The Economic Contributions of Northern Arizona University to the State of Arizona in 2003

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Executive Summary

- This study estimates the economic contributions of Northern Arizona University (NAU) to the State of Arizona for fiscal year 2003. Separate models were developed to demonstrate the economic impact of NAU on the entire state as well as the impacts on Coconino, Maricopa and Yuma counties, and on the Balance of State (the remaining twelve counties.)

- The Minnesota IMPLAN Group model was used to measure the economic impacts analyzed in this report. This widely acclaimed model provides measures for both the direct impact and the ensuing multiplier impacts resulting from NAU operations.

- This study contains information on the total expenditures, employment, employee compensation and personal income associated with NAU operations throughout the state.

- The total impact is further divided to show the individual contributions arising from the following five subgroups related to NAU activities: University (including employees), students, visitors to campus, NAU retirees, and NAU graduates in fiscal 2003.

- Total expenditure in 2003 by all parties related to NAU exceeded $911 million. The direct expenditure by these groups was $535 million while the remaining $376 million is the result of indirect and induced expenditures associated with the multiplier. This suggests that for each $1000 of spending that occurs to directly support NAU, an additional $700 is spent elsewhere within the state as a result of the multiplier impacts on the economy. Overall, these numbers are conservative since they do not include intangible impacts such as businesses that locate within the region simply because the university is also here, nor do they include the benefits that emanate from scientific discovery or research.

- The total spending impact in Coconino County was $610 million. The impact in Maricopa County was $71 million. In Yuma, the impact was almost $15 million, and in the Balance of State, this impact was just under $74 million.

- Total employment generated in Arizona by NAU and all its affiliated activities during this year was 12,542 positions (full-time equivalent). Of this amount 8,287 persons made up the direct employment, and the remaining 4,254 positions are due to the multiplier. This suggests that for each 100 persons employed by NAU and other entities as a direct result of NAU's operations, another 51 positions are also created due to the multiplier effects on the State's economy.

- On a county-by-county basis, the total number of positions created in support of NAU's presence was 8,902 in Coconino, 1,173 in Maricopa, 259 in Yuma and 1,419 in the Balance of State. These numbers include both the direct employment at NAU as well as the new jobs generated through the multiplier in each county.
- Direct spending by NAU and its employees in 2003 was just over $279 million. Of this amount, $265 million was spent in Coconino County.
- Direct spending by NAU students were $169 million. Of this amount, almost $108 million was spent in Coconino County.
- Direct spending by visitors to NAU campuses and to students, were $41 million. Over $39 million of this amount occurred in Coconino County.
- Direct spending by NAU retirees who currently reside within Arizona exceeded $16.8 million. Expenditures by NAU retirees residing in Coconino County were $8.7 million.
- Students who receive their degrees at NAU earn incremental income above and beyond what they would earn if they had not completed these degrees. The spending associated with the incremental income earned each year by those alumni who continue to reside in Arizona after graduation also contributes to the expenditure impact on Arizona and its counties. The direct expenditures resulting from the incremental income earned by last year's graduates were estimated to exceed $28.6 million statewide including $4.8 million by those alums who remained in Coconino County.
- Direct employment associated with NAU accounts for almost 10.4% of total employment in Coconino County. This figure increases to 14.4% once the multiplier impacts are included. Directly or indirectly, one of every seven jobs in the county exists due to NAU's presence.
- The NAU impact statewide that can be attributed to sponsored research grants and projects occurring during 2003 was almost $84 million dollars. After accounting for the multiplier and other effects, this research activity was also responsible for employing 1,169 persons directly at NAU and elsewhere throughout the State.
- Almost $155 million in tax revenues were collected during the period from households and businesses that were impacted by NAU operations and the expenditure by other groups included in this study. This generated a net fiscal gain of over $109 million dollars to the federal government and over $34 million to Arizona and local governments when all the revenues and costs are included.
- Future construction planned by NAU in the FY 2004 – FY 2009 period is expected to add an additional $149 million in expenditures over the six years, and generate an average of an additional 189 jobs per year. Once the multipliers are factored in, these impacts will increase to $255 million in expenditures over this period with 384 new jobs each year.
- The lifetime earnings differential above a high school graduate for all NAU graduates presently living in Arizona is almost $22.4 billion dollars. An NAU graduate with a bachelor's degree can expect to earn $500,000 more than a high school graduate.

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Introduction

This study measures the economic contributions of Northern Arizona University to the State of Arizona as well as the separate contributions made to Coconino, Maricopa and Yuma Counties and to the Balance of State (the remaining twelve counties) for Fiscal year 2003. Universities such as Northern Arizona University (NAU) serve as centers for learning and research, but are also major contributors to the economic development of the regions where they exist.

The economic well-being of the residents of Flagstaff and other communities throughout Arizona is enhanced by the purchases of goods and services and the number of jobs created as a result of the daily activities on NAU's campuses. The influx of outside monies and the ongoing research and development activities also contribute to an enhanced quality of life for Arizona citizens. Thus it is important from time to time for the university to quantify its impacts in order to provide a measure of the return on the investment of public funds spent in support of higher education. Previous studies have been performed to measure the impact of NAU on Flagstaff and Coconino County; however, this study is the first to measure these contributions on a statewide level. NAU's unique role as a provider of education throughout Arizona also means that its impact will occur over the entire state as well. Therefore, separate models were produced to demonstrate the impacts occurring on several distinct regions within Arizona as well as on the state overall.

In this study, we isolate the quantifiable impacts of the operational expenditures of NAU. We examine the impact of the annual operations and construction spending at NAU, as well as the impacts resulting from the expenditures by employees, students, visitors to the campuses, retirees and alumni.

The overall impact on the state and on each local economy greatly exceeds the initial impact created by the direct expenditures described above. As these dollars are spent and re-spent within each county, a multiplier effect is created which generates additional dollars in the local economies. Therefore, two sets of impacts are provided – the direct or initial impacts, and the total or overall impacts. We also estimate the number of jobs created in each location as well as the amount of wages, salaries and personal income generated as a result of these activities in fiscal 2003.

The study examines only the monetary effects of these expenditures. The full impact of NAU extends far beyond the dollars and cents associated with daily spending activities; however, the non-monetary impacts are typically omitted in studies of this type as they are difficult to assess.

We do not estimate, for example, the dollar value that is associated with the increased level of cultural and sporting activities that occur in Flagstaff due to the presence of the university. Furthermore, the population of northern Arizona is also influenced by the presence of Northern Arizona University. Migration of residents and businesses into the area is due, in part, to the existence of NAU and the job opportunities and research opportunities associated with such a large employer.

This study begins with a history of NAU's changing role in providing higher education services to the residents of Arizona. This is followed by a description of the methodology employed to measure the expenditure, employment, and income impacts associated with the university presence. We include sections on the impacts of alumni and retirees in addition to the traditional impacts associated with spending by employees, students and visitors. The final section of the study examines the fiscal impact that NAU and its activities exert on the budgets of all governments -- federal, state and local. We provide tables that show the number of dollars collected by each type of government as a result of the spending and re-spending that occurs from NAU activities. In addition, we contrast the additional costs with the additional benefits generated by the same set of activities.

History of Northern Arizona University

NAU's history spans 105 years. In 1899, the Arizona Territorial Legislature established the forerunner of Northern Arizona University (NAU). Twenty-three students were enrolled in the first class at the Northern Arizona Normal School in September 1899.

Growth of the Normal School, both in enrollment and in its importance to the State, eventually led to changes in the institution's status and name. In 1925, the state legislature changed the school's status to that of a four-year degree-conferring college and authorized the initial Bachelor of Education degree program. In the same year, the name of the school was changed to Northern Arizona State Teachers College, and in 1929, the name was changed once again to Arizona State Teachers College at Flagstaff.

In 1937, the legislature authorized the first Master of Arts in Education program. In 1945 the school's name was changed to Arizona State College at Flagstaff. The Bachelor of Science in Forestry was authorized in 1958.

Arizona State College became Northern Arizona University on May 1, 1966. Two years later, the Arizona Board of Regents approved the authorization of the first doctoral programs at NAU in the areas of Biological Science and in Education.

Northern Arizona University's role in higher education in Arizona has expanded in numerous ways since becoming a university in 1966. During fiscal 2003, NAU enrolled over 19,000 students and offered programs to students in locations throughout the state as well as on the World Wide Web. NAU's influence is not confined to the classroom. Faculty and staff make significant contributions to community and public service across the state. The citizens of Arizona benefit from ongoing initiatives in education, ecological research, technology, business, nursing and hotel/restaurant management as well as from outreach activity through university centers and institutes. These include conferences and seminars, as well as a significant and growing importance of externally funded research conducted by university faculty.

The NAU main campus (The Mountain Campus) is located on approximately 740 acres of land in Flagstaff, Arizona. The existing buildings and physical infrastructure of the Flagstaff campus have a current replacement value of $783 million. The university also operates a campus in Yuma in concert with Arizona Western College. The replacement value of building and physical property in Yuma is $7.6 million. An additional $1.7 million may also be attributed to NAU buildings and physical property in Kingman.

Students can also enroll at one of over thirty NAU Statewide campuses as part of NAU Distance Learning programs, or students can enroll in the NAU Worldwide Campus and take their classes and earn their degrees online.

Currently, NAU offers its programs through the following academic units:

- College of Arts and Sciences
- College of Business Administration
- College of Engineering and Technology
- College of Education
- College of Fine Arts
- College of Health Professions
- College of Social and Behavioral Sciences
- School of Communication
- School of Hotel and Restaurant Management
- School of Forestry
- Graduate College

During the 2002-2003 fiscal year, NAU enrolled students from all 50 states and 75 countries. In the Fall 2002 semester, 17,101 students were from Arizona and 2,806 were from regions outside Arizona, including 351 international students. Furthermore, NAU's International Office provides opportunities for students to study abroad in 25 countries. In FY 2003, 320 NAU students studied in countries from Australia to Switzerland.

NAU offers Bachelor's degrees in 108 disciplines, as well as 44 Masters' offerings and 9 doctoral programs. Students also increase their educational experiences through participation in internships, field work and cooperative education programs offered through the university.

Since graduating its first students in 1901, 94,018 students have graduated from Northern Arizona University. Many of these alumni continue to participate in university-sponsored non-credit courses and other programs and conferences in Flagstaff and throughout the state.

In addition, residents of Flagstaff along with university students and employees have become accustomed to enjoying NAU events and activities including recitals, plays and concerts, music and art exhibits, Big Sky athletic programs, and KNAU, the university's public radio station.

The NAU library is named for distinguished alumni and long time residents of Flagstaff – Platt and Barbara Cline. The present facility contains over 200,000 square feet including a four

hundred seat assembly hall. The Cline Library houses over 1,400,000 volumes, including 560,000 books; 240,000 government documents; 35,000 maps; 373,000 microforms; 18,000 sound recordings; 10,000 videos, films and other non-print media; and 136,000 bound periodical volumes.

The Role of Universities in Economic Development

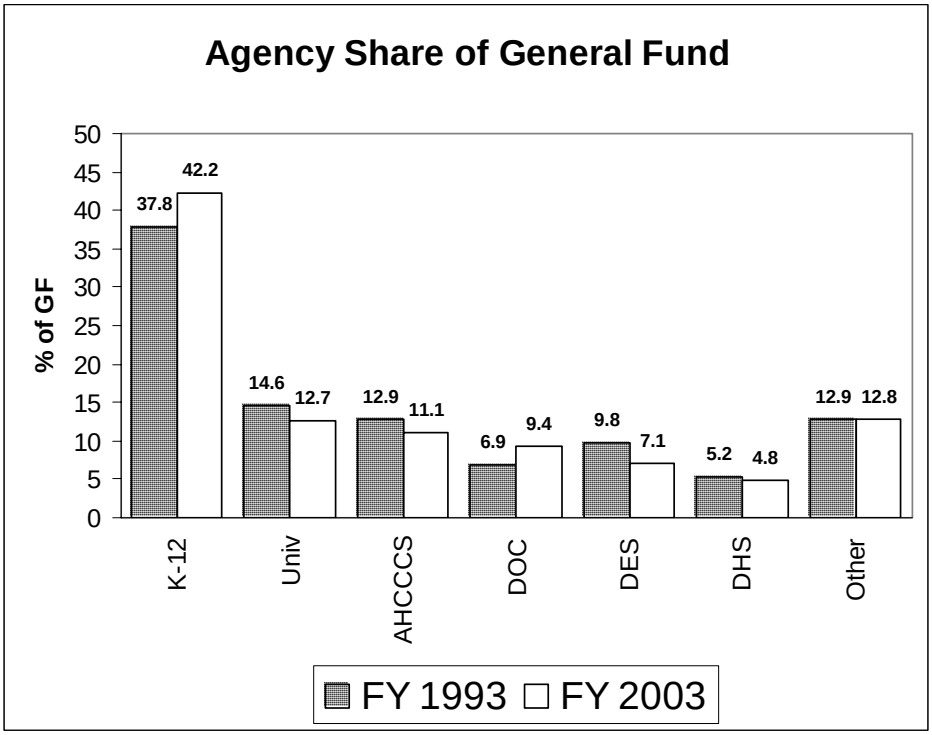
Faculty members at universities are responsible for generating significant numbers of ideas and concepts that have been adopted by economic developers across the nation. Examples include business incubators and research parks where universities have increasingly assumed a leadership role in providing technical assistance to businesses as well as instituting applied research and facilitating technology transfer to enhance economic development in local communities.

Over time, the missions of NAU and other universities have evolved to include activities to promote economic growth within the state. Consequently, NAU is an active participant in the promotion of economic development across Arizona. Faculty members working at NAU provide leadership at both national and state levels in fields as diverse as natural resource and conservation efforts, tourism research and Native American and rural policy programs and initiatives.

In November 2000, Arizona voters passed Proposition 301 that included a 0.6 cent increase in the state sales tax to establish the Technology and Research Initiative Fund (TRIF). Monies from this fund are being used to promote university research, development, and technology transfer to the New Economy along with establishing programs that will prepare students to contribute to Arizona's high technology industries. At Northern Arizona University, TRIF funds are presently used for "environmental research, development and education to accelerate Arizona's environmental business enterprises, and e-learning initiatives to address the teacher and nursing shortages and to educate engineers and information technology professionals, among others." (Arizona Statewide Economic Study, 2002).

Although universities are becoming more actively engaged in statewide economic activities, the share of state appropriations accruing to higher education has been diminishing in many states. Arizona is no exception. Figure 1 shows the changes in the percent of statewide funding that have occurred for the major agencies in Arizona in the ten years between 1993 and 2003. During this period, the share of state-appropriated funds flowing to higher education in Arizona declined from 14.6% to 12.7% of the state's total general funds budget.

Figure 1
Agency Share of General Fund



Source: http://www.azleg.state.az.us/jlbc/03app/gfspend.pdf

Measuring the Economic Impacts of a University

The traditional approach used to estimate the economic impact of a university is to measure the dollar impact of the additional economic activities which accrue to a region but which would then disappear if the university were to close down or if the university were not located in that area. Economic impacts occur whenever the university spends dollars for capital and operations items. In addition, spending by university employees and students, as well as by visitors to the campus, also contributes to the impact. In this study, we have also included spending that was made by NAU retirees and by NAU alumni for the most recent year.

