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CAROLE KEETON STRAYHORN • Texas Comptroller of Public Accounts

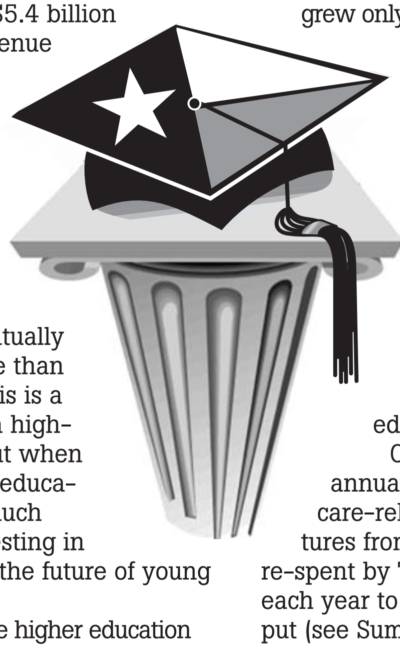
# The Impact of the State Higher Education System on the Texas Economy

*"Every dollar invested in our state's higher education system pumps more than five dollars into our Texas economy. It is a remarkable return on our money for Texans today and a vital stake in the future for successful generations of Texans tomorrow."*

—Carole Keeton Strayhorn

Higher education has a significant impact on the Texas economy, fueling the Texas economic engine with $28.7 billion a year. Considering that the system receives approximately $5.4 billion annually in state general revenue and local property taxes, every dollar invested in the state's higher education system eventually returns more than $5 to the Texas economy. This is a remarkable return, even for a high-stakes technology startup. But when it comes to the Texas higher education system, the stakes are much higher. For here, we are investing in our most important venture—the future of young Texans.

***Every dollar invested in the state's higher education system returns more than $5 to the Texas economy.***



Even with this vital role, state higher education funding is losing ground to other services. After adjusting for inflation, spending on public safety and corrections increased 258 percent in the last 15 years, while real higher education expenditures grew only 39 percent during the same period.

This report investigates the economic impact of higher education through two broad avenues. The first and most immediate impact is the additional sales, income and employment created by outside dollars being injected into the Texas economy. The second, which is fundamentally more important, is the longer-term role higher education plays in expanding the capacity of the state's economy through a more educated, productive work force.

Our study shows that $2.5 billion in annual student, research and health care-related higher education expenditures from out-of-state sources is spent and re-spent by Texas businesses and consumers each year to total $8.0 billion in economic output (see Summary Table 1). This gain could grow even more. If the currently unallocated $36 million in federal indirect cost recoveries were re-directed to public universities for research purposes, Texas would gain $118 million per year as the additional funds ripple through the economy.

While the first, more immediate, economic impact of higher education helps provide jobs and pay the bills, the second effect is more important over the longer term. As higher education raises the skill level of the work force, employees work smarter. This increases the overall capacity of the economy to produce more with the same number of employees—meaning that there is a larger economic pie to share with everyone.

To measure the second, "supply-side" impact, this report uses two approaches. First, based on the estimated lifetime earnings of our graduates, we estimate that the Texas higher education system eventually increases the economic output of the state by $23.5 billion a year. Second, by using a National Bureau of Economic Research statistical relationship between firm-level worker education and economic output, we estimate that each year of knowledge added by the higher education system increases Texas worker productivity by $18 billion over the workers' lifetime in the state labor force.

Considering both the earnings and productivity-based approaches, the Texas higher education system eventually expands the productive capacity of the Texas economy an average of $20.7 billion a year. Adding this "supply-side" gain to the $8.0 billion impact from out-of-state expenditures brings the total impact of the state higher education system on the Texas economy to $28.7 billion a year.

Higher education's contribution to the Texas economy is substantial compared to other industries. In fact, the sum of three years of higher education's economic impact far surpasses Texas' $68 billion oil and gas industry or $72 billion high technology business.

