UNIVERSITY OF ARIZONA RESEARCH EXPENDITURES: Generating Jobs, Wages and Tax Revenues in the Local Economy

An Economic and Tax Revenue Analysis for FY 2002

Tucson, Arizona
February 18, 2003
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IN THE LOCAL ECONOMY
An Economic and Tax Revenue Analysis
for FY 2002

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ACKNOWLEDGEMENTS

This study could not have been completed without the assistance of many individuals across the University of Arizona campus. First of all, we are indebted to the following individuals who provided the basic data without which this study would be impossible:

**Johanna Valdez**, Computing Manager, Office of Financial Services, for numerous runs to extract research-expenditures by category and location;

**Janet Hornung**, Director, Sponsored Project Services, for a breakdown of federal overhead expenses;

**John Wilson**, Director, Decisions and Planning Support, for data on wages and salaries by various employee and student categories;

**Rick Franco**, Program Coordinator in Procurement and Contracting Services, for his assistance in determining whether University expenditures occurred in Pima County, elsewhere in Arizona or out of state; and


There also are individuals who assisted in various ways by directing our requests to the data experts or by providing additional information used in the study. Among those are:

**Linda Charlip**, Director of Human Resources Research and Analysis and **Alice C. Langen**, Director of Research Standards and Compliance in the Office of the Vice President for Research and Graduate Studies.

We also thank the administrative and support staff in the Office of Economic Development for their assistance in the final production of this report.

And lastly, we thank the Office of the Vice President for Research and the Office of Economic Development for the opportunity to work on this challenging project.

Dr. Alberta H. Charney
Dr. Vera Pavlakovich-Kochi
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EXECUTIVE SUMMARY

The University attracted more than $285.1 million in research funding.

Funding for research comprises the largest portion of all grants, contracts and gifts to the University of Arizona. Of a total of $373.9 million in grants and awards that the University received in FY 2002, $285.1 million or 76.2 percent was for research.

The scope of this study is limited to University research-related expenditures.

Research expenditures are the most tangible sources of economic impacts of University research activity on the local economy, although it is just one of many ways in which University research affects the local economy.

University research awards and grants supported more than 3,400 direct jobs at the University.

Research-related expenditures generated an estimated 3,465 jobs at the University during FY 2002. These jobs included about 2,520 faculty, administrators, academic professionals and supporting staff positions directly involved in research activity. The administration of research projects and various research-supporting activities generated an additional 945 FTE positions within the University, of which about 90 FTE-equivalent positions were temporary jobs. This means that the actual number of people supported by research dollars was considerably larger given the fact that many positions are part-time positions.

University research awards and grants supported more than 1,400 student positions.

Research activity directly supported an estimated 1,435 FTE-equivalent student positions. Because these student positions were expressed as FTE-equivalent positions (i.e., assuming 2080 hours employed per year), the actual number of students directly involved in research or in support of research activity was more than double that figure. The majority of these research positions were filled with graduate students.

University faculty, staff and student spending generated close to 2,500 jobs in Pima County.

The aggregate payroll for all University research-related employees (including students and other University jobs created by research activity) was $170.3 million. The majority of these wages and salaries circulated back into the local economy through purchases of local goods and services.
The total job impact of University research-related employee spending (including student spending) was 2,485 additional local jobs.

**University faculty, staff and student spending generated an additional $36.5 million in wages and $110.3 million in sales in Pima County.**

Including the ripple effects, spending by University research-related faculty, staff and students generated $36.5 million in wages and a total sales volume of $110.3 million in Pima County.

**University research-related purchases and operating expenditures created an additional 1,500 jobs in Pima County.**

The University spent $51 million on research-related purchases of goods and services in Pima County. The University purchased local goods and services such as computer components and other high-tech equipment, professional and maintenance services, printing and photographic services and operating supplies. Including the ripple effect, these expenditures generated an additional 1,530 jobs in the local economy.

**University research-related purchases and operating expenditures created an additional $27.2 million in wages and $75.4 million in sales in Pima County.**

Including the ripple effects, University research-related purchases of goods and services generated an additional $27.2 million in wages and total sales of $75.4 million in Pima County.

**More than 600 jobs generated elsewhere in Arizona.**

Approximately $15.8 million of University of Arizona research expenditures were spent in Arizona outside of Pima County either through a direct allocation to non-Pima County departments and outreach offices, or through purchases that the main campus of the University made elsewhere in the state. The economic impact generated by these combined expenditures was an additional 624 jobs in Arizona outside of Pima County.

**More than $12 million in wages and $28.7 million in sales generated elsewhere in Arizona.**

University of Arizona research-related expenditures generated $12.4 million in wages and $28.7 million in sales in Arizona outside of Pima County.

**University research generated more than $20 million in tax revenues to state and local governments.**

University of Arizona research activity contributed substantial tax revenues to the city, county and state governments. The City of Tucson received an estimated $2.6 million; Pima County received an estimated $2.8 million; other Arizona counties received $0.4 million. An additional $1.4 million was collected by other Arizona cities and counties. The State of Arizona collected an estimated $12.9 million.

The total tax revenue impact was $20.1 million. (Note: tax revenues are a part of total estimated sales, and therefore must not be added to the overall impact).
Total economic and tax revenue impacts in Pima County

- 8,915 jobs
- $234.0 million in wages
- $2.6 million in tax revenues to the City of Tucson
- $2.8 million in tax revenues to Pima County
- $11.8 million in tax revenues to the State of Arizona
- $356.1 million in sales (including wages and tax revenues)

Additional impacts outside Pima County (in Arizona)

- 624 jobs
- $12.4 million in wages
- $1.4 million in tax revenues to cities and towns
- $0.4 million in tax revenues to counties
- $1.1 million in tax revenues to the State of Arizona
- $28.7 million in sales (including wages and tax revenues)

STATE-WIDE IMPACTS
(Pima County and the rest of Arizona)

- 9,539 jobs
- $246.4 million in wages
- $20.1 million in tax revenues to state and local governments
- $384.6 million in sales (including wages and tax revenues)
INTRODUCTION

Universities are recognized not only as centers of learning, research and innovation, but also as important engines in regional economic development. Universities are often major employers in local economies; they support numerous local vendors through purchases of goods and services for their daily operations and create additional jobs in various sectors of the local economy through employee and student spending. They also attract numerous visitors and thus contribute to the local tourism industry. Universities produce highly skilled, highly educated human resources and nurture innovation and technological change, all of which are important as regions and localities compete for investment and high wage jobs in a globalized economy. As centers of innovation, universities attract funding for research and development, and thus inject new money into local economies. Transfer of technology from university labs to the private sector and creation of new firms are additional aspects that are gaining attention among regional economic developers.