The entire local economy would be negatively influenced if these expenditures were to end. For example, receipts at local hotels and other lodging facilities would decline with the reduction of out-of-town visitors to the campus and to its students. Local restaurant and entertainment enterprises would also feel the negative impacts. Banking, insurance and other business and personal services firms would experience a reduction in their sales and service activities.

The closure of a university also impacts the region's supply of available labor. Many businesses depend on university students and employees as primary sources of labor and technical expertise. The decreased availability of student workers and interns would increase operating costs for local firms when they were compelled to increase wages to replace relatively inexpensive laborers with more expensive workers.

A host of quality-of-life activities are also associated with a university, and these will be negatively impacted if the university were to close. Most obvious, perhaps are the athletic and cultural events held at university locations. Local public radio programming would disappear, numerous seminars and workshops conducted by university personnel would decline, and the overall physical and cultural infrastructure of the region typically shrinks in a smaller environment.

The Multiplier Effect

When the level of direct expenditures increases in a region, these dollars are spent and re-spent in the local economy, creating additional incomes and jobs. This generates a magnified impact on the region called the "multiplier." The process also works in reverse when the level of expenditure in an area declines instead of increases. In these instances, the reduced levels of spending generate additional cutbacks elsewhere in the region as well as further reduce employment. This begins a negative chain of events that result in a multiple decline in local economic activity.

The value of the multiplier varies based upon the amount of spending and re-spending that exists within each community. Therefore, every location has its own multiplier. For example, if a local area has a multiplier of 2.00, a million dollars of direct spending in that area will generate an additional $1 million in spending, and the total impact on the area will be $2 million.

Underestimation of the Overall Impact

This approach to measuring impacts focuses only on the amount of spending that is attributed to the presence of the university in a region. As such, the true impact of the university on the local economy is underestimated. As an example, the existence of a university may increase home values in an area. Rental costs for local houses and apartments may rise due to the higher demand resulting from the presence of hundreds or thousands of students and faculty who live in the area because of the university. Although the impacts of higher housing costs are not measured by the model, the demand for housing exhibited by these residents, particularly in the areas adjacent to the university, is very often responsible for the elevated cost of housing in many university towns.

The typical economic impact model also ignores the benefits arising from the discovery and application of significant scientific and technological research outcomes stemming from faculty and student activities. These outcomes can greatly influence the life and well-being of millions of citizens, yet the direct tie-in to the university is often too nebulous to permit an analysis that measures the cause and effect of these activities. Furthermore, we have not considered enhancements and improvements in the local community resulting from the increase in worker productivity associated with completing a college degree, nor the general attractiveness of a region as a desirable place to work and live due to the presence of the university in the area. While these factors impact local living conditions, their measurement is extremely difficult and their impacts are not incorporated into this study.

Costs vs. Benefits of a University

Although a university brings numerous and significant benefits to a local area, that region also incurs increased costs due to the university's presence in the region. One example of these costs is the revenue foregone from tax-exempt property owned by the university. Since the land and infrastructure occupied by most state universities is removed from the local tax rolls, the assessment on remaining property in the region is likely to be higher to make up for lost revenues. A lack of adequate levels of parking and increased congestion in and around the university often occurs. Additional costs are imposed on the city water and sewer infrastructure, as well as increased levels of crime and the cost of enhanced police and fire forces needed for protection. The increased rental costs in the region were already mentioned above. Finally, local school systems are often impacted due to the enrollment of the school-age children of university employees and students. However, any large-scale level of economic activity will impose similar costs on a community, and these items must be considered as part of the overall cost-benefit picture that emerges in a growing community.

The following section describes the methodology employed to estimate the economic impact of Northern Arizona University on the State of Arizona and the local communities where NAU provides educational opportunities.

Methodology

The period of analysis for this study is the 2003 Fiscal Year which began July 1, 2002 and ended on June 30, 2003. The output, income, jobs and tax impacts associated with the activities of NAU are presented for the entire state as well as for Coconino, Maricopa and Yuma counties and for the remaining twelve counties which are referred to in this study as the Balance of the State.

The specific model used for this study was developed in 1985 by the Minnesota IMPLAN Group Inc. IMPLAN refers to IMpact Analysis for PLANning. The model employs a sophisticated computer program which adapts the national input-output tables to county and state levels. This procedure permits computations generated for the national economy to be uniquely broken out and designed for use at state and local levels. The smallest geographic region that IMPLAN uses is at the county level. Therefore, the local region is synonymous with the county. In this analysis, we estimate the impact of NAU at the state level, but we also provide the impacts on selected Arizona counties since NAU activities are present in numerous Arizona locations.

The IMPLAN methodology estimates the impacts on a state or county that stem from a given event or the elimination of a set of economic activities. The model therefore analyzes impacts resulting from the changes in demand that would occur if NAU were to cease to exist. The model is discussed in detail in Appendix B at the conclusion of this report.

Input-output models identify three distinct effects on the region – direct, indirect and induced – and the magnitudes of these impacts are the same size regardless of whether the initial change in spending is positive or negative. Only the direction of the change will vary. The impacts are primarily grouped into output, income, employment and tax arenas. The magnitude of the

impact in each community is a function of university spending in the region as well as expenditures made by NAU employees, students, visitors to the university and others associated with NAU.

When NAU or its students, employees, visitors and others related to NAU increase their spending, this action is called the direct effect. These expenditures immediately increase local sales activity and generate increases in local employment and income levels.

This increase in demand for local inputs generates a ripple or multiplier effect in the local economy. This action is the indirect effect, which occurs when local businesses gear up to replace and expand the level of these inputs. To meet these demands, the firms must also increase their purchase of inputs from other producers, some of whom may be local. As a result, those producers must also increase hiring of labor inputs required to produce the desired goods and services.

The chain of events does not stop here. Increases in employment resulting from higher direct and indirect spending will increase the incomes of local households. These households, in turn, will spend a portion of their new incomes in the local economy. This spending stimulates even more demand for output and creates additional employment opportunities in the local region. This tertiary increase in economic activity is the induced effect, and is a reflection of the changes that occur due to higher household incomes in a region.

Therefore, the total effect of changes in spending by the university or anyone associated with NAU, will be the sum of the direct, indirect, and induced effects described above.

The proprietors' income and the wages and salaries flowing to employees in the affected businesses provide a measure of the income effect. The employment effect is gauged by the number of jobs that exist as a result of the increased initial sales activities and the higher business-to-business transactions that occur to meet the demands of increased economic activity in the state and counties. The tax impact is a measure of the fiscal change resulting from the operations at NAU. The tax impact is shown for the Arizona state government as well as for various counties that are influenced by NAU's presence.

IMPLAN recognizes that a portion of the expenditures resulting from changes in demand in any given region will occur outside the physical boundaries of that region. This effect is called leakage, and refers to the impacts felt in areas outside the region being measured. Therefore, the leakage must be subtracted from the local budget in order to provide an accurate measure of the total impact. To demonstrate this point, assume NAU Transportation Services purchases gasoline from local distributors in order to operate its fleet of State-owned vehicles. Only a portion of the proceeds from these gasoline sales remains in the local area. The crude oil is pumped at the source and refined at facilities throughout the world. The transportation of the gasoline to Flagstaff is often undertaken by individuals living outside the region, and for firms whose owners reside elsewhere. The local gas stations are impacted only by the dollar amount of the increased sales which remain in the local economy. Most of the value spent for a gallon of gasoline is used to fund the activities of entities that produce and transport the gasoline to the local service stations and is not counted as part of the impact on the region.

The Impact of Northern Arizona University on Arizona including Coconino, Maricopa and Yuma Counties as well as the Balance of the State

The impacts of Northern Arizona University are analyzed for Arizona overall and separately for Coconino, Maricopa and Yuma Counties as well as for the Balance of the State. The impacts are separated into five distinct components. The first and largest impact results from the day-to-day activities undertaken at NAU as well as spending by NAU employees. These figures include spending from all sources for construction, operations and wages and salaries at NAU. The numbers used in this study were obtained from appropriate NAU departments and offices throughout the campus network.

The second largest impact is generated by expenditures made by students attending NAU campuses throughout Arizona. Over the past several years, NAU enrollments have increased dramatically in various locations throughout Arizona while enrollments in Flagstaff have declined. As a result, the impact of student spending has become more widely dispersed and generates a substantial economic impact in regions outside Coconino County.

The third impact is attributed to the spending by visitors to NAU campuses as well as to those persons who visit students who are attending NAU. Spending by visitors is included in the overall impact in order to account for dollars spent at athletic, music, cultural and other events occurring on the campus as well as by friends, family, and others who travel to the campus to visit or conduct business at the university. Some stay overnight, others do not; still others spend several days on campus for retreats, camps, Elderhostel and other events that span several days. Their impacts are measured by the amount of money spent during the time they visited the campus.

Spending by NAU retirees was also considered when determining the overall impact of NAU on the state and county economies. Expenditures made by these persons are considered as part of the impact associated with NAU since their presence in the state can be partly attributed to their prior employment at the university. In line with the methodology presented earlier, these individuals may not have a reason to reside in Arizona if NAU had not been here to provide them employment. Their continued residence in Arizona in their post-employment years can; therefore, be counted as part of NAU's contribution to the state and county-level impacts.

Finally, NAU presently confers over 3,700 degrees each year to graduates at the bachelor, master and doctoral levels. These students will earn greater salaries over the course of their working lives compared to what they would earn without their degrees. Therefore, the incremental spending that results from the higher incomes earned by NAU alumni also contributes to the NAU impact on the state economy. Since this study is designed to measure the impact attributed to NAU on an annual basis, we have included numbers that capture alumni spending due to their higher incomes on a one-year rather than a lifetime basis.

A case could be made for including all of NAU's living alumni that live and work in Arizona. During each year of their working lives, these graduates earn more than they would have had they not completed their degrees. This earnings differential tends to increase during their careers and results in substantial increases in lifetime incomes. A separate review of the impact of all NAU alumni is presented at the end of this study to highlight this contribution.

The impacts of each of these activities are discussed and presented in the following sections of this report. The overall impact in each region was compiled by summing the impacts generated by each of the five spending groups. Comparable analyses are presented here for the State of Arizona as well as for the four separate county models (Coconino, Maricopa, Yuma, Balance of State).

We used the following measures to demonstrate NAU's impact in various ways. Information is presented and analyzed at the statewide level and for each of the county areas listed above for the following variables:

- Total Expenditure or Output
- Employment
- Employee Compensation
- Personal Income

Overall NAU Impact on Arizona

The overall impact of NAU on the State's economy in 2003 was $911,172,600. This figure represents the total spending (direct, indirect and induced) by all of the sectors mentioned above (NAU and its employees, students, visitors, retirees and incremental alumni expenditures.) The spending impact along with the impacts related to employment, employee compensation and personal income are shown in Table 1. A more detailed breakout of where these impacts occurred is found in Tables A-1 to A-4 in Appendix A. (Note: In input-output analysis, government services are valued at their production costs, because these services are not sold at market prices. As a result total output and total expenditure are the same amounts.) As shown in Table 1, almost $535 million of the $911 in total expenditure is a result of direct spending by these groups. An additional $152 million resulted from indirect expenditures by Arizona businesses whose operations were positively influenced by the increased levels of initial spending in the state. Furthermore, almost $225 million in induced expenditures resulted from increased household spending that was generated by increased household incomes. The difference between the $911 million in overall spending and the $535 million in direct spending is referred to as the multiplier effect. Here, the multiplier is 1.70 which means that every $1 million dollars of expenditure made by NAU generates an additional $700,000 in spending somewhere else in Arizona.

The overall effects of these spending activities associated with NAU also generated a significant increase in statewide employment. Full-time equivalent direct employment at NAU averaged 4,443 in fiscal 2003. In addition, another 3,844 full-time equivalent workers were employed as a result of spending by students, visitors, retirees and alumni. Overall, 8,287 jobholders in the state directly owe their positions to spending by NAU and these groups of individuals. This, in turn, stimulated additional employment within the state that added 1,618 jobs in the indirect sector. The increase in household incomes that resulted from more persons being employed in both the direct and indirect sectors created an additional 2,636 jobs in the induced sector. In total, 12,541 persons are employed in Arizona as a result of NAU's presence. This results in a statewide employment multiplier of 1.51, and says that each 100 full-time jobs at NAU generate another 51 positions elsewhere in the state.

NAU's direct impact on employee compensation was almost $244 million. This figure includes all wages and salaries paid to employees at NAU as well as the salaries paid to workers employed in other sectors that were initially impacted by the spending of NAU faculty, staff, students and other spending groups. As these dollars were spent and re-spent in the state, they generated additional compensation to workers employed in the indirect and induced sectors. This activity increased NAU's contribution to the total employee compensation in the state to over $378 million. The multiplier effect related to employee compensation is 1.55. This means that for each $1 paid to employees at NAU, another 55 cents in employee payments also occurred somewhere else in Arizona.

The final area of analysis addresses the amount of personal income generated in the state as a result of NAU and its activities. The personal income reflects the salaries and benefits paid to employees at NAU and to workers in other businesses that benefited from spending by NAU's presence. Personal income also includes proprietors' income as well as other property income received by local landlords. In fiscal 2003, the amount of personal income directly associated with NAU's presence was $312 million. The direct personal income was supplemented by additions to income generated in the indirect and induced sectors and eventually resulted in an increase in total personal income of $531 million in the state. These increases generated a personal income multiplier equal to 1.70. This suggests that for each $1 million in personal income generated at NAU, another $700,000 in personal income was created in the state.

Table 1

The Statewide Impact of the Operations of NAU for Fiscal Year 2003

Impact	Direct	Indirect	Induced	Total
Total Output	534,798,900	151,653,500	224,720,200	**911,172,600**
Employment	8,287	1,618	2,636	**12,542**
Employee Compensation	243,991,800	59,363,500	75,141,000	**378,496,300**
Personal Income	312,065,400	91,017,900	127,698,800	**530,782,100**

Overall NAU Impact on Arizona Counties

A similar analysis was prepared for each of the county-wide analyses in this study. The results are shown in Table 2 below and the interpretations are similar to what was presented for the state in the previous section. NAU's contribution to output, employment, employee compensation and personal income are reported separately for Coconino, Maricopa and Yuma counties as well as for the Balance of the State. The impacts vary considerably, with approximately 3/4 of the total impact occurring in Coconino County which is home to the Mountain Campus, and 1/4 of the impacts occurring in the remaining counties of the state.

