,119	2,177	0.44	-2,774
Rubber Products	127,771	680	0.26	-1,977
Glass Products	70,793	1,093	0.74	-379
Clay Products and Refractories	39,555	404	0.49	-418
WATER TRANSPORTATION	300,419	280	0.04	-5,967
Marine Transportation Services	144,494	164	0.05	-2,841
Boat Building and Repairing	135,287	96	0.03	-2,717
Water Passenger Transportation	20,638	20	0.05	-409

(continued)

	Employment in 2013		Arizona	
	United States	Arizona	Location Quotient	Excess Employment
WOOD PRODUCTS	328,576	3,827	0.56	-3,005
Wood Components and Products	214,707	3,121	0.70	-1,343
Wood Processing	101,562	197	0.09	-1,915
Prefabricated Wood Building	12,307	509	1.99	253
<b>TOTAL OF LOCAL CLUSTERS</b>	<b>75,719,641</b>	<b>1,455,001</b>	<b>0.92</b>	<b>-119,466</b>
LOCAL COMMERCIAL SERVICES	8,319,195	154,586	0.89	-18,398
Local Professional Services	5,520,935	100,428	0.87	-14,371
Building Support Services	1,124,464	25,846	1.11	2,465
Security Services	853,928	15,067	0.85	-2,689
Miscellaneous Repair Services	274,812	3,711	0.65	-2,003
Laundry and Linen Services	252,688	4,916	0.94	-338
Testing Laboratories	125,608	1,880	0.72	-732
Stationery and Office Supply Retailing	86,477	1,614	0.90	-184
Commercial Photography, Printing & Signmaking	80,283	1,124	0.67	-545
LOCAL COMMUNITY & CIVIC ORGANIZATIONS	4,321,057	71,210	0.79	-18,639
Social Service Organizations	2,271,468	46,382	0.98	-850
Religious Organizations	1,685,205	21,557	0.62	-13,484
Labor Organizations	151,567	983	0.31	-2,169
Business Associations	111,103	1,167	0.51	-1,143
Trusts	91,807	1,071	0.56	-838
Political Organizations	9,907	50	0.24	-156
LOCAL EDUCATION & TRAINING	1,437,961	28,549	0.95	-1,351
Elementary and Secondary Schools	937,944	19,435	1.00	-68
Job Training Services	399,302	7,517	0.91	-786
Recreational and Other Services	100,715	1,597	0.76	-497
LOCAL ENTERTAINMENT & MEDIA	1,428,439	27,506	0.93	-2,196
Sporting and Hobby Retailing	373,557	7,593	0.98	-175
Electronic and Photographic Retailing	345,324	6,712	0.93	-468
Newspapers	218,736	3,349	0.74	-1,199
Electronic Media	217,787	3,271	0.72	-1,258
Movie Theatres	126,178	3,919	1.49	1,295
Book and Periodical Retailing	93,277	1,810	0.93	-130
Musical Instruments Retailing	28,521	477	0.80	-116
Video Rental	25,059	375	0.72	-146
LOCAL FINANCIAL SERVICES	3,001,990	64,502	1.03	2,080
Deposit-taking Institutions	1,874,364	41,018	1.05	2,044
Insurance Agents and Brokers	656,079	9,787	0.72	-3,855
Tax Return Preparation Services	187,007	4,034	1.04	145
Pension, Health, and Welfare Funds	156,390	5,722	1.76	2,470
Collection Agencies	128,150	3,941	1.48	1,276

(continued)

	Employment in 2013		Arizona	
	United States	Arizona	Location Quotient	Excess Employment
LOCAL FOOD & BEV PROCESSING & DISTRIB	4,022,208	71,932	0.86	-11,703
Retail Food Stores	2,796,921	51,508	0.89	-6,649
Food Wholesaling	604,486	10,176	0.81	-2,393
Commercial and Retail Bakeries	173,519	2,341	0.65	-1,267
Beer, Wine, and Liquor Retailing	157,172	1,217	0.37	-2,051
Vending and Direct Selling	147,281	3,274	1.07	212
Beer and Liquor Wholesaling	108,400	2,582	1.15	328
Tobacco Retailing	34,429	834	1.16	118
LOCAL HEALTH SERVICES	16,572,058	287,904	0.84	-56,685
Hospitals	5,814,098	104,492	0.86	-16,403
Healthcare Provider Offices	4,878,065	96,402	0.95	-5,029
Home and Residential Care	4,632,713	64,447	0.67	-31,883
Drug Stores	699,975	10,325	0.71	-4,230
Medical Laboratories	293,895	6,579	1.08	468
Funeral Service and Crematories	135,705	1,521	0.54	-1,301
Optical Goods Retailing	82,480	2,184	1.27	469
Medical Equipment Distribution and Rental	35,127	1,954	2.68	1,224
LOCAL HOSPITALITY ESTABLISHMENTS	11,652,210	241,459	1.00	-830
Hospitality Establishments	10,422,861	214,960	0.99	-1,767
Recreational Facilities and Instruction	1,072,749	23,506	1.05	1,200
Gifts and Souvenirs Retailing	156,600	2,993	0.92	-263
LOCAL HOUSEHOLD GOODS & SERVICES	1,539,700	32,913	1.03	897
Landscape and Horticultural Services	547,533	15,093	1.33	3,708
Furniture and Homefurnishings Retailing	477,932	9,823	0.99	-115
Gardening Products and Supplies Retailing	207,521	2,587	0.60	-1,728
Hardware Retailing	133,056	2,774	1.00	7
Hardware Wholesaling	84,120	1,334	0.76	-415
Appliance Retailing	63,132	1,032	0.79	-281
Electronics Repair	26,406	270	0.49	-279
LOCAL INDUSTRIAL PRODUCTS & SERVICES	535,302	9,584	0.86	-1,547
Industrial Machinery and Distribution	248,297	3,873	0.75	-1,290
Industrial Products and Services Wholesaling	197,209	3,772	0.92	-329
Miscellaneous Equipment Rental and Leasing	51,882	1,114	1.03	35
Industrial Repair Services	37,914	825	1.05	37
LOCAL LOGISTICAL SERVICES	2,167,270	36,919	0.82	-8,146
Local Transportation Services	1,432,329	21,845	0.73	-7,938
Local Passenger Transportation	499,493	10,495	1.01	109
Passenger Car Rental	150,716	1,750	0.56	-1,384
Truck Leasing	46,337	1,750	1.82	786
Warehousing Services	38,395	1,079	1.35	281