While the wide range of local economic impacts that emanate from universities are becoming better appreciated, there is no single comprehensive method for quantifying all of the components of those economic and revenue impacts. And yet, there is a growing need to quantify universities’ local economic roles, which are often reduced to simple measures of new jobs, wages and tax revenues. This trend in part reflects an increasing public scrutiny of and demand for assessment of “return” on investment in higher education. It also reflects a growing need on the part of universities to better understand their changing roles in the economy at large and their ability to attract additional funding as state support for higher education continues to tighten.

In 1999 an economic and revenue impact analysis of the University of Arizona\(^1\) was conducted in which four ongoing sources of impacts on the local economy were examined. These were (a) University expenditures for equipment, office supplies, communications, utilities, repair and maintenance, and other goods and services needed to run the organization, (b) spending by University employees, (c) student spending, and (d) visitor spending. In addition, the impacts of construction activity for FY 1998 were analyzed. The study estimated that the University contributed 40,911 jobs, representing over 11 percent of total employment in Pima County. The combined wage impact of all University employee spending, student spending and visitor spending associated

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with the University accounted for $865 million in Pima County wages. The University contributed close to $96 million in tax revenues to state, county and city governments. The combined dollar impact in Pima County was over $1.86 billion for FY 1998. Taking into account the spillovers to other counties in Arizona, the total dollar impact was more than $1.9 billion and more than 42,500 jobs statewide.

One of the findings of the 1999 study was that a significant portion of the impact on the Pima County economy did not originate from either state appropriated funding or student tuition payments. Instead, a large portion of the impacts resulted from contracts, grants and gifts, and student and visitor spending. The study estimated that for every $1 received from state appropriated funding, the University generated $6.31 in sales. Furthermore, it was estimated that one new job was created for every $7,470 the University received in state appropriated funding. These high returns on state appropriated funding were possible in large part through the University’s ability to attract additional monies that were injected into the Pima County economy by grants, contracts and gifts. The revenues to the University from federal grants and contacts, private gifts and non-federal grants and contracts amounted to $335.7 million, which represented about 38 percent of total University revenues in FY 1998.

Funding for research comprises the largest portion of all grants, contracts and gifts. According to the most recent data, out of a total of $373.9 million in grants and awards the University received in FY 2002, $285.1 million was for research.\(^2\) This represents 76.2 percent of all grants and awards combined.

A recently conducted study\(^3\) explored the relationship between university research and development (R&D) activity and the local rate of new firm formation and economic growth across Labor Market Areas (LMAs) in the United States. The authors of that study concluded that university R&D expenditures were significantly related to new firm formation in the same LMA. Furthermore, they found that university R&D spending also was associated with localities with higher levels of human capital, which also contributed substantially toward generating new firms. The study concluded that research universities and investment in R&D at those universities were major factors contributing to economic growth in the labor market areas in which the universities were situated.

**SCOPE OF THIS STUDY**

Research expenditures are the most tangible sources of economic impacts of university research activity on the local economy, although it is just one of many venues in which university research affects the local economy. Another important aspect, which is difficult to measure, is the transfer of technology from university labs to the private sector, both in terms of start-up companies and

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well-established companies. Collection of basic data takes time to identify spin-offs and requires a close collaboration with individual companies. For now, these sources of University impacts on the Pima County economy remain outside the realm of our analysis.

Instead, the scope of this study is limited to measurement of the impacts of the University’s research expenditures in terms of number of jobs, wages, tax revenues and total dollar impact (sales) that these expenditures generate in Pima County. Using additional information, the study also estimates impacts that spill out of Pima County into the rest of the state.

Because research funding is just one part of all University revenues, the results of this analysis need to be understood as a part of the overall University impact on the economy of Pima County; they should not be added to the existing impacts of the University as reported in the 1999 study. However, because different fiscal years are used, neither can they be directly subtracted from the overall 1999 estimates. Also note that research-related visitors impacts, which constitute an important source of additional jobs and wages in the local economy, are not considered in this study because of the lack of data. Aside from these limitations, the results of this study provide reasonable measures of the significance of research expenditures in the University’s total economic and tax revenue impacts.

This study is designed as a first step in a more comprehensive measurement of the University’s research activity that involves transfer of technology and new firm creation in the local economy. Thus, the results of this study represent only a fraction of a much larger sum of economic and tax revenue impacts associated with the University’s research activity.

DATA AND METHODOLOGY

Data

A distinction needs to be made between (a) data reporting total research dollars awarded to the University and (b) actual expenditure data associated with research activity. The first type pertains to all research funding that is awarded to researchers through the grant writing process in a given year. What is actually spent on research activity during the same year will not be the same amount, for various reasons. The primary reason for the difference is that research grants are frequently awarded for more than one year, thus any given year’s research expenditures include money awarded in previous years and the current year. Similarly, this year’s awards include money that will be expended in future years. For example, according to the Office of the Vice President for Research,4 the University received $289.6 million in research awards in FY 2001, while expenditures on active projects in the same fiscal year were $281.2 million. While the first data set is used to compare the University with other institutions, the second data set is more appropriate for the analysis of impacts on the local economy.

4 Source: http://vpr2.admin.arizona.edu/orca/Profile/Profile2001, on September 10, 2002.
The Office of the Vice President for Research provides data on expenditures on sponsored projects accounts by college and division, as well as by major expenditure category (personal services, operations, travel, student support, capital investment and indirect charges). In addition, salary and wage expenditures are broken down by employee category (faculty, classified staff, hourly staff, ancillary staff, graduate students and hourly students). This information is available on the Internet (see footnote 4). At the time this study was initiated, the most current data for FY 2002 were not yet posted on the Internet. A copy of the preliminary report was obtained directly from the Office of Research and Contract Analysis.