Table 2

The Countywide Impact of the Operations of NAU On Coconino County for Fiscal Year 2003

Impact	Direct	Indirect	Induced	Total
Total Output	425,870,700	75,789,100	108,434,200	**610,094,000**
Employment	6,434	955	1,513	**8,902**
Employee Compensation	203,636,700	23,144,900	34,788,400	**261,570,000**
Personal Income	246,632,600	42,009,100	61,829,500	**350,471,200**

The Countywide Impact of the Operations of NAU On Maricopa County for Fiscal Year 2003

Impact	Direct	Indirect	Induced	Total
Total Output	44,870,600	11,488,800	14,717,100	**71,076,500**
Employment	893	115	165	**1,173**
Employee Compensation	15,955,300	4,254,400	4,999,800	**25,209,500**
Personal Income	26,663,300	6,676,400	8,442,200	**41,781,900**

The Countywide Impact of the Operations of NAU On Yuma County for Fiscal Year 2003

Impact	Direct	Indirect	Induced	Total
Total Output	10,136,900	1,822,100	2,623,400	**14,582,400**
Employment	198	24	37	**259**
Employee Compensation	4,021,500	566,500	818,600	**5,406,600**
Personal Income	6,310,400	988,400	1,478,600	**8,777,400**

The Countywide Impact of the Operations of NAU On Balance of the State for Fiscal Year 2003

Impact	Direct	Indirect	Induced	Total
Total Output	49,331,800	10,323,300	14,196,600	**73,851,700**
Employment	1,101	125	193	**1,419**
Employee Compensation	16,085,900	3,167,000	4,548,300	**23,801,200**
Personal Income	28,875,800	5,540,300	8,049,300	**42,465,400**

Overall Impacts in Coconino County

The overall county impacts are highlighted in Table 2. Coconino is the first county reported in the table. As expected, the majority impact of NAU operations is generated in Coconino County.

Total direct expenditures by NAU and its related spenders (employees, students, visitors, retirees and incremental alumni spending) was nearly $426 million in 2003. Additional rounds of expenditures boosted this total to $610 million once the impacts of the multiplier were considered.

Direct employment in the county was 6,434 and an additional 2,468 persons were hired in support of these workers elsewhere in the county for a total of 8,902 total jobs. Thus, for every 100 NAU employees, another 38 persons are hired elsewhere in the county due to the indirect and induced expenditures. Total employment in Coconino County averaged 61,850 in Fiscal 2003. ***Based on this study, direct employment associated with NAU accounts for almost 10.4% of total county employment. This figure increases to 14.4% once the multiplier impacts are included. In other words, one of every seven jobs in the county directly or indirectly, exists due to NAU's presence.***

Employee compensation in the county was directly enhanced by $204 million reflecting NAU payroll as well as payments made to others in direct support of the university. Overall, this compensation exceeded $261.5 million after accounting for the multiplier impacts.

Personal income of county residents rose by almost $247 million as a direct result of NAU operations and by $350 million once all the side impacts are included. ***The $350 million represents approximately 11.8% of total personal income in the county.*** (This figure is based upon an update of the official 2001 Personal Income figures for the county as estimated in the Bureau of Economic Analysis BEARFACTS report.)

Overall Impacts in Maricopa County

Northern Arizona University also exerts a considerable economic influence in Maricopa County. The amount of these impacts is also shown in Table 2. Total direct expenditures by NAU and others directly affiliated with the university in Maricopa County were almost $45 million in 2003. Once these dollars had been spent and re-spent in the county, NAU's total contribution to spending rose to $71 million in Maricopa County.

NAU-related employment in Maricopa County was 893 and 1,173 jobs exist in the county after accounting for the jobs multiplier. In Maricopa, every 100 NAU jobs, generates another 31 jobs elsewhere in the county.

NAU presence in Maricopa County also directly added nearly $16 million in employee compensation in the State's largest county. NAU's employee compensation impact rises to $25.2 million after the multiplier effects are added to the total.

Personal income in Maricopa County was higher by $26.7 million as a direct result of NAU operations there. Personal income increased by $41.8 million in Maricopa after adding the indirect and induced impacts to this amount.

Overall Impacts in Yuma County

The overall Yuma County impacts also appear in Table 2 above. Total direct expenditures by NAU and its related spenders (employees, students, visitors, retirees and incremental alumni spending) in Yuma County exceeded $10.1 million in 2003. Additional rounds of expenditures boosted this total to $14.6 million once the impact of the multiplier is considered.

Direct NAU-related employment in the county was 198 persons and an additional 61 persons were hired in support of these workers elsewhere in the county for a total of 259 total jobs. Thus, for every 100 NAU employees, another 31 persons are hired elsewhere in the county due to the indirect and induced expenditures.

NAU employees and its students and others directly employed as a result of NAU operations received slightly more than $4 million in employee compensation in Yuma County during 2003. This figure rises to $5.4 million once the multiplier effects are added to the total.

Personal income of Yuma county residents rose by $6.3 million as a direct result of NAU operations and by $8.8 million once all the indirect and induced impacts are included.

Overall Impacts in the Balance of the State

Finally, we estimate Northern Arizona University's impacts on the remaining areas of the state. Once again, NAU exerts a considerable economic influence in these regions. These impacts are included in Table 2. Direct expenditures by NAU and others affiliated with the university in these counties exceeded $49.3 million in 2003. After spending and re-spending, total spending in the Balance of State increased by $73.9 million due to NAU's presence.

NAU-related employment in the Balance of the State was 1,101; however, 1,419 jobs exist in these areas after accounting for the jobs multiplier of 1.29, or 29 jobs for every 100 NAU jobs.

NAU directly added $16.1 million in employee compensation in these counties, and $23.8 million after the multiplier effects are added to this total.

Personal income added to the Balance of State was $28.9 million as a direct result of NAU operations. Personal income increased by $42.5 million overall.

The overall impacts presented here illustrate the magnitude of the impact that NAU generates outside Coconino County in regions throughout the state. Once the multiplier effects have been included, NAU's satellite and distance education operations located in counties outside Coconino County are responsible for 2,851 jobs and $160 million in expenditures which created $93 million of new income in these counties in addition to the economic impacts generated in Coconino County.

Analysis of Impacts by Type of Spender

This section of the report reviews the impacts generated by type of spender. The levels of expenditure and employment in the State and in each county are summarized here to reflect the spending generated by each of the five separate groups analyzed in this report. These spending groups are NAU and its employees, its students, visitors to the campuses, NAU retirees living in Arizona, and 2003 NAU alumni residing in Arizona.

Tables 3 through 12 provide the information on the overall expenditure and employment impacts associated with the spending levels made by each of these five groups. Impacts are again shown for the state as well as for Coconino, Maricopa and Yuma counties and the Balance of the State. These numbers reflect activity for Fiscal 2003, and as in the previous section, the expenditures made by the alumni are based solely on the incremental income received by NAU alumni as a result of obtaining their degrees from NAU, not on their total income. For purposes of internal consistency, this study is designed to measure the estimated annual spending for only the most recent year's graduates, and does not include spending by all NAU alumni residing in Arizona.

Highlights of Impacts by Type of Spender (Summary of Tables 3-12)

State of Arizona:

The total impact in Arizona generated by the following groups in FY 2003 was:

- NAU and NAU Employees: $508.9 million and 7,085 jobs
- Students: $264.5 million and 3,389 jobs
- Visitors to the campuses: $ 66.7 million and 1,185 jobs
- Retirees: $ 26.4 million and 342 jobs
- Alumni 2003: $ 44.6 million and 541 jobs

Total Statewide impact: $911.2 million and 12,542 jobs

Coconino County:

The total impact in Coconino County generated by the following groups in FY 2003 was:

- NAU and NAU Employees: $390.9 million and 5,211 jobs
- Students: $145.3 million and 2,262 jobs
- Visitors to the campuses: $ 55.5 million and 1,154 jobs
- Retirees: $ 11.9 million and 181 jobs
- Alumni 2003: $ 6.5 million and 95 jobs

Total impact in Coconino County: $610.1 million and 8,902 jobs

Maricopa County:

The total impact in Maricopa County generated by the following groups in FY 2003 was:

- NAU and NAU Employees: $ 12.2 million and 479 jobs
- Students: $ 33.8 million and 402 jobs
- Visitors to the campuses: $ 0.1 million and 2 jobs
- Retirees: $ 5.2 million and 64 jobs
- Alumni 2003: $ 19.7 million and 226 jobs

Total impact in Maricopa County: $ 71.1 million and 1,173 jobs

Yuma County:

The total impact in Yuma County generated by the following groups in FY 2003 was:

- NAU and NAU Employees: $ 3.8 million and 81 jobs
- Students: $ 7.6 million and 116 jobs
- Visitors to the campuses: $ 1.3 million and 32 jobs
- Retirees: $ 0.2 million and 3 jobs
- Alumni 2003: $ 1.8 million and 26 jobs

Total impact in Yuma County: $ 14.6 million and 259 jobs

Balance of the State:

The total impact in the Balance of State generated by the following groups in FY 2003 was:

- NAU and NAU Employees: $ 8.4 million and 498 jobs
- Students: $ 43.4 million and 599 jobs
- Visitors to the campuses: $ 0.8 million and 16 jobs
- Retirees: $ 6.8 million and 102 jobs
- Alumni 2003: $ 14.6 million and 204 jobs

Total impact in Balance of the State: $ 73.9 million and 1,419 jobs

Table 3

Expenditures Made in Arizona Classified by Type of Spender in Fiscal Year 2003

Category	Direct	Indirect	Induced	Total
NAU and Employees	279,172,200	87,483,500	142,267,500	508,923,200
Students	169,129,500	42,407,200	52,915,900	264,452,600
Visitors	41,108,500	10,440,600	15,180,000	66,723,100
Retirees	16,759,900	4,224,100	5,454,800	26,438,800
Alumni	28,628,800	7,097,100	8,901,900	44,628,800
Total Expenditures	534,798,900	151,653,500	224,720,200	911,172,600

Note: Column numbers may not add to total due to rounding.

Table 4

The Employment Impact Generated in Arizona Classified by Type of Spender in Fiscal Year 2003

Category	Direct	Indirect	Induced	Total
NAU and Employees	4,443	973	1,669	7,085
Students	2,351	417	621	3,389
Visitors	901	106	178	1,185
Retirees	233	45	64	342
Alumni	360	76	105	541
Total Employment	8,287	1,618	2,636	12,542

Note: Column numbers may not add to total due to rounding.

Table 5

Expenditures Made in Coconino County Classified by Type of Spender in Fiscal Year 2003

Category	Direct	Indirect	Induced	Total
NAU and Employees	264,958,600	49,273,500	76,661,200	390,893,300
Students	107,844,800	17,127,900	20,323,500	145,296,200
Visitors	39,626,400	6,961,400	8,875,500	55,463,300
Retirees	8,669,200	1,557,900	1,690,100	11,917,200
Alumni	4,771,800	868,400	883,900	6,524,100
Total Expenditures	425,870,700	75,789,100	108,434,200	610,094,000

Note: Column numbers may not add to total due to rounding.

Table 6

The Employment Impact Generated in Coconino County Classified by Type of Spender in Fiscal Year 2003

Category	Direct	Indirect	Induced	Total
NAU and Employees	3,508	633	1,070	5,211
Students	1,774	204	284	2,262
Visitors	945	85	124	1,154
Retirees	136	21	24	181
Alumni	71	12	12	95
Total Employment	6,433	955	1,514	8,902

Note: Column numbers may not add to total due to rounding.

Table 7

Expenditures Made in Maricopa County Classified by Type of Spender in Fiscal Year 2003

Category	Direct	Indirect	Induced	Total
NAU and Employees	6,802,900	1,889,500	3,484,400	12,176,800
Students	21,891,400	5,577,100	6,355,100	33,823,600
Visitors	85,500	22,200	30,000	137,700
Retirees	3,340,300	834,300	1,045,100	5,219,700
Alumni	12,750,600	3,165,700	3,802,400	19,718,700
Total Expenditures	44,870,600	11,488,800	14,717,800	71,076,600

Note: Column numbers may not add to total due to rounding.

Table 8

The Employment Impact Generated in Maricopa County Classified by Type of Spender in Fiscal Year 2003

Category	Direct	Indirect	Induced	Total
NAU and Employees	420	20	39	479
Students	277	53	71	402
Visitors	2	0	0	2
Retirees	43	9	12	64
Alumni	151	32	43	226
Total Employment	893	115	165	1,173

Note: Column numbers may not add to total due to rounding.

Table 9

Expenditures Made in Yuma County Classified by Type of Spender in Fiscal Year 2003

Category	Direct	Indirect	Induced	Total
NAU and Employees	2,386,400	361,600	1,006,600	3,754,600
Students	5,452,400	1,038,800	1,090,100	7,581,300
Visitors	883,600	147,600	228,200	1,259,400
Retirees	144,500	27,500	32,200	204,200
Alumni	1,270,000	246,500	266,400	1,782,900
Total Expenditures	10,136,900	1,822,100	2,623,400	14,582,400

Note: Column numbers may not add to total due to rounding.

Table 10

The Employment Impact Generated in Yuma County Classified by Type of Spender in Fiscal Year 2003

Category	Direct	Indirect	Induced	Total
NAU and Employees	62	5	14	81
Students	88	13	15	116
Visitors	27	2	3	32
Retirees	2	0	1	3
Alumni	18	4	4	26
Total Employment	198	24	37	259

Note: Column numbers may not add to total due to rounding.

Table 11

Expenditures Made in the Balance of State Classified by Type of Spender in Fiscal Year 2003

Category	Direct	Indirect	Induced	Total
NAU and Employees	5,024,300	614,200	2,728,500	8,367,000
Students	29,562,100	6,367,100	7,443,300	43,372,700
Visitors	513,000	116,700	163,500	793,200
Retirees	4,483,000	1,031,600	1,251,500	6,766,100
Alumni	9,749,500	2,193,700	2,609,800	14,553,000
Total Expenditures	49,331,800	10,323,300	14,197,600	73,851,700

Note: Column numbers may not add to total due to rounding.

Table 12

The Employment Impact Generated in the Balance of State Classified by Type of Spender in Fiscal Year 2003

Category	Direct	Indirect	Induced	Total
NAU and Employees	453	8	37	498
Students	424	74	101	599
Visitors	12	2	2	16
Retirees	72	13	17	102
Alumni	140	29	35	204
Total Employment	1,101	125	193	1,419

Note: Column numbers may not add to total due to rounding.

Fiscal Impacts

The IMPLAN model also provides a means to calculate the impact that NAU exerts on government revenues, both at the national and at state and local levels. Even though NAU commands a tax exempt status, the spending that occurs in the state and local economies that can be traced to NAU's presence generates tax revenues that are paid by entities in those economic sectors that are subject to taxes. Estimates were generated by the model to determine the levels of taxes and other government revenues collected as a result of the direct, indirect and induced spending. Estimates are reported separately for the federal government and for state and local governments. Descriptions of the tax categories used in the model are presented here.

- Corporate profits tax: Federal and state corporate income taxes.
- Dividends: Corporate dividends paid on stock held by government entities including employee retirement funds or trust accounts.
- Indirect Business Taxes**:** These taxes exist at all levels of government and include sales taxes, excise taxes (e.g., gasoline), and estate and gift taxes. Non-taxes include fees, forfeitures and fines.
- Personal taxes: Personal taxes are primarily levied against income and property , motor vehicles, and customs duties.
- Personal non-taxes include user fees (e.g., hunting & fishing licenses), and other fees, forfeitures and fines.
- Payroll Tax: This is the Social Security program and includes employee and employer contributions as well as other social insurance taxes (Medicare, unemployment).