Even that does not tell the whole story. Because it is so difficult to measure, this analysis cannot account for the many other offshoots of higher education, including inventions, patents and the general advancement of knowledge—which has played such a substantial role in the success of the U.S. economy. Also, although higher education's role is generally accepted, this study does not account for its role in attracting firms and workers from other states, research and development spin-offs and the other economic development in Texas. ✯

## EXECUTIVE SUMMARY

- Over time, state higher education contributes $28.7 billion annually to the Texas economy. This is greater than a $5 economic return for every $1 in state government appropriations.
- Spending and re-spending of out-of-state higher education student, research and health care expenditures add $8.0 billion per year to state economic output.
- The higher earnings and productivity of higher education's students eventually increases state economic capacity by another $20.7 billion per year.
- Even with these positive impacts, state higher education funding is losing ground to other areas.
- The current allocation of public university federal indirect cost recovery funding restricts state economic growth.
- Difficulties quantifying general knowledge and economic development roles of higher education understate even these total estimated impacts. ✯

SUMMARY TABLE 1

## Estimated Impact of Texas Higher Education System on State Economic Output, FY00-01

**(Amounts in Million $)**

| | Economic Impact | Earnings Method | Productivity Method | Average |
|---|---|---|---|---|
| **Multiplier Impacts** | | | | |
| Student Expenditures | $2,628 | | | |
| Research & Related Expenditures | $4,396 | | | |
| MD Anderson Cancer Center | $969 | | | |
| Total Multiplier Impacts | $7,993 | | | $7,993 |
| **Discounted Earnings Gains** | | | | |
| Sub-Baccalaureate Degrees(1) | $3,124 | | | |
| Bachelor's Degrees | $6,605 | | | |
| Advanced Degrees(2) | $2,890 | | | |
| Total Earnings Gains(3) | $12,618 | $23,454 | | |
| **Discounted Productivity Gains** | | | | |
| Manufacturing | $2,079 | | | |
| Non-Manufacturing | $15,916 | | | |
| Total Productivity Gain | $17,995 | | $17,995 | |
| Average Earnings/Productivity Gains | | | | $20,725 |
| Total Economic Impact | | $23,454 | $17,995 | $28,718 |
| **State and Local Funding** | | | | |
| 2000-01 State GR Appropriation/Year(4) | $4,641 | | | |
| Less: Texas A&M Services | $146 | | | |
| Plus: Available University Fund | $326 | | | |
| Direct Educational Appropriation | $4,821 | | | |
| Plus: Community College Property Tax | $536 | | | |
| Total State & Local Funding | $5,358 | | | |

(1) Includes community college certificates, some college and associate's degrees.
(2) Includes master's, doctoral and professional (including medicine and law) degrees.
(3) In order to estimate productivity gain, discounted earnings gain is divided by earning's 54 percent share of Texas economic output.
(4) Includes undedicated general revenue and employee benefits.

Sources: Carole Keeton Strayhorn, Texas Comptroller of Public Accounts and Legislative Budget Board, *Fiscal Size Up: 2002-03 Biennium.*

# I. Introduction

The Texas higher education system consists of 142 public and private colleges, universities and health-related institutions and teaching centers, including 101 state-supported and 41 private institutions. The enrollment in all colleges and universities in the state in the fall of 2001 was approximately 1 million and is expected to reach nearly 1.2 million students by 2015.

Texas, more than any other of the most populous states, depends heavily upon public, rather than private higher education institutions, to educate its students. Almost 90 percent, or 925,000 students, are enrolled at its publicly-funded institutions, which include 57 community colleges and other two-year institutions (480,000), 35 universities (432,000), and nine public health-related institutions (13,100).[1] Public higher education in the state is funded through a combination of tuition, student fees, hospital and clinic revenue and other local funds (including gifts from benefactors), income from the Permanent University Fund and general revenue appropriations made by the Legislature. Tuition rates are set by each institution's boards of regents within a range prescribed by the Legislature; institutions may double the maximum tuition rate for graduate students. The boards of regents of the various colleges and universities also set many student fees.