The Office of Financial Services generated detailed data, by expenditure category, for this study. It was necessary to identify which accounts comprised “research” in order to pull out only expenditures associated with research activity. In consultation with a senior staff member of the Office of Financial Services, it was decided to use the so-called WICHE code 20, assigned to accounts set up to record expenditures for organized research. In order to assess the economic impact of research dollars, it is necessary to know what types of goods and services are purchased using those dollars. Thus the Office of Financial Services searched their databases for WICHE code 20 “research” accounts and sorted them by University-designed 4-digit “object codes,” which identify each expenditure, by type. University research dollars were expended in more than 150 different object codes, including wages and salaries, and expenditure categories ranging from scientific equipment, audio-visual services, mailing expenses to miscellaneous business and professional services.

The University of Arizona has operations throughout the state, primarily through the Cooperative Extension Offices of the College of Agriculture. To separate research expenditures in Pima County from expenditures elsewhere in the state, the Office of Financial Services separately searched for WICHE code 20 accounts in all non-Pima County departments and sorted them by object codes.

The object code for “indirect charges” represents research funds collected by the University to cover the costs associated with supporting research activity on campus. Because this object code represented a substantial amount of money and was very non-specific as to type of expenditure, the University’s Office of Sponsored Projects Services provided a further breakdown of indirect charges, e.g., administrative costs, maintenance, building and interest, equipment, library and student services.

For this analysis, each of the 150 plus object codes (and the breakdown of indirect charges) also were assigned a code corresponding to the industry sectors in the Pima County Input-Output (I-O) Model. University of Arizona research expenditures directly affect 26 different industry sectors. In addition to assigning I-O industry codes to each expenditure line, the values in each expenditure line were distributed in three groups to reflect purchases in Pima County, the rest of Arizona.

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1 Western Interstate Commission for Higher Education.
or out-of-state. In some cases, this determination was made by assumption and logic. Wages and salaries were assumed to be spent locally. Out-of-state travel was allocated to out-of-state, except for a small portion for some local ticket purchases. For other categories, the computer runs generated by the University’s Purchasing Office for the 1999 study were used. Based on zip codes of billing addresses, University expenditures were allocated by object code to Pima County, elsewhere in Arizona or out-of-state. This resulted in the following breakdown: 71.1 percent of direct expenditures spent in Pima County, 4.8 percent in Arizona outside of Pima County and the remaining 24.1 percent out of the state.

Thus, the preparation of data for this study involved the following: first, each expenditure category was allocated among Pima County, the rest of Arizona and out-of-state. Then the Pima County portion was entered into the appropriate I-O industrial sector for Pima County impact analysis. Statewide impacts also were computed for the research dollars that either (a) came to the main campus but were spent elsewhere in the state, (b) were directly associated with non-Pima County University departments such as certain Cooperative Extension Offices, or (c) went to non-Pima County departments but were spent somewhere else in the state, rather than at their local sites. Research dollars that leaked out of the state when purchases were made out-of-state were excluded from the analysis together with direct leakages, e.g., federal taxes and social security contributions.

Each expenditure category also was examined to determine if it represented a taxable item under the state sales or fuel tax statutes and then coded whether it was (1) retail sales and use tax, (2) utilities, (3) contracting, (4) equipment rentals, (5) communications, (6) restaurants, (7) printing, (8) hotels or motels or (9) gasoline. These designations were used determine direct tax revenues paid by the University.

### Estimates of University of Arizona research-related employees and students

Unlike the overall impact study of the University, where the number of employees and students was easily obtainable from University records, it was difficult to obtain a clear-cut number of faculty who were supported exclusively by research. It was even more complicated in cases of administrative and support personnel who draw only a portion of their wages and salaries from research projects. Therefore, the number of direct University employees was estimated from additional data specifically generated for this study by the Office of Decision and Planning Support. First, employee categories (clinical faculty, regular faculty, administrative and professional, classified staff and temporary employees) were identified in the “WICHE 20” expenditure files. For these categories, the Office of Decision and Planning Support created several files showing payroll data, by most frequently used employee category, which were matched with the “WICHE 20” categories. A number of assumptions were made to convert non-FTE (full-time-employee) positions to FTE-equivalent positions. These estimates are shown in Tables 4 and 5 as “UA employees (direct jobs).”
Similarly, the number of graduate and other students supported by research dollars was not readily available. The “WICHE 20” files provided only the total amount spent on each student category. Using the Office of Decision and Planning Support data in combination with the average estimated cost of a graduate assistantship, the FTE-equivalent number of graduate students were estimated. Thus, although a larger number of students were involved in research projects during a year, the estimates basically referred to an annualized number of FTE-equivalent positions. For example, students are generally allowed to work up to 20 hours per week, which makes 0.5 FTE (or 1040 hours a year). Thus, two 0.5 FTE student positions (possibly occupied by two different persons) were annualized as one FTE-equivalent position.

In addition, a number of jobs were estimated from “indirect charges” that, as mentioned earlier, covered the costs associated with supporting research activity on campus. These estimates are shown in Tables 4 and 5 as “other UA jobs related to research.”

**Sources of economic impacts**

In a strict economic interpretation, impact is generated only through new money injected into a local (regional) economy. For example, when a firm exports its products, *i.e.*, sells its products to consumers outside the region, the company brings new money into the local economy. Similarly, tourism generates new money as visitors spend their incomes in the region. By analogy, research money that a university receives in the form of grants, awards and gifts is considered new money. Most of it comes from agencies outside the state, *e.g.* National Science Foundation, National Health Institute and NASA. Research funding from within the state is also new money under the assumption that, if it were not for the University, it would have leaked out of the region through investments made elsewhere.

Out of the total research money received, a certain portion leaks out of the local economy through direct purchases of goods and services from establishments located outside the region. Each expenditure category was examined and only the locally spent portion was entered into the impact analysis.

In addition to direct jobs (including student positions) at the University that are directly supported by research dollars, economic impacts of University research activity in the local economy are generated from two main sources. First are impacts generated through spending by University research-related employees and students. The second source of impacts is associated with the University research-related expenditures on goods and services.

**Models**

Two basic models that were applied in the 1999 study of economic and tax revenue impacts of the University as a whole were used in this study. Economic impacts -- number of jobs, wages and total sales (total dollar impact) -- generated by the University’s research expenditures in Pima
County were estimated by means of the Pima County Input-Output Model. Tax revenues collected by city, county and state governments were estimated by means of the Revenue Models built for various counties in Arizona. Each model estimated revenues for the major city(ies) in that county, the county-level government, and the state of Arizona.