Tables 13 through 17 provide data that show the tax impacts generated for the State and for each county discussed in the model.

NAU Fiscal Impact on the State—Table 13 provides the fiscal impacts identified in the statewide model resulting from NAU-related expenditures. Arizona state government and various local jurisdictions received annual revenues of nearly $43.4 million during fiscal 2003. Payments to the national government exceeded $111.5 million during this period.

Table 13

The Fiscal Impact of NAU Operations in Arizona in FY 2003

		Payments from					
		Employee Compensation	Proprietary Income	Household Expenditures	Corporations	Indirect Business Taxes	Total
Payments to Federal Government	Corporate Profits Tax	0	0	0	9,695,700	0	9,695,700
	Indirect Bus Tax: Custom Duty	0	0	0	0	10,034,800	10,034,800
	Indirect Bus Tax: Excise Taxes	0	0	0	0	3,200,700	3,200,700
	Indirect Bus Tax: Fed NonTaxes	0	0	0	0	984,500	984,500
	Personal Tax: Estate and Gift Tax	0	0	0	0	0	0
	Personal Tax: Income Tax	0	0	41,939,800	0	0	41,939,800
	Personal Tax: NonTaxes (Fines, Fees)	0	0	504,900	0	0	504,900
	Soc Sec Tax, Employee Contribution	21,495,000	1,462,000	0	0	0	22,957,000
	Soc Sec Tax, Employer Contribution	22,243,900	0	0	0	0	22,243,900
	Sub-Total	43,738,900	1,462,000	42,444,700	9,695,700	14,220,000	111,561,300
Payments to State & Local Government	Corporate Profits Tax	0	0	0	1,295,100	0	1,295,100
	Dividends	0	0	0	12,800	0	12,800
	Indirect Bus Tax: Motor Vehicle Lic	0	0	0	0	318,400	318,400
	Indirect Bus Tax: Other Taxes	0	0	0	0	690,800	690,800
	Indirect Bus Tax: Property Tax	0	0	0	0	10,520,300	10,520,300
	Indirect Bus Tax: S/L NonTaxes	0	0	0	0	2,003,500	2,003,500
	Indirect Bus Tax: Sales Tax	0	0	0	0	18,296,200	18,296,200
	Personal Tax: Estate and Gift Tax	0	0	0	0	0	0
	Personal Tax: Income Tax	0	0	6,201,200	0	0	6,201,200
	Personal Tax: Motor Vehicle License	0	0	716,400	0	0	716,400
	Personal Tax: NonTaxes (Fines, Fees)	0	0	2,606,300	0	0	2,606,300
	Personal Tax: Other Tax (Fish/Hunt)	0	0	139,200	0	0	139,200
	Personal Tax: Property Taxes	0	0	206,500	0	0	206,500
	Soc Sec Tax, Employee Contribution	78,900	0	0	0	0	78,900
	Soc Sec Tax, Employer Contribution	303,200	0	0	0	0	303,200
	Sub-Total	382,100	0	9,869,600	1,307,900	31,829,300	43,388,900
Total		**44,122,900**	**1,462,000**	**52,314,300**	**11,003,600**	**46,049,200**	**154,952,100**

NAU Fiscal Impact on Coconino County—Table 14 provides the fiscal impacts identified in the Coconino County model resulting from NAU-related expenditures in the County. Arizona state government and various local jurisdictions received annual revenues of just over $26 million during fiscal 2003. Payments to the national government were almost $60.2 million during this period.

Table 14

The Fiscal Impact of NAU Operations in Coconino County in FY 2003

		Payments from					
		Employee Compensation	Proprietary Income	Household Expenditures	Corporations	Indirect Business Taxes	Total
Payments to Federal Government	Corporate Profits Tax	0	0	0	5,482,400	0	5,482,400
	Indirect Bus Tax: Custom Duty	0	0	0	0	5,621,400	5,621,400
	Indirect Bus Tax: Excise Taxes	0	0	0	0	1,793,000	1,793,000
	Indirect Bus Tax: Fed NonTaxes	0	0	0	0	551,500	551,500
	Personal Tax: Estate and Gift Tax	0	0	0	0	0	0
	Personal Tax: Income Tax	0	0	24,195,100	0	0	24,195,100
	Personal Tax: NonTaxes (Fines, Fees)	0	0	289,800	0	0	289,800
	Soc Sec Tax, Employee Contribution	10,479,400	937,900	0	0	0	11,417,300
	Soc Sec Tax, Employer Contribution	10,844,500	0	0	0	0	10,844,500
	Sub-Total	21,323,900	937,900	24,484,900	5,482,400	7,965,900	60,194,900
Payments to State & Local Government	Corporate Profits Tax	0	0	0	732,300	0	732,300
	Dividends	0	0	0	7,200	0	7,200
	Indirect Bus Tax: Motor Vehicle Lic	0	0	0	0	191,600	191,600
	Indirect Bus Tax: Other Taxes	0	0	0	0	415,700	415,700
	Indirect Bus Tax: Property Tax	0	0	0	0	6,330,000	6,330,000
	Indirect Bus Tax: S/L NonTaxes	0	0	0	0	1,205,500	1,205,500
	Indirect Bus Tax: Sales Tax	0	0	0	0	11,008,700	11,008,700
	Personal Tax: Estate and Gift Tax	0	0	0	0	0	0
	Personal Tax: Income Tax	0	0	3,576,400	0	0	3,576,400
	Personal Tax: Motor Vehicle License	0	0	410,700	0	0	410,700
	Personal Tax: NonTaxes (Fines, Fees)	0	0	1,517,100	0	0	1,517,100
	Personal Tax: Other Tax (Fish/Hunt)	0	0	77,200	0	0	77,200
	Personal Tax: Property Taxes	0	0	122,000	0	0	122,000
	Soc Sec Tax, Employee Contribution	93,700	0	0	0	0	93,700
	Soc Sec Tax, Employer Contribution	359,800	0	0	0	0	359,800
	Sub-Total	453,500	0	5,703,300	739,500	19,151,500	26,047,800
Total		**21,778,600**	**937,900**	**30,188,200**	**6,221,900**	**27,117,300**	**86,243,900**

NAU Fiscal Impact on Maricopa County—Table 15 provides the fiscal impacts identified in the Maricopa County model resulting from NAU-related expenditures. Arizona state government and various local jurisdictions received annual revenues exceeding $4.4 million during fiscal 2003. Payments to the national government were almost $8.9 million during this period.

Table 15

The Fiscal Impact of NAU Operations in Maricopa County in FY 2003

		Payments from					
		Employee Compensation	Proprietary Income	Household Expenditures	Corporations	Indirect Business Taxes	Total
Payments to Federal Government	Corporate Profits Tax	0	0	0	1,105,200	0	1,105,200
	Indirect Bus Tax: Custom Duty	0	0	0	0	1,211,000	1,211,000
	Indirect Bus Tax: Excise Taxes	0	0	0	0	386,300	386,300
	Indirect Bus Tax: Fed NonTaxes	0	0	0	0	118,800	118,800
	Personal Tax: Estate and Gift Tax	0	0	0	0	0	0
	Personal Tax: Income Tax	0	0	2,888,900	0	0	2,888,900
	Personal Tax: NonTaxes (Fines, Fees)	0	0	34,200	0	0	34,200
	Soc Sec Tax, Employee Contribution	1,486,100	130,300	0	0	0	1,616,400
	Soc Sec Tax, Employer Contribution	1,537,900	0	0	0	0	1,537,900
	Sub-Total	3,024,000	130,300	2,923,100	1,105,200	1,716,100	8,898,800
Payments to State & Local Government	Corporate Profits Tax	0	0	0	147,600	0	147,600
	Dividends	0	0	0	1,500	0	1,500
	Indirect Bus Tax: Motor Vehicle Lic	0	0	0	0	35,700	35,700
	Indirect Bus Tax: Other Taxes	0	0	0	0	77,300	77,300
	Indirect Bus Tax: Property Tax	0	0	0	0	1,177,800	1,177,800
	Indirect Bus Tax: S/L NonTaxes	0	0	0	0	224,300	224,300
	Indirect Bus Tax: Sales Tax	0	0	0	0	2,048,400	2,048,400
	Personal Tax: Estate and Gift Tax	0	0	0	0	0	0
	Personal Tax: Income Tax	0	0	427,100	0	0	427,100
	Personal Tax: Motor Vehicle License	0	0	48,500	0	0	48,500
	Personal Tax: NonTaxes (Fines, Fees)	0	0	175,700	0	0	175,700
	Personal Tax: Other Tax (Fish/Hunt)	0	0	9,700	0	0	9,700
	Personal Tax: Property Taxes	0	0	13,700	0	0	13,700
	Soc Sec Tax, Employee Contribution	4,400	0	0	0	0	4,400
	Soc Sec Tax, Employer Contribution	17,100	0	0	0	0	17,100
	Sub-Total	21,500	0	674,700	149,100	3,563,600	4,408,900
Total		**3,045,700**	**130,300**	**3,597,800**	**1,254,300**	**5,279,700**	**13,307,800**

NAU Fiscal Impact on Yuma County—Table 16 provides the fiscal impacts identified in the Yuma County model resulting from NAU-related expenditures. Arizona state government and various local jurisdictions received annual revenues of nearly $1 million during fiscal 2003. Payments to the national government exceeded $1.6 million during this period.

Table 16

The Fiscal Impact of NAU Operations in Yuma County in FY 2003

		Payments from					
		Employee Compensation	Proprietary Income	Household Expenditures	Corporations	Indirect Business Taxes	Total
Payments to Federal Government	Corporate Profits Tax	0	0	0	173,900	0	173,900
	Indirect Bus Tax: Custom Duty	0	0	0	0	185,900	185,900
	Indirect Bus Tax: Excise Taxes	0	0	0	0	59,300	59,300
	Indirect Bus Tax: Fed NonTaxes	0	0	0	0	18,200	18,200
	Personal Tax: Estate and Gift Tax	0	0	0	0	0	0
	Personal Tax: Income Tax	0	0	566,800	0	0	566,800
	Personal Tax: NonTaxes (Fines, Fees)	0	0	7,300	0	0	7,300
	Soc Sec Tax, Employee Contribution	285,300	36,200	0	0	0	321,500
	Soc Sec Tax, Employer Contribution	295,200	0	0	0	0	295,200
	Sub-Total	580,500	36,200	574,200	173,900	263,400	1,628,300
Payments to State & Local Government	Corporate Profits Tax	0	0	0	23,200	0	23,200
	Dividends	0	0	0	200	0	200
	Indirect Bus Tax: Motor Vehicle Lic	0	0	0	0	7,800	7,800
	Indirect Bus Tax: Other Taxes	0	0	0	0	17,000	17,000
	Indirect Bus Tax: Property Tax	0	0	0	0	258,700	258,700
	Indirect Bus Tax: S/L NonTaxes	0	0	0	0	49,300	49,300
	Indirect Bus Tax: Sales Tax	0	0	0	0	449,900	449,900
	Personal Tax: Estate and Gift Tax	0	0	0	0	0	0
	Personal Tax: Income Tax	0	0	83,800	0	0	83,800
	Personal Tax: Motor Vehicle License	0	0	10,400	0	0	10,400
	Personal Tax: NonTaxes (Fines, Fees)	0	0	38,200	0	0	38,200
	Personal Tax: Other Tax (Fish/Hunt)	0	0	1,800	0	0	1,800
	Personal Tax: Property Taxes	0	0	3,300	0	0	3,300
	Soc Sec Tax, Employee Contribution	1,400	0	0	0	0	1,400
	Soc Sec Tax, Employer Contribution	5,300	0	0	0	0	5,300
	Sub-Total	6,700	0	137,500	23,500	782,600	950,300
Total		**587,300**	**36,200**	**711,700**	**197,400**	**1,046,100**	**2,578,700**

NAU Fiscal Impact on the Balance of the State—Table 17 provides the fiscal impacts identified in the Balance of the State model resulting from NAU-related expenditures. Arizona state government and various local jurisdictions received annual revenues exceeded $4.9 million during fiscal 2003. Payments to the national government were almost $8.3 million during this period.

Table 17

The Fiscal Impact of NAU Operations in the Balance of Arizona in FY 2003

		Payments from					
		Employee Compensation	Proprietary Income	Household Expenditures	Corporations	Indirect Business Taxes	Total
Payments to Federal Government	Corporate Profits Tax	0	0	0	1,201,000	0	1,201,000
	Indirect Bus Tax: Custom Duty	0	0	0	0	1,068,300	1,068,300
	Indirect Bus Tax: Excise Taxes	0	0	0	0	340,700	340,700
	Indirect Bus Tax: Fed NonTaxes	0	0	0	0	104,800	104,800
	Personal Tax: Estate and Gift Tax	0	0	0	0	0	0
	Personal Tax: Income Tax	0	0	2,786,800	0	0	2,786,800
	Personal Tax: NonTaxes (Fines, Fees)	0	0	35,000	0	0	35,000
	Soc Sec Tax, Employee Contribution	1,265,300	172,300	0	0	0	1,437,600
	Soc Sec Tax, Employer Contribution	1,309,400	0	0	0	0	1,309,400
	Sub-Total	2,574,800	172,300	2,821,700	1,201,000	1,513,900	8,283,600
Payments to State & Local Government	Corporate Profits Tax	0	0	0	160,400	0	160,400
	Dividends	0	0	0	1,600	0	1,600
	Indirect Bus Tax: Motor Vehicle Lic	0	0	0	0	40,600	40,600
	Indirect Bus Tax: Other Taxes	0	0	0	0	88,200	88,200
	Indirect Bus Tax: Property Tax	0	0	0	0	1,342,900	1,342,900
	Indirect Bus Tax: S/L NonTaxes	0	0	0	0	255,700	255,700
	Indirect Bus Tax: Sales Tax	0	0	0	0	2,335,500	2,335,500
	Personal Tax: Estate and Gift Tax	0	0	0	0	0	0
	Personal Tax: Income Tax	0	0	412,100	0	0	412,100
	Personal Tax: Motor Vehicle License	0	0	49,500	0	0	49,500
	Personal Tax: NonTaxes (Fines, Fees)	0	0	181,800	0	0	181,800
	Personal Tax: Other Tax (Fish/Hunt)	0	0	9,000	0	0	9,000
	Personal Tax: Property Taxes	0	0	15,100	0	0	15,100
	Soc Sec Tax, Employee Contribution	7,000	0	0	0	0	7,000
	Soc Sec Tax, Employer Contribution	26,800	0	0	0	0	26,800
	Sub-Total	33,700	0	667,500	162,000	4,063,000	4,926,300
Total		**2,608,600**	**172,300**	**3,489,200**	**1,363,000**	**5,576,900**	**13,210,000**

Analysis of Net Fiscal Benefits

The net fiscal benefits attributed to NAU are shown in Table 18. IMPLAN generates estimates of the increased outputs required of the government sectors in order to support NAU activities. These outputs represent costs that NAU imposes on the county or the state. The net effect on government budgets is found by comparing the revenue collections in Tables 13-17 with these increased costs. The net benefit is positive so long as the additional revenues generated in each region exceed the additional costs. Table 18 shows the fiscal impacts first for the federal government, and then for Arizona state and local governments. In each instance, the net effect shows a surplus in the governments' budgets. The positive net fiscal effects imply that NAU's operations and their associated activities have a favorable economic impact on the government budget positions.