***After adjusting for inflation, spending on public safety and corrections increased by 258 percent and health and human service expenditures increased by 161 percent from 1984-85 to 2000-01, while real public and higher education expenditures increased by only 82 percent and 39 percent, respectively, during this period.***

Tuition for general academic institutions (public universities and state colleges) may range from a minimum of $44 per hour up to a maximum of $88 per hour in 2002-2003 for resident students. Resident tuition rates at public institutions are somewhat below the national average rate for undergraduate tuition at public colleges and universities. Nonresident tuition is $262 to $306 per semester credit hour in 2002-2003 and is set to equal the average nonresident tuition charged by the five most populous states, excluding Texas. Graduate tuition varies by program, with institutions allowed to charge up to twice the undergraduate rate. Tuition and fees for certain professional fields are higher.

During the 2002-2003 biennium, state higher education "all-funds" appropriations totaled $15.7 billion, or almost 14 percent of the state budget. This was an increase of $1.6 billion, or 11.3 percent, over total higher education funding in 2000-01. Of this amount, general revenue totals $10.6 billion. Student-paid tuition and fees and the clinic and hospital revenues of health-related institutions generate most of the remaining $5.1 billion.[2]

Even though state higher education financing is increasing, it is still losing ground to other areas. After adjusting for inflation, spending on public safety and corrections increased by 258 percent and health and human service expenditures increased by 161 percent from 1984-85 to 2000-01, while real public and higher education expenditures increased by only 82 percent and 39 percent, respectively, during this period. From 1984-85 to 2000-01, total inflation-adjusted state spending doubled.[3] Texas also continues to trail most other large states in higher education funding. Even though state public university funding increased by 36 percent from 1992-93 to 1997-98, on a per-capita basis, Texas still ranked 8th out of the 10 most populous states on state appropriations per full-time equivalent student.[4]

**Previous Studies**

At least five previous studies have attempted to quantify the impact of the Texas higher education system on the state economy. The first and most ambitious was the study of the University of Texas System conducted by UT Austin's Bureau of Business Research (BBR) in the summer of 1994.[5] Similarly, in 1998 Resource Economics conducted a more narrowly focused study of the University of Houston System.[6] CC Benefits has recently completed a fairly comprehensive study of the economic benefits of the state's public community college system. Finally, the Texas Faculty Association and the Texas Guaranteed

Student Loan Association have carried out two more succinct studies of the statewide higher education system in recent years.

**UT System Study**

Based on operating budget summaries and a survey of its component institutions and other sources, the BBR found that University of Texas system attracted a total of $835 million to the state in 1994. This total included $659 million in research and development funding and $176 million in out-of-state and international student expenditures. Then, based on economic multipliers from the Comptroller's input-output study,[7] the BBR estimated that these $835 million in outside revenues directly and indirectly support a total of $2.4 billion in business activity, $1.6 billion in personal income and 35,623 jobs throughout the state.[8]

In addition to the immediate economic impact, BBR also looked at the long-term effect of a University of Texas education on the earnings of its graduates. Here, based on U.S. earnings differentials between high school and college graduates and the direct and indirect costs—including lost wages—of an average UT System four-year education, the study estimated that the annual rate of return on an average system bachelor's degree was approximately 14.5 percent. Finally, using an approach suggested by Gary Becker and Edward Denison,[9] the UT analysis suggests that because of "advances in knowledge" caused by university research, the total social return to the Texas economy from a college education and associated research is closer to 20 to 25 percent.[10]

**University of Houston Study**

Unlike the UT System study, Resource Economics concentrated on analyzing only the long-term economic return instead of shorter-term multiplier effects in its study of the University of Houston (UH). On the other hand, the UH System looked at a much wider range of graduates than UT.

Following an approach similar to the BBR, Resource Economics found that the rate of return from a BA/BS degree at the University of Houston was 16.2 percent. For higher-level degrees, the annual rate of return ranged from 10.5 percent for a PhD, to 14.1 percent for a master's and to 17 percent for a professional degree, such as law and optometry. Then, by discounting future earnings by 5 percent and reducing this total by current direct and indirect college costs (including foregone earnings), Resource Economics found that the net present value of a UH bachelor's, master's, doctoral and professional degrees was $205,000; $266,000; $341,000; and $341,000 respectively. Finally, based on these net present values and UH's 5,100 average annual number of graduates,[11] Resource Economics calculated that in 1998, the system contributed about $1.3 billion in annual income to the Texas economy.