**UNIVERSITY RESEARCH GRANTS AND AWARDS (REVENUES)**

In FY 2002, the University received $373.9 million in grants and awards. Out of that total, $285.1 million was earmarked for research activity. Table 1 shows total awards and research awards and grants by colleges and divisions. Figure 1 shows only distribution of research awards and grants. The College of Science and the College of Medicine were the two top recipients of research awards and grants with over $79 million each, followed by Agriculture with $34.3 million and Engineering and Mines with $27.2 million. Optical Sciences received close to $9.9 million, followed by Business and Public Administration with $6.3 million, and Nursing with $3.2 million. Other colleges and divisions, including Arizona Research Labs, Public Health, Arizona State Museum, Education and Architecture, received close to $20.0 million in research awards and grants.

**TABLE 1**

<table>
<thead>
<tr>
<th>Total and Research Awards/Grants Received by Colleges and Divisions, FY 2002</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research $</td>
</tr>
<tr>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>Science</td>
</tr>
<tr>
<td>Medicine</td>
</tr>
<tr>
<td>Agriculture</td>
</tr>
<tr>
<td>Engineering &amp; Mines</td>
</tr>
<tr>
<td>Pharmacy</td>
</tr>
<tr>
<td>Social &amp; Behavioral Sciences</td>
</tr>
<tr>
<td>Optical Sciences</td>
</tr>
<tr>
<td>Business &amp; Public Admin</td>
</tr>
<tr>
<td>Nursing</td>
</tr>
<tr>
<td>Other Academic &amp; Administrative</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
</tr>
</tbody>
</table>

Note: Other Academic & Administrative includes the Arizona Research Labs, Public Health, Arizona State Museum, the College of Education, College of Architecture and others.

Figure 1

**Research awards and grants by colleges and divisions, FY 2002**

($ in millions)


**U**iversity research-related expenditures can be addressed from two perspectives. First, as shown in Table 2 and Figure 2, expenditures can be analyzed by the use of the funds.

**Table 2**

**University research expenditures by major funding uses, FY 2002**

<table>
<thead>
<tr>
<th></th>
<th>$</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personal Services</td>
<td>154,171,364</td>
<td>51.5</td>
</tr>
<tr>
<td>Operations</td>
<td>52,422,119</td>
<td>17.5</td>
</tr>
<tr>
<td>Travel</td>
<td>6,837,788</td>
<td>2.3</td>
</tr>
<tr>
<td>Student Support</td>
<td>7,612,093</td>
<td>2.5</td>
</tr>
<tr>
<td>Capital</td>
<td>15,263,617</td>
<td>5.1</td>
</tr>
<tr>
<td>Indirect Costs</td>
<td>63,282,442</td>
<td>21.1</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>299,589,423</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

*Note: The amount for Personal Services includes $21,068,871 in Employee Benefits.*

*Source: Profile 2002, UA Office of Research and Contract Analysis (based on Sponsored Projects accounts).*
The major expenditure category was personal services such as wages and salaries for faculty, project administration and supporting staff, accounting for 51.5 percent. Operations were the second major expenditure category (17.5 percent), followed by capital expenditures (mostly equipment), student support and travel. About 21.1 percent was for the indirect costs, i.e., reimbursement to the University for use of buildings, utilities and communications, and administrative support.

This study required greater detail on how and where University research dollars were spent. For this perspective on expenditures, two alternatives were considered: WICHE code 20 research accounts and sponsored projects expenditures. WICHE code 20 research accounts include all research, but also a relatively small amount of state funds (less than 10 percent). This shortcoming, however, was considered less significant in comparison with sponsored projects expenditures, which include gifts and non-research contracts.

WICHE code 20 research accounts were sorted and broken down into detailed spending categories. University research expenditures by major spending category and location of purchases (excluding out-of-state purchases) are shown in Table 3. The University spent approximately $325.6 million in Pima County and an additional $6.3 in other counties in Arizona. Thus, total research-related expenditures in FY 2002 amounted to $331.9 million.
### TABLE 3

<table>
<thead>
<tr>
<th></th>
<th>Pima County $</th>
<th>Rest of Arizona $</th>
<th>Total $</th>
</tr>
</thead>
<tbody>
<tr>
<td>Employee Wages and Salaries</td>
<td>124,300,796</td>
<td>3,147,445</td>
<td>127,448,241</td>
</tr>
<tr>
<td>Employee Related Expenses</td>
<td>23,930,709</td>
<td>608,146</td>
<td>24,538,855</td>
</tr>
<tr>
<td>Graduate Student Assist. &amp; Wages</td>
<td>21,957,241</td>
<td>45,036</td>
<td>22,002,277</td>
</tr>
<tr>
<td>Capital</td>
<td>21,546,294</td>
<td>230,554</td>
<td>21,776,848</td>
</tr>
<tr>
<td>Utilities</td>
<td>1,061,303</td>
<td>469,957</td>
<td>1,531,260</td>
</tr>
<tr>
<td>Communications</td>
<td>2,589,698</td>
<td>97,747</td>
<td>2,687,445</td>
</tr>
<tr>
<td>Operating Supplies</td>
<td>22,608,101</td>
<td>988,766</td>
<td>23,596,867</td>
</tr>
<tr>
<td>Repair &amp; Maintenance Services</td>
<td>2,182,982</td>
<td>123,300</td>
<td>2,306,282</td>
</tr>
<tr>
<td>Outside Professional Services</td>
<td>25,767,233</td>
<td>109,767</td>
<td>25,877,000</td>
</tr>
<tr>
<td>Printing, Photography &amp; Media</td>
<td>1,419,992</td>
<td>7,771</td>
<td>1,427,763</td>
</tr>
<tr>
<td>Other Miscellaneous Services</td>
<td>4,972,918</td>
<td>129,245</td>
<td>5,102,163</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>3,773,415</td>
<td>133,509</td>
<td>3,906,924</td>
</tr>
<tr>
<td>Licenses, Rentals &amp; Royalties</td>
<td>2,044,515</td>
<td>34,716</td>
<td>2,079,231</td>
</tr>
<tr>
<td>Travel</td>
<td>6,698,518</td>
<td>74,695</td>
<td>6,773,213</td>
</tr>
<tr>
<td>Indirect Costs</td>
<td>60,707,349</td>
<td>134,299</td>
<td>60,841,648</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>325,561,064</strong></td>
<td><strong>6,334,953</strong></td>
<td><strong>331,896,017</strong></td>
</tr>
</tbody>
</table>

Source: UA Office of Financial Services, WICHE object codes, unaudited data.