(continued)

	Employment in 2013		Arizona	
	United States	Arizona	Location Quotient	Excess Employment
LOCAL MOTOR VEHICLE PRODUCTS & SERV	4,041,435	82,785	0.99	-1,250
Automobile Dealers	1,141,224	24,549	1.03	819
Gasoline Stations	884,128	17,296	0.94	-1,088
Automotive Repair Shops	607,360	12,739	1.01	110
Automotive Parts Retailing	494,393	10,277	1.00	-3
Other Automotive Services	272,613	6,806	1.20	1,137
Automotive Parts Wholesaling	254,776	3,662	0.69	-1,636
Other Motor Vehicles Distribution	138,488	3,733	1.30	853
Parking Services	130,344	1,978	0.73	-732
Automotive Wholesaling	118,109	1,745	0.71	-711
LOCAL PERSONAL SERVICES (NONMEDICAL)	2,530,601	44,671	0.85	-7,949
Child Care Services	862,043	11,559	0.64	-6,366
Other Personal Services	625,784	12,860	0.99	-152
Hair Care Services	537,868	9,824	0.88	-1,360
Personal Products Retailing	372,534	8,737	1.13	991
Photographic and Photofinishing Services	60,298	709	0.57	-545
Cleaning Services	39,787	464	0.56	-363
Repair Services	32,287	518	0.77	-153
LOCAL REAL ESTATE, CONSTRUCT & DEVEL	8,022,214	178,057	1.07	11,248
Specialty Contractors	3,628,945	84,030	1.11	8,572
Real Estate Services	1,517,453	32,189	1.02	636
General Contractors	1,042,612	20,362	0.94	-1,317
Construction Materials Retailing	958,369	21,423	1.08	1,495
Highway and Street Construction	250,457	5,872	1.13	664
Construction Materials Wholesaling	194,583	3,874	0.96	-172
Water and Sewer Line Construction	148,640	4,326	1.40	1,235
Building Equipment Distribution	143,762	2,949	0.99	-40
Concrete Products	114,006	2,122	0.90	-249
Developers	23,387	910	1.87	424
LOCAL RETAIL OF CLOTHING & GENL MERCH	4,739,875	99,326	1.01	768
General Merchandise Retailing	2,986,525	66,332	1.07	4,232
Apparel Retailing	1,578,036	29,617	0.90	-3,196
Jewelry Retailing	126,305	2,352	0.90	-274
Sewing, Needlework, and Piece Goods Retailing	43,209	965	1.07	67
Luggage Retailing	5,800	60	0.50	-61
LOCAL UTILITIES	1,388,126	23,098	0.80	-5,766
Communications Services	772,805	11,455	0.71	-4,614
Electric Power Distribution	363,345	7,500	0.99	-55
Sanitary Services	96,607	1,752	0.87	-257
Natural Gas Distribution	84,165	1,750	1.00	0
Heating Oil and Other Fuel Dealers	71,204	641	0.43	-840

Source: Institute for Strategy and Competitiveness, Harvard Business School (employment). The location quotient and excess employment were calculated using per capita employment. The population estimate for the nation came from the U.S. Department of Commerce, Census Bureau. The population estimate for Arizona came from the Arizona Department of Administration, Office of Employment and Population Statistics. Use of the Census Bureau's population estimate for Arizona would lower the location quotients.

# THE PRODUCTIVITY AND PROSPERITY PROJECT

The Productivity and Prosperity Project: An Analysis of Economic Competitiveness (P3) is an ongoing initiative begun in 2005, sponsored by Arizona State University President Michael M. Crow. P3 analyses incorporate literature reviews, existing empirical evidence, and economic and econometric analyses.

Enhancing productivity is the primary means of attaining economic prosperity. Productive individuals and businesses are the most competitive and prosperous. Competitive regions attract and retain these productive workers and businesses, resulting in strong economic growth and high standards of living. An overarching objective of P3's work is to examine competitiveness from the perspective of an individual, a business, a region, and a country.

## THE CENTER FOR COMPETITIVENESS AND PROSPERITY RESEARCH

The Center for Competitiveness and Prosperity Research is a research unit of the L. William Seidman Research Institute in the W. P. Carey School of Business, specializing in applied economic and demographic research with a geographic emphasis on Arizona and the metropolitan Phoenix area. The Center conducts research projects under sponsorship of private businesses, nonprofit organizations, government entities and other ASU units. In particular, the Center administers both the Productivity and Prosperity Project, and the Office of the University Economist.

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