Table 18

Net Fiscal Impacts

	Impact of Total Project
Federal Government	
Additional revenue	$111,561,300
Additional cost	$ 2,292,200
Net effect on gov't surplus	**$109,269,100**
State & Local Governments	
Additional revenue	$43,388,900
Additional cost	$ 9,241,300
Net effect on gov't surplus	**$34,147,600**

At the national level the net effect exceeds $100 million and is largely comprised of revenues paid for personal and corporate income taxes collected as well as payments into the Social Security system. At the state and local level, the net government surplus is $34.1 million and is for the most part reflecting collections of increased sales, property and income taxes along with other user fees and taxes paid by NAU households, students, visitors, retirees and alums, as well as by those businesses that benefited from NAU purchases of their goods or services.

Impacts of NAU Research-Related Expenditures

Research expenditures constitute a significant source of economic activity in the local economy. Much of this impact is difficult to quantify. For example, basic research often generates improvements in the quality of life, or results in technology transfer from the university to the business sector. University assistance to businesses and communities is often a means by which university faculty transfer knowledge directly to local constituents which then leads to changes in the future economic landscape of a region. This is no different at NAU where a lengthy history of business and economic outreach to the local region has existed. Furthermore, scientists in the fields of geology, forestry, biology and in other disciplines, provide a continuing stream of research activity that is incorporated into the future lifestyle of local citizens and others across the globe. Faculty members in Education, Engineering and Health Professions are also engaged in ongoing projects that markedly impact the world outside the walls of NAU.

The impacts of the above activities are only partially captured in an impact analysis designed to measure the economic effects of research activity. Nevertheless, research at NAU provides a major source of economic impact on Coconino County and across the State. In fiscal 2003, NAU was the recipient of $52.1 million dollars in research funding. These dollars were received from federal and state and local grants as well as from numerous non-government sources within and outside Arizona. In addition, over $8 million in Proposition 301 dollars were received during the year. The impacts of these dollars are magnified as they are spent in the state and local regions. Estimates provided by the model indicate that the impact of these research dollars in Arizona was $83,997,000 in fiscal 2003. These expenditures support numerous positions at the NAU campuses as well as contribute to significant amounts of additional expenditure statewide. Seven hundred and thirty-three positions at NAU and other locations in the state resulted directly from these research dollars in 2003. In addition, another 436 positions resulted from the additional expenditures associated with the research funding. Overall, the total number of jobs generated in the state as a result of the research dollars was 1,169.

Impacts Expected from Future Construction Activity at NAU

According to the NAU Capital Improvement Plan (CIP) for FY 2004-FY 2006, the replacement value of buildings and physical property on the Flagstaff campus is $783 million and an additional $9.3 million exists at the Yuma and Kingman locations.

Construction expense at NAU's campuses varies each year, and exceeded $18 million in fiscal 2003. Future construction over the FY 2004 though FY 2009 period is projected to reach $149 million, or an average of $24.8 million per year. This number includes $8 million in anticipated construction activity in Yuma.

While construction activity will generate $149 million in direct expenditures over this period, the total impact expected from new construction once the multiplier impacts are considered will approach $255 million in current dollars.

The employment impact of the construction activity will also be spread over six years. Average increases in direct employment for this period as a result of the construction will exceed 189 jobs per year while the overall increase in annual employment after accounting for the indirect and induced effects will add 384 new jobs per year.

Measuring the Impact Associated with a Hypothetical Decline of 1,000 Students

The IMPLAN model is particularly useful in defining the incremental changes associated with either real or hypothetical changes that occur in a region. For purposes of this section, we analyze the annual impact on Coconino County that would occur if 1,000 fewer full-time equivalent students were to leave Northern Arizona University and at the same time move away from Coconino County.

The numbers shown here reflect expected changes based upon the decreased expenditure levels that would result from the reduced number of students as well as the reduction in visitor expenditures associated with fewer visitors to these students. The figures do not include any accompanying reductions in spending by NAU or by NAU employees although these numbers would also decline over time. However, the impact of fewer students on NAU budgets and on the number of employees changes more slowly, and these effects are not easily captured in a one-year analysis.

Based on the model, we expect that overall expenditures made in Coconino County would decrease by $12.8 million in one year if one thousand fewer students attended the Mountain Campus. Once the effect of this impact is expanded to include the changes in the levels of indirect and induced expenditure, the total decline in spending in the county would reach $17.3 million on an annual basis.

Employment levels in the county would also decrease. The model estimates direct employment would decline by 222 positions throughout the county while overall employment after considering the multiplier would decrease by 282 positions. The reduction in jobs would first occur on the campus as fewer employees would be hired in residence halls, support services, and other offices on campus. However, local businesses would also reduce employment to account for reductions in sales that result from fewer students walking in the door on a daily basis.

The model further projects where the declines in expenditures and sales would occur. Table 19 shows which sectors would be impacted most severely by a reduction of 1,000 students along with the amount of the decline in direct and total expenditures. The real estate sector would experience the largest impact. Eating and drinking places, miscellaneous retail, food stores and hotels and lodging places would also be highly impacted by the loss of the 1,000 students.

Finally, we also project the tax implications surrounding a decline of 1,000 students. Local governments within Coconino County would experience a reduction in sales tax collections of $621,400 in one year based on the anticipated reduction in local spending. This amount reflects lowered tax revenues accruing to the County as well as to Flagstaff and other communities within the county that levy sales and Bed Board and Booze taxes on expenditures.

Property tax revenues would also decline as a result of reduced market assessments associated with lower housing demand in the region as well as from the number of homes and apartments that would not have to be built to accommodate these students. The model anticipates a reduction exceeding $357,000 in property taxes paid within the county.

Table 19

Reduction in Spending Activity by Sector Associated with 1,000 Fewer Students

Sector	Lower Direct Expenditure	Lower Total Expenditure
Real Estate	2,980, 600	3,510,900
Eating and Drinking	2,034,700	2,232,300
Miscellaneous Retail	1,424,500	1,522,300
Food Stores	1,114,100	1,186,500
Hotels and Lodging Places	724,500	820,100
Automotive Dealers & Service Stations	659,900	760,800
Insurance Agents and Brokers	626,100	632,200
Communications	539,900	611,600
Amusement and Recreation	449,100	476,500
Apparel and Accessory Stores	266,800	446,700
Subtotal all other sectors	1,783,000	5,088,800
Total Decline in all Sectors	**12,755,200**	**17,288,700**

Estimates of Earnings Differentials of Educational Attainment

In addition to economic impacts attributable to the expenditures analyzed throughout this report, one could also put forth the concept that the economy as well as an individual benefits from earnings differentials associated with educational attainment. One of the most important contributions that Northern Arizona University provides to Arizona's economy is the increased productivity and skills that a university graduate offers over a non-university graduate. The purpose of this section is to quantify and analyze incremental earnings of NAU graduates over their lifetimes to provide some measure of the economic impact of earnings differentials on the state's economy.

Table 20, incorporates information from the U.S. Census Bureau that shows average annual earnings correlated with educational attainment compared to a high school degree and also the incremental earnings over the prior degree.

Table 20

Average Annual Earnings by Degree

	1999 Mean Earnings	Value Added Over High School	Value Added Above Prior Degree
High School	24,572		
Bachelors	45,678	21,106	21,106
Masters	55,641	31,069	9,963
Doctorate	86,833	62,261	31,192

2002 Statistical Abstract Table No. 211
U.S. Census Bureau, Current Population Reports, P20-536

Table 21 provides data on the NAU 2003 graduating class by degree and also the number of graduates from that class who reside in Arizona. The purpose of this table, provided by the university registrar, is to identify one year's "product" or "throughput" in terms of educational attainment from the university.

Table 21

2003 NAU Graduates by Degree

Degree	2003 NAU Graduates	2003 Graduates Residing in Arizona
Bachelors	2,400	1,434
Masters	1,256	751
Doctorate	76	45
Total	**3,732**	**2,230**

Table 22 estimates the earnings differential that a recent NAU graduate can expect to earn over his or her working life above the prior degree attainment. As an example, a new graduate with a bachelor's degree can expect, on average, to earn $500,233 in additional income over his or her working lifetime when compared to a high school graduate. The lifetime earnings differential has also been "discounted" using a rate of 3% per annum to state the amount in present value, or today's, monetary units. (The economic literature concerning the appropriate discount rate for public investments is extensive. The authors' interpretation of this literature is that the long-run rate of real economic growth is a reasonable approximation of society's time preference. In the United States, the long-run rate of growth in real GDP is close to 3% per year.)

Table 22

Lifetime Earnings Differential - Above Prior Degree

Degree	Estimated Age at Graduation	Years to Age 65	Average Yearly Earnings Above Prior Degree[1]	Lifetime Differential	Present Value Factor	Present Value of Earnings Differential per Graduate
Bachelors	23	42	21,106	886,452	23.701	500,233
Masters	28	37	9,963	368,631	22.167	220,850
Doctorate	31	34	31,192	1,060,528	21.132	659,149

Assumptions:

1) Earnings differential is based on national statistics. See Table 20, Column 4.

2) Present Value discount rate assumed at 3% net of inflation.

When we consider the 3,732 graduates from NAU in 2003 as that year's output, the present value of expected lifetime earnings above prior degree attainment for that cohort can be estimated using the numbers derived in Table 22.

Table 23 shows the 2003 graduating class can expect to earn during their working lifetime an additional $1.5 billion resulting from their NAU degrees. The implications here are significant when viewed in terms of expenditures returned to the economy and increased taxes paid due to higher income levels.

Table 23

Present Value of Lifetime Earnings Differential – All 2003 NAU Graduates

Degree	Estimated Age at Graduation	Years to Age 65	Present Value of Earning Differential (Table 22)	2003 Graduates	Lifetime Earning Differential Above Prior Degree
Bachelors	23	42	500,233	2,400	1,200,559,200
Masters	28	37	220,850	1,256	277,387,600
Doctorate	31	34	659,149	76	50,095,324
Total:				**3,732**	**1,528,042,124**

Assumption:

1) Lifetime Earning Differential represents incremental earnings above prior degree attainment.

Finally, the information in Table 24 presents an estimate of the lifetime earnings differentials applicable to degree attainment for all 54,169 NAU graduates residing in Arizona. The amounts and economic implications are again significant. Table 24 shows that all NAU graduates residing in Arizona will earn, over their working lives, an additional $22 billion due to academic attainment at the university.

Table 24

Present Value of Lifetime Earnings Differential – All NAU Graduates Residing in Arizona

Degree	Estimated Age at Graduation	Years to Age 65	Present Value of Earning Differential (Table 22)	Graduates Residing in Arizona	Present Value Lifetime Earning Differential Above Prior Degree
Bachelors	23	42	500,233	36,449	18,232,992,617
Masters	28	37	220,850	17,142	3,785,810,700
Doctorate	31	34	659,149	578	380,988,122
Total:				**54,169**	**22,399,791,439**

Assumption:

1) Present value of lifetime earnings differential for all NAU graduates used for population as a whole without regard to year of graduation.

There are additional economic impact analyses that can be pursued under the differential earnings hypothesis such as the number of jobs created, taxes paid and the multiplier effects attributable to higher incomes. The purpose of this section, however, was to impart the unquestionable fact that NAU has a material effect on the state's economy that is directly attributable to educational attainment of its students while enrolled at the institution.

Appendix A:
Aggregated Impact Results

IMPLAN generates some very large tables as part of the economic impact analysis. These tables are too large to include in this report; however, the tables have been aggregated along one-digit SIC code and summary information from the aggregated tables is presented in the body of the report. The aggregated tables are included here as Appendix A. The figures presented in the tables have been rounded to the nearest whole job or the nearest whole dollar. For this reason, the individual rows may not sum to the total shown. The totals shown are accurate.

Definitions of specific terms that appear below are given here:

- *Final Demand* - the dollar value of goods and services purchased by their ultimate consumer. The tables show the change in final demand (in millions of dollars per year) due to one of the following sources of direct spending: the operations of NAU, spending by employees, students, visitors, retirees and alumni.
- *Employee Compensation Impact-* additional wages and salaries generated by NAU operations, and spending by employees, students, visitors, retirees and alumni.
- *Employment Impact* - the increase in the number of full-time jobs due to NAU operations, and spending by employees, students, visitors, retirees and alumni.
- *Indirect Business Taxes Impact* - the increase in indirect business taxes (sales and excise taxes, property taxes, etc.) due to NAU's presence and spending activity by associated parties.
- *Other Property Type Income Impact* - the increase other property-type income (e.g., rent, interest, corporate profits, surplus of government enterprises) due to NAU operations, and spending by associated parties.
- *Output Impact* - (also known as Total Industry Output, TIO) the dollar value of goods and services sold by an industry. Some of an industry's output is sold to its ultimate consumer (final demand), and some is sold to other industries for use in their production operations. The tables show how much additional output has been generated by each of the sources of direct spending analyzed in the study.
- *Proprietors' Income Impact* - the increase in proprietors' and other property owners' incomes. Since NAU is a non-profit organization, there is no direct increase in proprietors' income from its operation. However, spending by the associated parties described in the model creates additional proprietors' income.
- *Personal Income Impact* - Employee compensation plus proprietors' income and other property income.
- *Total Value Added* - value added is the income (profits and wages) generated by a firm's operations. Value added is computed as the value of a firm's output minus the value of that firm's inputs (e.g., raw materials, but not labor). The tables show the increase in value added (employee compensation, property income and indirect business taxes) as a result of the spending by NAU and associated parties.

Most of the sectors listed, such as agriculture, are commonly understood. However, the government sector is sometimes misinterpreted - it represents government spending rather than

increases in taxes. This spending is a measure of what is necessary to support additional infrastructure and services created by the activities associated with NAU. The tables use abbreviations for some of the longer sector names. These abbreviations are listed below:

- *TCPU* - Transportation, Communications and Public Utilities. A sector of the economy, an aggregation of industries thought to have similar characteristics.
- *FIRE* - Finance, Insurance and Real Estate. A sector of the economy.
- *AGG* - aggregated. For purposes of reporting, the 528 sectors have been summed to these ten broad sectors: Agriculture, Mining, Construction, Manufacturing, TCPU, Trade, FIRE, Services, Government, Other.