The major expenditure category was wages and salaries to faculty, administrative personnel and supporting staff, totaling $148.2 million in Pima County (including employee related expenses). In addition, close to $22 million was paid to students in the form of graduate assistantships and wages to students involved in research projects. The University spent about $21.5 million on equipment and other miscellaneous capital investment. Over $22.6 million was spent on various research-related supplies, the majority of which were purchased locally.

Research-related operations also create direct demand for various services in the community. For example, the University spent about $25.8 million on outside professional services, $2.2 million on repair and maintenance, about $1.4 million on printing, photo production and media, about
$6.7 million on travel and close to $5 million on various other services. More than $3.6 million was spent on utilities and communications.

**ECONOMIC IMPACTS**

The economic impacts of the University’s research-related activity are presented in five broad categories (Table 4). First, research grants and awards directly support a large number of faculty, administrative, professional and other staff positions at the University. Secondly, research-based scholarships support a large number of graduate and other students involved in research projects. Third, research-supported University operations generate additional direct jobs at the University, such as grant administration, facility maintenance and other services provided internally. These three categories are considered the direct impacts.

The fourth category includes impacts generated by University employees and students who spend their earnings in the local community, while the fifth category refers to the impact of University purchases of goods and services from local businesses, referred to as “external” purchases. The last two categories contain direct, indirect and induced impacts that occur outside the University in the local community. Table 4 provides estimates of economic impacts generated by these categories.

**Research-related direct University jobs in Pima County**

The research-related expenditures generated an estimated 2,520 direct University jobs. These jobs included faculty, administrators, academic professionals and supporting staff positions. These were FTE or FTE-equivalent positions, including an estimated 90 FTE-equivalent temporary jobs. This means that the actual number of people supported by research dollars was considerably larger given the fact that many positions were part-time positions.

The research activity directly supported an estimated 1,435 FTE-equivalent student positions. Because these student positions were expressed as FTE-equivalent positions (i.e., assuming 2080 hours a year), the actual number of students directly involved in research or in support of research activity was more than double that figure. The majority of these research positions were filled with graduate students, although research dollars also supported undergraduate students.

An additional 945 direct jobs within the University were related to a portion of “indirect charges” that cover the costs associated with supporting research activity on campus, from various research-supporting services to maintenance of labs and other University facilities.

Thus, in terms of FTE-equivalent positions, the research activity directly supported 4,900 jobs at the University.
University faculty, staff and student spending impact in Pima County

The aggregate payroll for all University employees (including students and other University jobs created by research activity) was $170.3 million. The majority of these wages and salaries circulated back into the local economy. This support of local industry and services created additional jobs and income in Pima County. The total impact of University research-related employee spending (including student spending) was 2,485 additional local jobs with $36.5 million in wages. Including all ripple effects, total sales volume in Pima County generated by University research faculty, staff and student spending was $110.3 million (Table 4).

University research-related purchases and operating expenditures impact in Pima County

University research expenditures benefit Pima County in a variety of ways. The University purchases local goods and services, including computer components and other high-tech equipment, professional and maintenance services, printing and photographic services and operating supplies. Based on information provided by the University purchasing department, the University spent $51 million on purchases of goods and services in Pima County. Dollars spent outside Pima County, but in Arizona, were estimated separately. They have no economic impact on Pima County, but add to the overall, statewide impact of the University of Arizona. Dollars spent out of state were assumed to have no economic impact on Arizona and therefore were excluded from the analysis.¹

As shown in Table 4, research-related purchases generated 1,530 jobs and $27.2 million in wages. The total sales impact (including wages) for this category was $75.4 million.

Total economic impact in Pima County

The total impact of University research expenditures on employment and wages in the Pima County economy is substantial. The employment impact of the University’s research expenditures in FY 2002 was over 8,900 jobs. As Table 4 reveals, this figure included employees directly employed by the University and also those jobs created by the University expenditures in the community. This total employment impact (University employees and all jobs created by University expenditures) represented over 2.5 percent of wage and salary employment⁷ in Pima County in FY 2002. While this percentage might look small at first glance, it is actually quite amazing, given the narrow definition used in this study. It means that 1 of every 40 jobs in all of Pima County was supported by University research dollars brought into the state by University faculty and professionals.

University research expenditures generated $234 million in wages in Pima County. Total sales (including wages) were $356 million.²

¹ i.e., excluding selfemployed.

² i.e., excluding selfemployed.
TABLE 4

ECONOMIC IMPACTS OF UNIVERSITY OF ARIZONA RESEARCH EXPENDITURES IN PIMA COUNTY, FY 2002
($ IN 1,000)

<table>
<thead>
<tr>
<th></th>
<th>Jobs</th>
<th>Wages</th>
<th>Sales</th>
</tr>
</thead>
<tbody>
<tr>
<td>UA Employees (Direct Jobs)*</td>
<td>2,520</td>
<td>124,301</td>
<td>124,301</td>
</tr>
<tr>
<td>UA Student Positions **</td>
<td>1,435</td>
<td>21,957</td>
<td>21,957</td>
</tr>
<tr>
<td>Other UA Jobs Research-Related</td>
<td>945</td>
<td>24,060</td>
<td>24,060</td>
</tr>
<tr>
<td>UA Personnel &amp; Student Spending</td>
<td>2,485</td>
<td>36,492</td>
<td>110,345</td>
</tr>
<tr>
<td>UA External Purchases</td>
<td>1,530</td>
<td>27,240</td>
<td>75,390</td>
</tr>
<tr>
<td><strong>TOTAL ECONOMIC IMPACT IN PIMA COUNTY</strong></td>
<td>8,915</td>
<td>234,050</td>
<td>356,053</td>
</tr>
</tbody>
</table>

* Includes temporary employees, converted to FTE equivalent jobs
** Converted to FTE equivalent positions

It is important to note that only a very small portion of this economic impact is due to state appropriated funding. Rather, these jobs and associated wages and sales are the result of the University’s ability to attract grants, awards and gifts from sources other than state taxpayer supported funding.