Economic Impacts of NAU on Arizona Statewide

Table A-1

Output Impact

Copyright MIG 2003 IMPACT NAME: **State of Arizona** MULTIPLIER: Type SAM

Description	Direct*	Indirect*	Induced*	Total*
1 Agriculture (AGG)	0	1,081,234	1,930,870	3,012,104
28 Mining (AGG)	0	361,857	277,047	638,905
48 Construction (AGG)	0	19,905,350	3,375,512	23,280,862
58 Manufacturing (AGG)	5,398,639	11,066,207	12,020,969	28,485,816
433 TCPU (AGG)	18,331,642	14,239,040	17,275,086	49,845,768
447 Trade (AGG)	120,474,480	9,366,739	51,637,540	181,478,768
456 FIRE (AGG)	72,147,288	31,672,566	56,671,296	160,491,152
463 Services (AGG)	317,008,832	61,054,952	75,097,984	453,161,792
510 Government (AGG)	1,438,006	2,905,587	5,914,778	10,258,371
516 Other (AGG)	0	0	519,090	519,090
Total of Sectors	**534,798,887**	**151,653,532**	**224,720,171**	**911,172,627**

*** 2003 Dollars**

Table A-2

Employment Impact

Copyright MIG 2003 IMPACT NAME: **State of Arizona** MULTIPLIER: Type SAM

Description	Direct*	Indirect*	Induced*	Total*
1 Agriculture (AGG)	0	25	29	54
28 Mining (AGG)	0	1	1	1
48 Construction (AGG)	0	275	41	316
58 Manufacturing (AGG)	28	62	59	148
433 TCPU (AGG)	65	78	97	240
447 Trade (AGG)	2,589	100	959	3,648
456 FIRE (AGG)	415	198	223	836
463 Services (AGG)	5,152	861	1,154	7,166
510 Government (AGG)	39	19	27	85
516 Other (AGG)	0	0	46	46
Total of Sectors	**8,287**	**1,618**	**2,636**	**12,542**

*** Number of Full-Time Jobs**

Table A-3

Employee Compensation Impact

Copyright MIG 2003 IMPACT NAME: **State of Arizona** MULTIPLIER: Type SAM

Description	Direct*	Indirect*	Induced*	Total*
1 Agriculture (AGG)	0	305,029	401,370	706,400
28 Mining (AGG)	0	10,297	8,788	19,085
48 Construction (AGG)	0	10,315,802	1,491,468	11,807,269
58 Manufacturing (AGG)	1,629,529	3,073,056	2,415,052	7,117,637
433 TCPU (AGG)	3,714,006	3,533,811	4,255,645	11,503,461
447 Trade (AGG)	50,721,024	3,785,445	21,880,842	76,387,312
456 FIRE (AGG)	9,468,395	5,229,861	7,510,905	22,209,162
463 Services (AGG)	177,034,080	31,817,644	35,025,396	243,877,120
510 Government (AGG)	1,424,776	1,292,519	1,632,433	4,349,728
516 Other (AGG)	0	0	519,090	519,090
Total of Sectors	**243,991,810**	**59,363,464**	**75,140,988**	**378,496,263**

*** 2003 Dollars**

Table A-4

Personal Income Impact

Copyright MIG 2003 IMPACT NAME: **State of Arizona** MULTIPLIER: Type SAM

Description	Direct*	Indirect*	Induced*	Total*
1 Agriculture (AGG)	0	601,584	894,860	1,496,444
28 Mining (AGG)	0	22,058	19,454	41,512
48 Construction (AGG)	0	13,314,256	1,932,556	15,246,811
58 Manufacturing (AGG)	1,855,638	4,394,775	3,972,094	10,222,507
433 TCPU (AGG)	9,377,223	6,655,183	8,410,077	24,442,483
447 Trade (AGG)	71,241,746	5,143,411	30,145,290	106,530,448
456 FIRE (AGG)	44,434,059	18,115,692	34,060,830	96,610,582
463 Services (AGG)	183,731,054	41,179,533	45,073,029	269,983,611
510 Government (AGG)	1,425,649	1,591,467	2,671,543	5,688,660
516 Other (AGG)	0	0	519,090	519,090
Total of Sectors	**312,065,368**	**91,017,958**	**127,698,823**	**530,782,147**

*** 2003 Dollars**

Economic Impact of NAU Overall on Coconino County

Table A-5

Output Impact

Copyright MIG 2003 IMPACT NAME: **Coconino County** MULTIPLIER: Type SAM

Description	Direct*	Indirect*	Induced*	Total*
1 Agriculture (AGG)	0	501,560	342,054	843,614
28 Mining (AGG)	0	2,618	1,696	4,314
48 Construction (AGG)	0	15,828,317	1,717,855	17,546,172
58 Manufacturing (AGG)	0	2,626,782	1,494,815	4,121,598
433 TCPU (AGG)	11,232,948	6,560,272	7,470,676	25,263,896
447 Trade (AGG)	82,375,744	4,340,965	27,431,560	114,148,264
456 FIRE (AGG)	39,972,252	21,128,614	28,102,868	89,203,736
463 Services (AGG)	291,415,584	22,732,822	39,283,364	353,431,776
510 Government (AGG)	874,210	2,067,110	2,528,727	5,470,047
516 Other (AGG)	0	0	60,586	60,586
Total of Sectors	**425,870,738**	**75,789,060**	**108,434,201**	**610,094,003**

*** 2003 Dollars**

Table A-6

Employment Impact

Copyright MIG 2003 IMPACT NAME: **Coconino County** MULTIPLIER: Type SAM

Description	Direct*	Indirect*	Induced*	Total*
1 Agriculture (AGG)	0	14	8	22
28 Mining (AGG)	0	0	0	0
48 Construction (AGG)	0	246	22	268
58 Manufacturing (AGG)	0	23	12	34
433 TCPU (AGG)	38	42	47	127
447 Trade (AGG)	2,044	68	624	2,735
456 FIRE (AGG)	310	137	110	556
463 Services (AGG)	4,017	406	672	5,095
510 Government (AGG)	25	20	16	60
516 Other (AGG)	0	0	4	4
Total of Sectors	**6,433**	**955**	**1,513**	**8,902**

*** Number of Full-Time Jobs**

Table A-7

Employee Compensation Impact

Copyright MIG 2003 IMPACT NAME: **Coconino County** MULTIPLIER: Type SAM

Description	Direct*	Indirect*	Induced*	Total*
1 Agriculture (AGG)	0	145,953	96,732	242,685
28 Mining (AGG)	0	405	253	659
48 Construction (AGG)	0	8,013,935	698,866	8,712,801
58 Manufacturing (AGG)	0	648,346	331,223	979,568
433 TCPU (AGG)	2,326,012	1,508,145	1,718,867	5,553,024
447 Trade (AGG)	33,563,864	1,699,714	11,386,691	46,650,268
456 FIRE (AGG)	4,575,085	2,000,641	2,145,838	8,721,563
463 Services (AGG)	162,302,592	7,941,972	17,470,304	187,714,864
510 Government (AGG)	869,104	1,185,757	891,277	2,946,138
516 Other (AGG)	0	0	48,344	48,344
Total of Sectors	**203,636,657**	**23,144,867**	**34,788,395**	**261,569,915**

*** 2003 Dollars**

Table A-8

Personal Income Impact

Copyright MIG 2003 IMPACT NAME: **Coconino County** MULTIPLIER: Type SAM

Description	Direct*	Indirect*	Induced*	Total*
1 Agriculture (AGG)	0	282,995	187,591	470,587
28 Mining (AGG)	0	789	494	1,283
48 Construction (AGG)	0	10,394,085	915,062	11,309,148
58 Manufacturing (AGG)	0	961,581	472,776	1,434,356
433 TCPU (AGG)	5,818,285	2,795,436	3,404,786	12,018,507
447 Trade (AGG)	48,047,140	2,351,455	15,939,703	66,338,298
456 FIRE (AGG)	24,721,760	12,421,883	17,098,438	54,242,080
463 Services (AGG)	167,175,314	11,584,138	22,595,747	201,355,198
510 Government (AGG)	870,131	1,216,741	1,166,504	3,253,376
516 Other (AGG)	0	0	48,344	48,344
Total of Sectors	**246,632,630**	**42,009,104**	**61,829,445**	**350,471,178**

*** 2003 Dollars**

Economic Impact of NAU Overall on Maricopa County

Table A-9

Output Impact

Copyright MIG 2003 IMPACT NAME: **Maricopa County** MULTIPLIER: Type SAM

Description	Direct*	Indirect*	Induced*	Total*
1 Agriculture (AGG)	0	101,812	72,524	174,336
28 Mining (AGG)	0	26,388	7,371	33,760
48 Construction (AGG)	0	1,108,939	227,043	1,335,982
58 Manufacturing (AGG)	708,031	990,332	855,720	2,554,083
433 TCPU (AGG)	2,912,479	1,291,423	1,066,230	5,270,132
447 Trade (AGG)	15,912,841	733,281	3,438,064	20,084,186
456 FIRE (AGG)	13,524,034	2,773,508	3,764,773	20,062,314
463 Services (AGG)	11,602,171	4,159,388	4,855,313	20,616,872
510 Government (AGG)	211,047	303,728	399,502	914,277
516 Other (AGG)	0	0	30,614	30,614
Total of Sectors	**44,870,602**	**11,488,799**	**14,717,155**	**71,076,556**

*** 2003 Dollars**

Table A-10

Employment Impact

Copyright MIG 2003 IMPACT NAME: **Maricopa County** MULTIPLIER: Type SAM

Description	Direct*	Indirect*	Induced*	Total*
1 Agriculture (AGG)	0	2	1	4
28 Mining (AGG)	0	0	0	0
48 Construction (AGG)	0	14	3	16
58 Manufacturing (AGG)	4	5	4	13
433 TCPU (AGG)	9	7	6	22
447 Trade (AGG)	300	8	61	368
456 FIRE (AGG)	64	21	14	99
463 Services (AGG)	510	56	72	639
510 Government (AGG)	5	2	2	9
516 Other (AGG)	0	0	2	2
Total of Sectors	**893**	**115**	**165**	**1,173**

*** Number of Full-Time Jobs**

Table A-11

Employee Compensation Impact

Copyright MIG 2003 IMPACT NAME: **Maricopa County** MULTIPLIER: Type SAM

Description	Direct*	Indirect*	Induced*	Total*
1 Agriculture (AGG)	0	31,540	18,693	50,234
28 Mining (AGG)	0	166	56	223
48 Construction (AGG)	0	544,445	102,920	647,365
58 Manufacturing (AGG)	194,728	277,054	171,392	643,174
433 TCPU (AGG)	585,439	320,289	271,394	1,177,123
447 Trade (AGG)	6,907,548	297,698	1,468,125	8,673,372
456 FIRE (AGG)	1,830,731	602,662	509,572	2,942,966
463 Services (AGG)	6,226,767	2,044,773	2,309,821	10,581,360
510 Government (AGG)	210,083	135,762	117,280	463,125
516 Other (AGG)	0	0	30,591	30,591
Total of Sectors	**15,955,295**	**4,254,391**	**4,999,845**	**25,209,531**

*** 2003 Dollars**

Table A-12

Personal Income Impact

Copyright MIG 2003 IMPACT NAME: **Maricopa County** MULTIPLIER: Type SAM

Description	Direct*	Indirect*	Induced*	Total*
1 Agriculture (AGG)	0	60,535	39,946	100,481
28 Mining (AGG)	0	347	118	465
48 Construction (AGG)	0	697,089	132,241	829,330
58 Manufacturing (AGG)	221,721	396,821	280,038	898,581
433 TCPU (AGG)	1,508,523	602,462	525,641	2,636,626
447 Trade (AGG)	9,549,162	403,021	2,015,137	11,967,320
456 FIRE (AGG)	8,229,481	1,659,100	2,264,005	12,152,585
463 Services (AGG)	6,944,176	2,686,081	2,963,071	12,593,327
510 Government (AGG)	210,195	170,957	191,429	572,581
516 Other (AGG)	0	0	30,591	30,591
Total of Sectors	**26,663,258**	**6,676,413**	**8,442,217**	**41,781,887**

*** 2003 Dollars**

Economic Impact of NAU Overall on Yuma County

Table A-13

Output Impact

Copyright MIG 2003 IMPACT NAME: **Yuma County** MULTIPLIER: Type SAM

Description	Direct*	Indirect*	Induced*	Total*
1 Agriculture (AGG)	0	16,325	24,756	41,081
28 Mining (AGG)	0	23,589	4,170	27,758
48 Construction (AGG)	0	216,518	41,850	258,368
58 Manufacturing (AGG)	122,822	96,479	39,953	259,255
433 TCPU (AGG)	573,645	214,798	164,639	953,081
447 Trade (AGG)	3,600,826	131,990	670,561	4,403,377
456 FIRE (AGG)	2,542,341	418,049	667,002	3,627,392
463 Services (AGG)	3,242,827	645,575	915,435	4,803,837
510 Government (AGG)	54,444	58,743	93,570	206,757
516 Other (AGG)	0	0	1,460	1,460
Total of Sectors	**10,136,904**	**1,822,066**	**2,623,396**	**14,582,366**

*** 2003 Dollars**

Table A-14

Employment Impact

Copyright MIG 2003 IMPACT NAME: **Yuma County** MULTIPLIER: Type SAM

Description	Direct*	Indirect*	Induced*	Total*
1 Agriculture (AGG)	0	0	0	1
28 Mining (AGG)	0	0	0	0
48 Construction (AGG)	0	3	1	4
58 Manufacturing (AGG)	1	1	0	2
433 TCPU (AGG)	2	1	1	5
447 Trade (AGG)	95	2	15	112
456 FIRE (AGG)	19	4	3	26
463 Services (AGG)	78	12	16	106
510 Government (AGG)	2	0	1	3
516 Other (AGG)	0	0	0	0
Total of Sectors	**197**	**24**	**37**	**259**

*** Number of Full-Time Jobs**

Table A-15

Employee Compensation Impact

Copyright MIG 2003 IMPACT NAME: **Yuma County** MULTIPLIER: Type SAM

Description	Direct*	Indirect*	Induced*	Total*
1 Agriculture (AGG)	0	3,987	5,127	9,114
28 Mining (AGG)	0	26	5	30
48 Construction (AGG)	0	94,355	15,697	110,053
58 Manufacturing (AGG)	13,505	17,295	7,025	37,824
433 TCPU (AGG)	111,018	46,523	39,400	196,941
447 Trade (AGG)	1,453,272	51,419	277,210	1,781,900
456 FIRE (AGG)	246,958	46,645	39,242	332,844
463 Services (AGG)	2,144,214	276,645	405,585	2,826,444
510 Government (AGG)	52,496	29,605	28,269	110,370
516 Other (AGG)	0	0	1,021	1,021
Total of Sectors	**4,021,463**	**566,499**	**818,581**	**5,406,543**

*** 2003 Dollars**

Table A-16

Personal Income Impact

Copyright MIG 2003 IMPACT NAME: **Yuma County** MULTIPLIER: Type SAM

Description	Direct*	Indirect*	Induced*	Total*
1 Agriculture (AGG)	0	8,807	10,828	19,635
28 Mining (AGG)	0	77	14	90
48 Construction (AGG)	0	129,485	21,677	151,162
58 Manufacturing (AGG)	15,856	23,841	9,922	49,619
433 TCPU (AGG)	291,592	80,989	74,052	446,632
447 Trade (AGG)	2,109,609	70,816	386,118	2,566,543
456 FIRE (AGG)	1,547,629	251,408	404,759	2,203,797
463 Services (AGG)	2,293,270	391,836	535,884	3,220,991
510 Government (AGG)	52,468	31,078	34,321	117,866
516 Other (AGG)	0	0	1,021	1,021
Total of Sectors	**6,310,424**	**988,337**	**1,478,597**	**8,777,358**