State-wide economic impacts

About $6.3 million of the University of Arizona research expenditures were spent directly (as reported in WICHE code 20 accounts) in Arizona outside Pima County. An analysis of expenditures for goods and services by location, suggested that an additional 9.5 million spilled out of Pima County as the main campus of the University made purchases elsewhere in the state. The economic impacts generated by these combined expenditures are summarized in Table 5. As shown in Table 5, the University research-related expenditures generated 624 jobs and $12.4 million in wages outside Pima County in other Arizona counties. Total sales were $28.6 million.
Table 5

**ECONOMIC IMPACTS OF UNIVERSITY OF ARIZONA RESEARCH EXPENDITURES IN THE REST OF ARIZONA, FY 2002**

($ in 1,000)

<table>
<thead>
<tr>
<th></th>
<th>Jobs</th>
<th>Wages $</th>
<th>Sales $</th>
</tr>
</thead>
<tbody>
<tr>
<td>UA Employees (Direct Jobs)*</td>
<td>106</td>
<td>3,074</td>
<td>3,074</td>
</tr>
<tr>
<td>UA Student Positions **</td>
<td>5</td>
<td>45</td>
<td>45</td>
</tr>
<tr>
<td>Other UA Jobs Created by Research Activity</td>
<td>2</td>
<td>65</td>
<td>65</td>
</tr>
<tr>
<td>UA Personnel &amp; Student Spending</td>
<td>48</td>
<td>698</td>
<td>2,112</td>
</tr>
<tr>
<td>UA External Purchases</td>
<td>463</td>
<td>8,499</td>
<td>23,259</td>
</tr>
<tr>
<td><strong>TOTAL ECONOMIC IMPACT IN THE REST OF ARIZONA</strong></td>
<td><strong>624</strong></td>
<td><strong>12,381</strong></td>
<td><strong>28,555</strong></td>
</tr>
</tbody>
</table>

* Includes temporary employees, converted to FTE equivalent jobs
** Converted to FTE equivalent positions


Table 6 shows the combined Pima County and non-Pima County economic impacts due to University research expenditures. The University research expenditures generated a total of 9,539 jobs of which 1,440 were student positions. The total wage impact was $246.4 million. Total sales impact in Arizona was $384.6 million.

Table 6

**TOTAL ECONOMIC IMPACTS OF UNIVERSITY OF ARIZONA RESEARCH EXPENDITURES, FY 2002**

($ in 1,000)

<table>
<thead>
<tr>
<th></th>
<th>Pima County</th>
<th>Rest of Arizona</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jobs</td>
<td>8,915</td>
<td>624</td>
<td>9,539</td>
</tr>
<tr>
<td>Wages ($)</td>
<td>234,053</td>
<td>12,381</td>
<td>246,431</td>
</tr>
<tr>
<td>Sales ($)</td>
<td>356,053</td>
<td>28,555</td>
<td>384,608</td>
</tr>
</tbody>
</table>

TAX REVENUE IMPACTS

In addition to generating economic impacts, in the form of jobs, output (sales) and wages, University of Arizona research expenditures also generate revenues to state and local governments. There are two types of revenue impacts estimated in this study.

Direct tax revenues

The first type refers to direct revenues, or taxes paid directly by the University to the government. The largest category of direct tax revenues collected by governments is state sales tax. The State retains the majority of this tax, but a portion is returned to counties and incorporated cities and towns (i.e., state-shared revenues). Use taxes are paid by the University on equipment and goods purchased out of state, but used within the state of Arizona. The State use-tax rate is set in accord with the state sales tax rate. Motor fuel taxes also are collected by the State, with a portion of state-shared revenues returned to counties and incorporated cities and towns.

Direct tax revenues are shown in Table 7. University of Arizona expenditures in Pima County generated over $1 million dollars for the state government and almost $100 thousand for the county government via state-shared revenues. Research dollars spent elsewhere in Arizona generated almost one-half million dollars, for a total tax revenue impact to the state government of over $1.5 million dollars.

<table>
<thead>
<tr>
<th></th>
<th>Pima County Government</th>
<th>State Government</th>
</tr>
</thead>
<tbody>
<tr>
<td>UA Expenditures in Pima County</td>
<td>95</td>
<td>1,068</td>
</tr>
<tr>
<td>UA Expenditures in Rest of State</td>
<td>481</td>
<td></td>
</tr>
<tr>
<td>TOTAL DIRECT REVENUES</td>
<td>95</td>
<td>1,549</td>
</tr>
</tbody>
</table>

Source: UA Eller College of Business and Public Administration, Economic and Business Research Program, Revenue Models.

Induced tax revenues

University of Arizona employees and students who are supported by University research dollars spend their earnings locally and generate substantial tax revenues to state and local governments. Tax revenues generated by the spending of University of Arizona employees and students are induced revenues. Induced tax revenues represent the major component of taxes paid by Arizo-
na’s residents. At the state level these include the individual income tax, sales tax, motor fuel tax and vehicle license tax. Counties receive a share of the state sales tax, motor fuel tax and vehicle license tax. In addition, the county imposes property tax. Cities receive a share of state income tax collections through the Urban Revenue Sharing Fund, as well as shares of state sales taxes, state motor fuel taxes and vehicle license tax. In addition, cities impose property taxes and city sales taxes. Revenues derived from each of these taxes are included in the estimates of “induced” tax revenues.

Induced revenues by source and level of government are shown in Table 8. The state government received over $7.8 million from University of Arizona employees who were paid directly from research dollars. Both Pima County and the City of Tucson each received approximately $1.9 million. When University personnel spend their money locally, they generate additional jobs and employees of these businesses also spend their earnings in the community. Including the ripple effect, University employee spending generated almost $1.7 million to the State of Arizona and over $400 thousand to both Pima County and the City of Tucson. Other cities and towns in Arizona also benefit from these tax revenues through state revenue sharing formulas. They received almost $200 thousand. In addition, the University made purchases in Pima County (external purchases), generating over $1.2 million in tax revenues to the State, over $300 thousand each to Pima County and the City of Tucson, about $147 thousand to other cities and towns in Arizona and $40 thousand to other Arizona counties. Research dollars paid as wages outside of Pima County generated $574 thousand in tax revenues to the State, $102 thousand to other cities and towns, and $74 thousand to other county governments in Arizona.

In total, induced revenues accruing to the State totaled approximately $11.3 million, with an additional $2.7 million to Pima County, $2.6 million to the City of Tucson, $419 thousand to other Arizona Counties (through revenue sharing formulas), and $1.3 million to other Arizona cities and towns. Induced tax revenues to state and local governments totaled $18.5 million.
TABLE 8
INDUCED TAX REVENUE IMPACTS OF UNIVERSITY OF ARIZONA RESEARCH EXPENDITURES, FY 2002
($ IN 1,000)

<table>
<thead>
<tr>
<th>Source of Impact</th>
<th>State of Arizona</th>
<th>Pima County</th>
<th>City of Tucson</th>
<th>Other AZ Counties</th>
<th>Other AZ Cities/Towns</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>In Pima County</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wages Of All UA Personnel</td>
<td>7,851</td>
<td>1,976</td>
<td>1,896</td>
<td>251</td>
<td>919</td>
<td>12,893</td>
</tr>
<tr>
<td>Wages Due To UA Personnel Spending</td>
<td>1,683</td>
<td>424</td>
<td>406</td>
<td>54</td>
<td>197</td>
<td>2,764</td>
</tr>
<tr>
<td>Wages Due To UA External Purchases</td>
<td>1,256</td>
<td>316</td>
<td>303</td>
<td>40</td>
<td>147</td>
<td>2,062</td>
</tr>
<tr>
<td>Total</td>
<td>10,790</td>
<td>2,716</td>
<td>2,605</td>
<td>345</td>
<td>1,263</td>
<td>17,719</td>
</tr>
<tr>
<td>Outside Pima County</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wages Related To UA Research</td>
<td>574</td>
<td>-</td>
<td>-</td>
<td>74</td>
<td>102</td>
<td>750</td>
</tr>
<tr>
<td>TOTAL REVENUE IMPACT (Pima and the rest of Arizona)</td>
<td>11,364</td>
<td>2,716</td>
<td>2,605</td>
<td>419</td>
<td>1,365</td>
<td>18,469</td>
</tr>
</tbody>
</table>

Source: UA Eller College of Business and Public Administration, Economic and Business Research Program, Revenue Models.

Total tax revenue impacts
Table 9 summarizes direct and induced tax revenue impacts. Direct tax revenues were estimated to be approximately $1.6 million and induced tax revenues approximately $18.5 million, resulting in a total tax revenue impact of $20.1 million. Of this $20.1 million, $12.9 million accrued to the state government.

TABLE 9
SUMMARY OF DIRECT AND INDUCED TAX REVENUE IMPACTS OF UNIVERSITY OF ARIZONA RESEARCH EXPENDITURES BY LEVEL OF GOVERNMENT, FY 2002
($ IN 1,000)

<table>
<thead>
<tr>
<th></th>
<th>Direct</th>
<th>Induced</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>State Government</td>
<td>1,549</td>
<td>11,364</td>
<td>12,912</td>
</tr>
<tr>
<td>Pima County Government</td>
<td>95</td>
<td>2,716</td>
<td>2,811</td>
</tr>
<tr>
<td>City of Tucson</td>
<td>2,605</td>
<td></td>
<td>2,605</td>
</tr>
<tr>
<td>Other Arizona Counties</td>
<td>419</td>
<td></td>
<td>419</td>
</tr>
<tr>
<td>Other Arizona Cities and Towns</td>
<td>1,365</td>
<td></td>
<td>1,365</td>
</tr>
<tr>
<td>TOTAL TAX REVENUE IMPACT</td>
<td>1,643</td>
<td>18,469</td>
<td>20,112</td>
</tr>
</tbody>
</table>

Source: UA Eller College of Business and Public Administration, Economic and Business Research Program, Revenue Models.
SUMMARY

This study estimated the economic and tax revenue impacts of the University of Arizona research-related expenditures in Pima County and the rest of Arizona in FY 2002. The University research activity supported 3,465 direct jobs, including faculty, administrative, professional and various supporting staff positions. In addition, research activity supported 1,435 FTE-equivalent student positions at the University. Another 108 direct jobs and 5 FTE-equivalent student positions were generated on the University of Arizona campuses outside Pima County.

Additional jobs were generated in the local economy through two major sources of economic and tax revenue impacts: spending by University research-related employees and students, and University purchases of goods and services related to research activity. These two sources generated an additional 4,015 jobs in Pima County and 511 jobs in Arizona outside Pima County. Thus, the total job impact, including direct jobs at the University and indirect and induced jobs in the local economy, was 8,915 in Pima County, or 2.5 percent of the County’s wage and salary employment in FY 2002. Additional 624 were created outside Pima County. Total state-wide job impact was 9,539.

The wage impact was $234.1 million in Pima County and $12.4 million outside Pima County. The total wage impact in Arizona was $246.4 million.

The sales impact (including wages) was $356.1 million in Pima County and $28.6 million outside Pima County. The total sales impact in Arizona was $384.6 million.

University of Arizona research activity contributed substantial tax revenues to the city, county and state governments. The City of Tucson received an estimated $2.6 million; Pima County received an estimated $2.8 million; other Arizona counties received $0.4 million. Other Arizona cities and counties collected an additional $1.4 million. The State of Arizona collected an estimated $12.9 million. Thus, the total tax revenue impact was $20.1 million. (Note: tax revenues are a part of total estimated sales, and therefore must not be added to the overall impact).

LIMITATIONS OF THE STUDY

This study has been limited to only two of the many ways in which University of Arizona research activity affects the local economy. One additional source that is obviously missing when assessing the overall impact of the University is the impact of visitors. Although intuitively we know that University research activity attracts a considerable number of visitors, there are no data that can provide a reasonable estimate of that impact.

Also, the impact of student spending is limited only to the dollars actually paid to students by the University from research dollars. This analysis excludes the spending of thousands of students who elect to come to the University of Arizona because of specific programs that have gained national standing. Typically, programs with national standing are those with active research programs.
As discussed earlier, this analysis excludes the economic impacts of technology transfer, spin-off firms and other new firm formations and economic growth that has been associated with University research activity.