*** 2003 Dollars**

Economic Impact of NAU Overall on the Balance of State

Table A-17

Output Impact

Copyright MIG 2003 IMPACT NAME: **Balance of State** MULTIPLIER: Type SAM

Description	Direct*	Indirect*	Induced*	Total*
1 Agriculture (AGG)	0	115,001	90,573	205,574
28 Mining (AGG)	0	98,198	26,174	124,371
48 Construction (AGG)	0	790,504	184,420	974,924
58 Manufacturing (AGG)	2,217,573	960,799	450,212	3,628,583
433 TCPU (AGG)	3,548,185	1,365,548	1,140,748	6,054,481
447 Trade (AGG)	16,931,462	641,204	3,300,579	20,873,244
456 FIRE (AGG)	15,710,370	2,617,796	3,683,160	22,011,326
463 Services (AGG)	10,636,893	3,545,127	4,983,293	19,165,312
510 Government (AGG)	287,375	189,135	296,507	773,017
516 Other (AGG)	0	0	40,900	40,900
Total of Sectors	**49,331,857**	**10,323,312**	**14,196,564**	**73,851,732**

*** 2003 Dollars**

Table A-18

Employment Impact

Copyright MIG 2003 IMPACT NAME: **Balance of State** MULTIPLIER: Type SAM

Description	Direct*	Indirect*	Induced*	Total*
1 Agriculture (AGG)	0	3	2	5
28 Mining (AGG)	0	0	0	0
48 Construction (AGG)	0	11	2	14
58 Manufacturing (AGG)	7	6	3	16
433 TCPU (AGG)	13	8	7	28
447 Trade (AGG)	397	9	72	479
456 FIRE (AGG)	100	23	16	139
463 Services (AGG)	575	63	86	724
510 Government (AGG)	8	1	2	11
516 Other (AGG)	0	0	4	4
Total of Sectors	**1,101**	**125**	**193**	**1,419**

*** Number of Full-Time Jobs**

Table A-19

Employee Compensation Impact

Copyright MIG 2003 IMPACT NAME: **Balance of State** MULTIPLIER: Type SAM

Description	Direct*	Indirect*	Induced*	Total*
1 Agriculture (AGG)	0	34,104	24,261	58,366
28 Mining (AGG)	0	2,862	1,072	3,934
48 Construction (AGG)	0	332,000	71,346	403,346
58 Manufacturing (AGG)	350,489	251,621	92,709	694,819
433 TCPU (AGG)	698,576	307,135	263,299	1,269,010
447 Trade (AGG)	7,134,833	250,876	1,378,976	8,764,685
456 FIRE (AGG)	1,764,994	482,011	381,243	2,628,247
463 Services (AGG)	5,853,681	1,427,392	2,212,293	9,493,365
510 Government (AGG)	283,370	78,994	81,918	444,282
516 Other (AGG)	0	0	41,148	41,148
Total of Sectors	**16,085,942**	**3,166,995**	**4,548,264**	**23,801,202**

*** 2003 Dollars**

Table A-20

Personal Income Impact

Copyright MIG 2003 IMPACT NAME: **Balance of State** MULTIPLIER: Type SAM

Description	Direct*	Indirect*	Induced*	Total*
1 Agriculture (AGG)	0	67,251	49,513	116,763
28 Mining (AGG)	0	6,239	2,120	8,359
48 Construction (AGG)	0	443,354	95,485	538,839
58 Manufacturing (AGG)	493,350	361,752	149,227	1,004,329
433 TCPU (AGG)	1,822,066	596,046	560,389	2,978,501
447 Trade (AGG)	9,990,001	344,351	1,915,201	12,249,552
456 FIRE (AGG)	9,476,796	1,594,719	2,216,601	13,288,117
463 Services (AGG)	6,810,103	2,035,243	2,906,692	11,752,039
510 Government (AGG)	283,515	91,354	112,947	487,816
516 Other (AGG)	0	0	41,148	41,148
Total of Sectors	**28,875,831**	**5,540,309**	**8,049,324**	**42,465,464**

*** 2003 Dollars**

Appendix B
An Introduction to I-O Modeling[1]

Historical Development

Input-output analysis is a branch of economic statistics, specifically, econometrics. The recent emergence of input-output analysis as a useful branch of economics dates from the development by Wassily Leontief in the 1930's of a general theory of production based on the economic interdependence of producing industries of the economy.

Early economists, notably Adam Smith, were concerned with the functioning of national economies or economies as a whole. Smith and other classical economists laid the groundwork for what is now referred to as macroeconomics. Much later, Alfred Marshall and his followers focused on the economics of the household and the firm. The method of these neoclassical economists, the founders of modern microeconomics, involved partial equilibrium analysis, that is, looking at "one thing at a time." John Maynard Keynes drew upon the work of both the classical and neoclassical economists in reviving interest in aggregative economics. While the neoclassical economists had concentrated on price theory -- examination of the forces that determine prices under given market conditions -- the Keynesians were concerned with the national economic forces that determined income and employment. Keynesians were concerned with the broad aggregates of total employment, total consumption, total investment, and national income. Neither Keynes nor the neoclassical economists was directly concerned with economic interdependence, or the way individual producing industries are knitted together in the structure that is the national economy.

Any developed economy, whether national, regional, or local, is characterized by a high degree of interdependence among producing industries of the economy. Each economic industry not only produces goods or services, but is also a consumer itself, purchasing other goods and services for use in the production process. Interindustry relations were recognized long before Leontief's time. Francois Quesnay's "Tableau Economique" of 1758 developed circular flow and general equilibrium concepts. The next major economist to focus on interindustry relationships was Leon Walras, who, in the 1870's, like his neoclassical contemporaries was interested in price determination. Unlike them, however, he was interested in the simultaneous determination of all prices in the economy, that is, general equilibrium analysis rather than partial equilibrium analysis. Walras examined both the interdependence of producing industries, and what each producing industry needed from other industries to produce a unit of a finished good. Walras believed his general equilibrium model to be a purely theoretical one; the model's computational problems were formidable. Further, the kind of national economic statistics needed for the model's database were rudimentary or nonexistent in his time.

The first empirical application of the input-output model in the Anglo-American world dates from 1936, when Wassily Leontief published an input-output system of the U.S. economy. Leontief simplified Walras' generalized model so that the model's equations could be estimated empirically. He used two simplifying assumptions. First, the large number of *commodities* in the Walrasian model was aggregated into relatively few outputs, one for each *industry*[2]. Second, the supply equation for labor and the demand equations for final consumption were abandoned, and the remaining production equations were expressed in the simplest linear form.

These simplifying assumptions define a sharp difference between input-output and most other conventional economic models. The assumption of linearity does not allow factor substitution or economies of scale. Time is missing, yet the purchase of inputs by one industry to make goods to sell to other industries implies a period analysis. In the "real world," the prevalence of joint products and multiproduct plants makes it impossible to aggregate only those plants with similar output and input structures; yet, the model assumes a single homogeneous output generated from the same inputs for each producing industry.

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[1] Appendix B is quoted, with permission, from Micro IMPLAN User's Guide: Version 91-F, pages G-1 through G-15.

[2] All terms that appear in italics in the text are defined in a short glossary at the end of this appendix.

Given these assumptions, the model is starkly simple. Its key variables are the outputs of industrial categories ("industries") into which the economy is divided. Each industry's output consists of summing its sales to all other industries and to *final demand,* i.e., to ultimate consumers rather than other producing industries. The amount of each product consumed in each industry depends only on the level of output for that industry. *Equilibrium* in the economy is attained when each industry's output equals its total purchases, which are in turn determined by the output of all other industries.

Because of these simplifying assumptions, the model is empirically tractable. The implausible assumptions for the production function do not appear to restrict the model too badly. Technology changes are slow enough so that the input coefficient matrix of one year seems to be good for several years. Even out-of-date tables are useful in that they can show the maximum input requirement for each industry. Perhaps most important of all, input-output models pass the critical test: for many purposes, they predict reasonably well.

The Basic Input-Output Model

The key to input-output analysis is the construction of the input-output or *transactions table,* which shows the flow of commodities from each of a number of producing industries to all consuming industries and final demand. From these flows between economic industries, two other structural tables can be developed: (1) A table of *technical coefficients or direct requirements* (terms used interchangeably here) and (2) a table of *direct and indirect coefficients or total requirements* (also interchangeable terms). Each of these three tables and their significance is discussed below.

The Transactions Table

Given that many industries produce more than one commodity, production information is often tabulated on an industry (I) by commodity (C) basis;

1) A *Make Matrix* (CxI) contains the value of commodities produced by the different industries. Note that one particular industry may produce a variety of commodities. Normally, it is assumed that the production of multiple commodities takes the form of one principal product and one or more byproducts.

2) A *Use Matrix* (IxC) contains the value of commodities and imports used by each industry in the production process. Note that one particular type of commodity may be used by a variety of different industries.

A traditional I-0 transactions table, however, is on an industry by industry (IxI) basis. It is therefore necessary to combine the Use and Make matrices in such a way that each industry is shown buying and selling from other industries. The "Industry-Technology Assumption" presumes that any by-products of an industrial process are technically related to the main production process, so that all commodities produced by an industry are produced with the same input structure. Therefore, since industries are classified/named based on their principal output, all individual producers within a particular industry are assumed to have the same input mix regardless of their output product mix. Thus, demand for an industry's output is in effect demand for a bundle of goods -- the principal output plus any joint production generated by the industry. This one-to-one correspondence between an industry and its "bundle of goods" output, enables the Use and Make matrices to be combined into an IxI transactions table.

Table A depicts a highly simplified, aggregated version of a transactions table in which all producing industries have been aggregated into three "super-industries:" agriculture, manufacturing, and services. A transactions table portrays the dollar flows of goods and services among industries in an economy for a given accounting period. In this table, sales and purchase transactions within the economy are set forth in a matrix of rows and columns. Each row shows the output sold by each industry shown along the left-hand side of the table to each industry shown across the top of the table. Each column shows the purchases made by each industry shown along the top of the table from the industries along the left-hand side. Because this is a square table, one row corresponds to each column. The entry in each cell represents a purchase for the column industry and a sale for the row industry.

Table B-1

Illustrative Transactions Table

	Purchasing Industries				
Producing Industries	**Agriculture**	**Manufacturing**	**Services**	**Final Demand**	**Total Output**
Agriculture	10	6	2	18	36
Manufacturing	4	4	3	26	37
Services	6	2	1	35	44
Primary Inputs	16	25	38	0	79
Total Outlay	36	37	44	79	196

Thus, the entries in the first column show agriculture purchasing $10 worth of output from itself, $4 worth of output from manufacturing, $6 from services, and $16 from primary inputs (e.g. labor), summing to a total outlay of $36. Reading along the row, agriculture sells $10 worth of output to itself, $6 to manufacturing, $2 to services, and $18 to final demand. Summing the sales results in a total output value of $36.

The distinction commonly made in economic analysis between the production of goods and services and their final disposition is reflected by dividing the industries of the transactions table into four groups or "quadrants", each representing either intermediate transactions, primary inputs, or final demand. Figure I presents a theoretical table with the four divisions.

Quadrant I shows the intermediate transactions, that is, the flow of goods and services which are both produced and consumed in the process of current production. This quadrant can have as many or as few industries as desired. Limitations in data and processing equipment often restrict the number of industries included in a model to 100 or fewer, but some national models have well over 400 industries.

Final demand, or the ultimate consumers' purchases from the producing industries, is recorded in the second quadrant. (To distinguish them from the industries in Quadrant 1, the components of final demand are called "Institutions".) The third quadrant represents the primary inputs of production. Here again, the decision as to the amount of detail to include is left to the model builder. Table A has only one industry in Quadrants II and III, whereas Figure 1 shows both final demand and primary inputs broken down into four industries each, i.e., the main industries of the national accounting system.

The fourth quadrant is sometimes omitted from published input-output tables, but it should be included if portrayal of a complete economy is desired. Quadrant IV records the primary inputs into final demand institutions, including such typical entries as income of government employees (H_G in Figure 1) and imports consumed directly by households (M_C in Figure 1). Note that in input-output terms, Quadrant I is endogenous to the model, while Quadrants II, III, and IV are exogenous.

Figure B-1

Structure of an Input-Output Transactions Table

		Purchasing Sectors							
		Intermediate Demand			Final Demand				Total
		Agriculture	**Manufacturing**	**Services**	**Household Consumption**	**Government Purchases**	**Capital Formation**	**Exports**	**Gross Output**
Producing Sectors		I. Intermediate Production and Consumption			II. Final Outputs of Producing Sectors				
Intermediate Inputs	Agriculture	X_{11}	X_{1j}	X_{1n}	C_1	G_1	I_1	E_1	X_1
	Manufacturing	X_{i1}	X_{ij}	X_{in}	C_i	G_i	I_i	E_i	X_i
	Services	X_{n1}	X_{nj}	X_{nn}	C_n	G_n	I_n	E_n	X_n
Primary Inputs	Payments to:	III. Primary Inputs to Production			IV. Primary Inputs to Final Demand				
	Households	H_1	H_j	H_n	H_C	H_G	H_I	H_E	H
	Government	T_1	T_j	T_n	T_C	T_G	T_I	T_E	T
	Depreciation	D_1	D_j	D_n	D_C	D_G	D_I	D_E	D
	Imports	M_1	M_j	M_n	M_C	M_G	M_I	M_E	M
Total Gross Outlays		X_1	X_j	X_n	C	G	I	E	X

In addition to summarizing basic consumption and production patterns, a transactions table can be used to describe other economic factors. For example, the following can be calculated from Figure 1:

Summing across a row, intermediate demand plus final demand measures the Total Gross Output of industry "i". Thus, in an "n"-industry model[3]:

$$X_i = \sum_{j=1}^{n} X_{ij} + (C_i+G_i+I_i+E_i)$$

Where: X_i = *Total Gross Output of Industry j*

$\sum X_{ij}$ = *Intermediate Demand for the output of Industry i*

$(C_i+G_i+I_i+E_i$ = *Final Demand for the output of Industry i*

Summing down a column, intermediate inputs plus primary inputs yields the Total Gross Outlays of industry j. Thus:

$$X_j = \sum_{ij=1}^{n} X_{ij} + (H_j+T_j+D_j+M_j)$$

Where: X_j = *Total Gross Outlays of Industry j*

$\sum X_{ij}$ = *Intermediate Inputs for Industry j*

$(H_j+T_j+D_j+M_j)$ = *Primary Inputs for Industry j*

We may also sum across the totals row or down the totals column to obtain the economy's Total Gross Output:

$$X = \sum_{i=1}^{n} X_i + (H+T+D+M)$$

$$X = \sum_{j=1}^{n} X_j + (C+G+I+E)$$

Now, since in equilibrium,

$$\sum_{i=1}^{n} X_i = \sum_{j=1}^{n} X_j$$

all intermediate flows cancel out. We then have:

(H + T + D) + M = C + G + I + E

or: Value Added + Imports = Final Demand.