APPENDIX

Definitions

Sales correspond to “output,” defined in the I-O model as the value of production, except for wholesale and retail trade. For the wholesale and retail sectors, output is the “margin” added to the goods being sold. Thus “sales” for these sectors equals output (margin) plus cost of goods sold. For construction sectors, output is equal to sales of construction companies; but the value of a construction project equals the construction output (sales) plus the cost of materials and outside subcontractors required for the project.

Note that by definition, sales include wages and salaries. In tables 4 and 5 direct wages and salaries of University employees equal “sales” because they are shown separately from the rest of direct “sales.” This is done only for arithmetic purposes in this particular case. The remaining portion of University’s direct sales, i.e., direct purchases of goods and services, are combined with the ripple effect (indirect and induced impacts) and shown as the total impact due to University purchases.

Input-Output (I-O) Model

An I-O model represents a regional economy in terms of transaction flows among economic sectors. For example, to produce $1 worth of staplers, 20 cents worth of input is needed from fabricated metal products, 20 cents worth from business services, 30 cents worth of labor and about 30 cents worth of other value-added (e.g., rent, interest and profit). An increase in the production of staplers will cause an increase in the production of other directly related sectors in proportion to their inputs per $1 of output in staplers. Because these directly related sectors also use inputs from other sectors, an increase in the production of staplers will indirectly affect many other sectors. Economic impacts also are induced by households spending the additional wage income earned in direct and indirect production. These household expenditures create additional sales and production of goods and services, resulting in increased employment and wages from that production.

The Pima County I-O Model portrays the economy in terms of a matrix of about 200 sectors that purchase and sell goods and services from and to each other. The county model is based on the Arizona I-O Model, developed by the Regional Science Research Institute.

The Pima County I-O Model was used to estimate indirect impacts, i.e., change in employment and wages in all other industries based on the purchases of goods and services for the purpose of the University research-related operations. The magnitude of indirect (interindustry) impacts
depends upon the percentage of locally produced goods and services represented in the model as the regional purchase coefficient. The more locally produced goods and services used, the higher the indirect impacts. Conversely, the higher the percent of goods and services purchased from outside the region, the higher the leakage and the lower the indirect impacts to the county.

Induced impacts, \textit{i.e.}, the impacts that result from an increase in employees’ spending, are estimated using the average household spending generated by the I-O model.

**The Revenue Impact Model**

The model computes state, county and city revenues associated with changes in business activity. The model is designed to be used in conjunction with other economic assessment information (\textit{e.g.}, wage impact results obtained from an input-output model) and other specific information about changes in business activity.

The model computes both direct revenue impacts and induced revenue impacts. Direct revenue impacts are computed for the following categories of revenues that are retained by the State of Arizona following distribution to cities, towns and counties:

- Use Tax
- Sales Taxes

Direct revenue impacts are computed for Pima County for the following categories:

- County Excise Taxes
- State Shared Sales Tax Revenues

Direct revenue impacts are computed for the City of Tucson for the following categories:

- City Sales Taxes
- State Shared Sales Tax Revenues

Induced revenue that is retained by the state (after sharing with the cities and counties) is computed for the following four categories:

- Income Tax
- Sales Tax
- Fuel Tax and Highway User Revenue Fund
- Vehicle License Tax

Induced revenue impacts are computed for five revenue sources for county governments:

- County Excise Tax
- State Shared Sales Tax
- State Shared Fuel Tax and Highway User Revenue Fund
- Vehicle License Tax
- Property Tax
Induced revenue impacts are computed for six different revenue sources for the largest city in each county:

- Urban Revenue Sharing
- State Shared Sales Tax
- State Shared Fuel Tax and Highway User Revenue Fund
- Vehicle License Tax
- Property Tax
- City Sales Tax

Note that the revenue impact model does not estimate revenues that will be distributed to special districts or school districts. However, it should be recognized that these other government entities will receive a portion of induced revenues.

The following discussion summarizes most of the assumptions and computations that underlie estimation of induced revenues. The Pima County spreadsheet computes the change in taxable activity associated with a change in wages of $X in the county. Thus, for $X increase in wages, the spreadsheets compute the change in the taxable income (personal and corporate), taxable sales (retail, contracting, communications, utilities, restaurants and bars, personal and real property rentals, printing and publishing), fuel consumption (gallons), motor carrier activity, vehicle license taxes, and net assessed value.

The responsiveness of each taxable activity to a change in wages (or personal income) is referred to as income “elasticity,” specifically defined as the percent of change in a taxable activity divided by the percent change in income. A very responsive taxable activity, \( i.e. \), one which grows faster than the growth in personal income, is known as an “elastic” revenue base. A taxable activity that grows less than proportionally to income is “inelastic,” and a taxable activity that grows proportionally to income is said to have a “unitary” elasticity.

Elasticities for each of the taxable activities were either obtained from secondary sources or computed by the authors. These elasticities were used in conjunction with existing tax laws in Arizona to compute total revenues generated from each taxable source. Then Arizona’s revenue sharing formulas were applied to compute the induced revenue impacts for the state, Pima County and City of Tucson.

Note that there are substantial linkages among the revenue sources. For example, a change in taxable activity in the City of Tucson also is a change in taxable activity in Pima County and the State. The revenue sharing formulas create additional linkages, \( e.g. \), a change in net assessed valuation in Pima County affects not only the County’s and the state’s property tax collections, it also can affect the amount of state-shared sales taxes received by the county government. Similarly, a change in Vehicle License Tax collections changes the amount of vehicle license taxes collected by the City of Tucson and Pima County, as well as affecting the Highway User Revenue Fund (HURF) distributions, because a portion of the Vehicle License Tax is deposited in HURF.
For a detailed description of Arizona’s revenues and revenue sharing formulas and computation of income elasticity’s implicit in the Pima County revenue model, contact the author.

REFERENCES


1 It was estimated that approximately $78.4 million of the total expenditures of $325.6 million (reported in Table 3) leaked out of the local economy through the purchases of goods and services that the University made outside Arizona in addition to out-of-state royalties and licenses, travel expenditures, federal taxes and social security contributions.

2 Note that the total impact of $356 million in Pima County was based on $231.3 million in direct expenditures in Pima County after the non-Pima portion was removed from total expenditures of $325.6 million reported in Table 3. (Compare with footnote 1).