[3] The definitions of C, G, etc can be found by reading Figure 1.

Transferring imports to the right-hand side of the equation gives the traditional social accounting identity of Gross Regional Income (allocations approach) and Gross Regional Product (expenditures approach)[4] that is:

$$H + T + D = C + G + I + E - M$$

or: Gross Regional Income = Gross Regional Product[5]

Thus, Gross Regional Product can be calculated both by the traditional income allocations approach and by the expenditures approach from an input-output model transactions table.

The Technical Coefficients, or Direct Requirements Table

Table B is a table of direct requirements or technical coefficients for the illustrative transactions table, Table A. The entries in this table are to be interpreted as the minimal requirements from each of the producing industries at the left of the table in order for each industry at the top to produce one dollar's worth of output for final demand. The word "minimal" is important. If it takes 2 tons of ore to yield 1 ton of iron, no doubt the same iron could be produced from even more ore, but as long as iron ore has value, no one would be foolish enough to use more than the absolutely required 2 tons.

Table B-2

Direct Requirements Table*

	Purchasing Industries		
Producing Industries	**Agriculture**	**Manufacturing**	**Services**
Agriculture	.278	.162	.045
Manufacturing	.111	.108	.068
Services	.167	.054	.023
Primary Inputs	.444	.676	.864

* *Each entry represents the inputs that the column industry requires from the row industry to produce a dollar's worth of output.*

These direct requirements or technical coefficients are determined by dividing the column entries for agriculture, manufacturing, and services in the illustrative transactions table (Table A) by the total outlay of the respective column. In this example, the manufacturing industry requires 16.2 cents worth of input from agriculture ($6/$37), 10.8 cents from manufacturing industries, and 5.4 cents from services in order to produce one dollar of output. In other words, the 16.2 cents would be interpreted as the "dollar's worth of inputs from agriculture per dollar's worth of output from manufacturing. " The remaining inputs to the manufacturing industry come from the exogenous or primary inputs part of the model.

[4] Where the "expenditures approach" tracks purchases by an industry, while the "allocations approach" tracks sales.
[5] "Regional" refers to any functional economic unit, from national to local. The "region" is defined by the model builder.

Using standard notation (as in Figure 1), the technical coefficients, a_{ij}, shown in Table B are computed as follows:

$$a_{ij} = X_{ij}/X_j \qquad i, j = 1..... n$$

where X_{ij} is the sales by industry i to industry j, and X_j is the total purchases of industry j. By definition, $X_j = X_i$ for all endogenous industries, i.e., all producing industries within the technical coefficients matrix of Quadrant I. The computation of a_{ij} for all cells in the first quadrant of the transactions table results in a matrix of a_{ij}'s or a "direct coefficients" table. Each column of a_{ij} represents a production function for that industry. Economists define the production function as the physical relation between the value of resource inputs and the value of the output of goods and services.

The direct coefficients embody most of the simplifying assumptions of input-output analysis. Input-output economics assumes that fixed proportions exist in all production processes; thus, the direct coefficients are constants. Once the coefficients have been developed, they remain constant for as long as the model is used. Further, when output is to be increased n times, all inputs must also be increased n times. This property, called constant returns to scale, means that average cost in real terms is the same at all output levels. Once an optimal combination of input factors is chosen, any level of output is obtainable simply by adjusting all inputs proportionately to the new output level. In addition, constant coefficients imply no substitution among inputs. A third condition implied by constant coefficients is production by each industry of a single, unvarying output. An aggregated industry is assumed to continue to produce the same average or homogeneous product it did at the time the model was developed.

These conditions, in defiance of many other economic models and theory, may not be unreasonable when one examines reality. There are many ways of producing any good. Each method uses some set of fixed proportions among inputs. Among all the possible ways, one is best at any given moment; that is the method which firms use. In this case, one may think of input-output tables as reflecting the set of "best" processes existing at that moment. That is, once a production method is adopted, it will be retained for a certain period, and it may be used to attain all possible output levels. The process may well change over time; therefore, the technical coefficients in an input-output system should be reviewed from year to year.

Economists usually assume that when output increases, the input requirements may increase more or less in direct proportion to the increase in output. However, statistical evidence suggests that the average cost of goods is independent of the scale of output in a great many cases. Thus, although not totally defensible theoretically, the assumptions brought about by constant coefficients in the input-output system may not be too much out of line with available facts. The important point is that if one is willing to accept the input-output assumptions, one can present the inter-industrial technical relations of the entire economy very neatly in a single input-output table. Such a table can be made and used, whereas without such simplifying assumptions, model estimation is not possible.

The Direct and Indirect Coefficients or Total Requirements Table

One of the most important applications of the input-output model is to calculate the equilibrium output levels in each industry of the economy. Output is in equilibrium if it is just equal to the quantity demanded for all purposes, such as inputs for production, consumption, investment, and exports. Once the transactions table is balanced (X_i's equal X_j's; i=j) and aggregate final demand equals aggregate primary inputs, an equilibrium exists.

Now suppose that someone, probably in a final demand institution, would like to buy more. This starts a chain reaction of increasing production everywhere. Using the table of technical coefficients (Table B) and given a lot of time, it is possible to calculate by hand the reaction as it ripples through all industries in the economy.

For example, suppose a foreign country would like to purchase $1 more from the agriculture industry. Using Table B, one can trace through the results. In order to sell an additional dollar's worth of output to final demand (in this case, exports), the agriculture industry must purchase 27.8 cents of output from itself, 11.1 cents output of output from the manufacturing industry, and 16.7 cents of output from the services industry. This is the first round. Now for agriculture to sell 27.8 cents to itself, it must again purchase 7.7 cents more output ($.278 times $.278) from itself and 3.1 cents ($.278 times $. 111) from manufacturing and 4.6 cents ($.278 times $.167) from services. The second round is not finished, because for manufacturing to sell 11.1 cents to agriculture, it must buy 1.8 cents ($.111 times $.162) from

agriculture, 1.2 cents ($.111 times $.108) from itself, and 0.6 cents ($.111 times $.054) from services. Services must also purchase 0.8 cents (16.7 cents times .045) from agriculture, 1.1 cents (16.7 cents times .068) from manufacturing, and 0.4 cents (16.7 cents times .023) from itself to sell 16.7 cents to agriculture. In just the first two rounds, agriculture has produced $1 for export, 27.8 cents plus 7.7 cents for itself, 1.8 cents for manufacturing, and 0.8 cents for services, totaling $1.38. Now, if one were to follow this process ad infinitum, the total amount each industry would be required to produce could be calculated.

Leontief devised a much simpler method of determining the total output requirements resulting from a final demand change using matrix algebra techniques. The Leontief method determines total industry requirements directly. (If one desires the round-by-round effects, the cumbersome method described above would have to be used).

The Leontief method can be demonstrated using the information on final demands and total outputs from Table A combined with the information contained in Table B. From this information, the following system of equations can be developed:

$$X_1 = .278\ X_1 + .162\ X_2 + .045\ X_3 + Y_1$$
$$X_2 = .111\ X_1 + .108\ X_2 + .068\ X_3 + Y_2$$
$$X_3 = .167\ X_1 + .054\ X_2 + .023\ X_3 + Y_3$$

where X_1, X_2, and X_3 are the total outputs of the three endogenous industries, while Y_1, Y_2, and Y_3 are the respective processing industries' sales to final demand, and the coefficients are the entries in the direct requirements table (Table B).

In matrix notation, the system becomes:

$$\begin{bmatrix} X_1 \\ X_2 \\ X_3 \end{bmatrix} = \begin{bmatrix} .278 & .162 & .045 \\ .111 & .108 & .068 \\ .167 & .054 & .023 \end{bmatrix} \cdot \begin{bmatrix} X_1 \\ X_2 \\ X_3 \end{bmatrix} + \begin{bmatrix} Y_1 \\ Y_2 \\ Y_3 \end{bmatrix}$$

or more simply stated:

$$\mathbf{X = AX + Y}$$

where **X** is the vector of total outputs, **A** is the matrix of direct coefficients, and **Y** is the vector of final demands.

The above may also be written:

$$X_1 - .278\ X_1 - .162\ X_2 - .045\ X_3 = Y_1$$
$$X_2 - .111\ X_1 - .108\ X_2 - .068\ X_3 = Y_2$$
$$X_3 - .167\ X_1 - .054\ X_2 - .023\ X_3 = Y_3$$

or:

$$(1 - .278)\ X_1 - .162\ X_2 - .045\ X_3 = Y_1$$
$$- .111\ X_1 + (1 - .108)\ X_2 - .068\ X_3 = Y_2$$
$$- .167\ X_1 - .054\ X_2 + (1 - .023)\ X_3 = Y_3$$

Again, in matrix notation:

$$\begin{bmatrix} (1-.278) & .162 & .045 \\ .111 & (1-.108) & .068 \\ .167 & .054 & (1-.023) \end{bmatrix} \cdot \begin{bmatrix} X_1 \\ X_2 \\ X_3 \end{bmatrix} = \begin{bmatrix} Y_1 \\ Y_2 \\ Y_3 \end{bmatrix}$$

which may also be written:

$$\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} - \begin{bmatrix} .278 & .162 & .045 \\ .111 & .108 & .068 \\ .167 & .054 & .023 \end{bmatrix} \cdot \begin{bmatrix} X_1 \\ X_2 \\ X_3 \end{bmatrix} = \begin{bmatrix} Y_1 \\ Y_2 \\ Y_3 \end{bmatrix}$$

and may be reduced to:

$$\mathbf{(I - A)\ X = Y}$$

where **I** is the identity matrix, **(I - A)** is called the Leontief matrix, and **A**, **X**, **Y** are as defined previously.

The coefficients are now in the proper form to solve the Leontief system and find the vector of outputs required to sustain a given vector of final demands. The mechanical process is first to find the Leontief inverse or the inverse of the Leontief **(I-A)** matrix. Inversion techniques are available in many math books, so they will not be dwelt on here. The Leontief inverse $\mathbf{(I - A)^{-1}}$ is defined as the *total requirements matrix* and is presented in Table C.

Table B-3

Direct Requirements Table*

	Purchasing Industries		
Producing Industries	**Agriculture**	**Manufacturing**	**Services**
Agriculture	1.4459	.2678	.0852
Manufacturing	.1996	1.1628	.0901
Services	.2582	.1100	1.0431
Primary Inputs	1.91	1.54	1.22

* *Each entry represents the output required both directly and indirectly from the row industry per dollar of deliveries to final demand by the column industry*

To develop a solution, we must pre-multiply both sides of the above equation by the Leontief inverse, as follows:

$$\mathbf{(I - A)^{-1}\ (I - A)\ X = (I - A)^{-1}\ Y}$$

which reduces to:

$$\mathbf{X = (I - A)^{-1}\ Y}$$

Using the information in table form and the above matrix, we can develop the following system of equations:

$$X_1 = 1.4459\ Y_1 + 0.2678\ Y_2 + 0.0852\ Y_3$$
$$X_2 = 0.1996\ Y_1 + 1.1628\ Y_2 + 0.0901\ Y_3$$
$$X_3 = 0.2582\ Y_1 + 0.1100\ Y_2 + 1.0431\ Y_3$$

Returning to our example, when a foreign country (or final demand institution outside of the model "region") wants to purchase $1 more from the agriculture industry, we would like to determine the total increase in output resulting from this $1 increase in final demand.

Using the above system of equations and looking at the $1 increase only, agriculture sales to final demand (Y_1) would equal 1, and manufacturing (Y_2) and services (Y_3) sales to final demand would be zero. After multiplying through, agriculture total output (X_1) equals $1.4459 (1 times the coefficient associated with Y_1), manufacturing output (X_2) equals $.1996, and services output (X_3) equals $.2582. Summing the three outputs, we find the total increase in output resulting from a $1 increase in final demand of the agriculture industry to be $1.91. We have found the total output, both direct and indirect, that this hypothetical economy is required to produce in order for the agriculture industry to sell one more dollar of output to a final demand industry. The total output requirement divided by the output sold to the final demand industry is designated as the "output multiplier. " The output multiplier is calculated by summing the appropriate column of the Leontief inverse. As presented in the total requirements table (Table C), by summing each column the output multipliers are 1.91, 1.54, and 1.22 for the agriculture, manufacturing, and service industries, respectively.

Multipliers

We have seen how input-output analysis is developed to tell us the effect on total output resulting from a given change in the amount of output purchased by a final demand institution. The answer is straightforward and involves only an interpretation of the Leontief inverse. The output directly sold to final demand is exogenous to the model, i.e., it must be determined outside the model. Once this "direct" change is determined, the direct and indirect outputs by industry can be calculated by premultiplying by the Leontief inverse.

The output multiplier developed in the previous subsection relates an increment of direct or final output to the resulting increment of total output -- direct and indirect combined. Although the output multiplier represents total requirements per unit of final output, it is not a particularly useful concept except as an indicator of the degree of structural interdependence between each industry and the rest of the economy. There are, however, many other multipliers that can be developed with input-output analysis, depending on the purpose of the economic study. Income and employment are the multipliers of interest in most studies, although, in recent years, water and pollution multipliers have also been frequently used. A multiplier can be developed for most any input or factor that has a determinable relationship with a industry's output. For more information, see Appendix E of the Micro IMPLAN User's Guide - "Multipliers".

IMPLAN's Glossary of Terms

Byproducts: During the production process, an industry may produce more than one output. The industry is classified according to the primary product, while secondary products are termed "*byproducts*".

Commodities: The goods and services produced by industries are classified in terms of one or more product types, or "*commodities*".

Direct and Indirect Coefficients (see also Total Requirements): The amount of output from industry i required (both directly and indirectly) to deliver one dollar's worth of industry j's output to final demand.

Direct Requirements (see also Technical Coefficients): The dollar value of industry i's output required by industry j to produce one dollar's worth of output.

Equilibrium: In the I-0 sense, equilibrium occurs when Total Gross Output equals Total Gross Outlays.

Final Demand: The ultimate consumers of commodities (goods and services).

Industry: The manufacturer or provider of goods and/or services. Industries are categorized on the basis of their primary product, though they may produce a range of commodities.

Make Matrix: The values of commodities (columns) produced by the different industries (rows). The sum of each row is that industry's Total Industry Output. The sum of each column is that commodity's Gross Commodity Production.

Technical Coefficients (see also Direct Requirements): The dollar value of industry i's production required by industry j to produce one dollar's worth of output.

Total Requirements Matrix (see also Direct and Indirect Coefficients): The amount of output from industry i required (both directly and indirectly) to deliver one dollar's worth of industry j's output to final demand.

Transactions Table: The flow of commodities from each of a number of producing industries to all consuming industries and final demand. This flow is expressed in terms of the dollar value of the commodities traded.

Use Matrix: The values of commodities and imports (rows) used in production by each industry (columns). The sum of each column is that industry's Gross Industry Commodity Demand. The sum of each row is the Intermediate Demand for that commodity.

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