**Community College Study**

Under contract with the Texas Association of Community Colleges, CC Benefits found that overall community colleges have a $13.5 billion economic impact on the state, directly and indirectly supporting a total of 351,530 jobs.[12] Although impressive, these results are not directly comparable to the estimate of the statewide economic benefits of the public higher education system presented in this report for two reasons.

First, in computing its $1.9 billion in direct and indirect benefits of college operations, CC Benefits uses essentially all the $1.2 billion in community college faculty and staff earnings. These state and locally funded earnings, however, would probably have been spent on other in-state purposes, Chapter II of this report follows the example established by other regional studies and uses only the relatively small share of faculty and higher education funding financed from federal and other out-of-state sources to compute multiplier-based statewide economic impacts.

Second, rather that focusing on one year of students or graduates, as in Chapter III and IV of this report, CC Benefits accumulates economic returns from 30 years of former community college students currently working within the state. Overall, CC Benefits compute that 167.1 million credit-hours of past community college instruction "embodied" in the work force directly account for $5.3 billion, or just more than 1 percent of total statewide earnings. CC Benefits then goes a step further to applying additional multiplier impacts to compute a total statewide economic impact (from these $5.3 billion in community college-attributed earnings) of $11.6 billion. As noted above, however, this sort of multiplier analysis may be inappropriate here because, except for a few export-based industries, most of the Texas economy is driven largely by in-state dollars.

**Statewide Studies**

The Texas Faculty's Association report, *The Economic Value of Higher Education in Texas* was written apparently in response to reductions in the higher education budget under consideration during the 1991 legislative session. In this environment, the study pointed out that based on the average 12 percent national-level rate of return, the $2.7 billion invested by the state in fiscal 1991 in higher education would pay for itself in economic output by 1997.

In 1997, another similarly-titled statewide study, *Economic Returns from Higher Education in Texas* by Texas Perspectives for the Texas Guaranteed Student Loan Association, concentrated once again on the returns from just a bachelor's degree. Based on the earnings differential between a college and high school degree, an annual direct education cost of $10,000 per year (for four years), foregone earnings while attending college, and a discount rate of 6 percent, Texas Perspectives estimates the net present value of a bachelor's degree to be $208,000. Moreover, although it is not presented, the baccalaureate rate of return, under these assumptions would be just over 12 percent.[13]

**Implications of Previous Research**

By focusing on a particular institution or type of economic impact, none of these studies present a complete picture of the impact of the higher education system on the Texas economy. The University of Texas and University of Houston studies offer the most comprehensive economic impacts, but focus on those two institutions alone.

Furthermore, by generally ignoring the fact that not all of the earnings gained from a higher educational degree are gained from the education itself rather than the innate abilities of the student, all of these studies probably overstate the economic return from a higher education degree. Most of these studies also assume that all college attendees work after graduation—an assumption that is not supported by the data.[14] Given the scope and limitations of previous work, a more comprehensive and realistic study of the impact of the state higher education system on the Texas economy is clearly needed. ✯

# II. Economic Impact of Out-of-State Expenditures

Regional economists have long used input-output analysis to estimate the impact of expenditures from outside sources on the regional economy.[15] Here, we use Type II final demand multipliers from the Comptroller's 1986 input-output study to determine the business and household spending generated by out-of-state higher educational students and federal expenditures.[16]

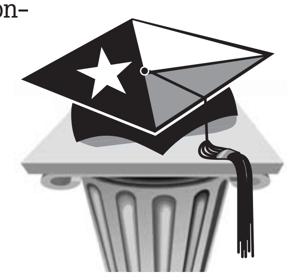
Our analysis indicates that in fiscal 2001, an estimated $878 million in expenditures by out-of-state and international students at community and technical colleges, public universities, and health-related institutions supported a total of $2.6 billion in economic activity across the state. During the same year, about $1.3 billion in federal and privately supported research added another $4.4 billion annually to the state economy. Finally, $276 million in out-of-state and international expenditures at the University of Texas' MD Anderson Cancer Center contributed another $969 million to the Texas economy in fiscal 2001. Altogether, the $2.5 billion in out-of-state student and higher education-related research and health care expenditures produced a total of $8.0 billion in economic activity in Texas each year.

### Out-Of-State Student Expenditures

In this analysis, direct out-of-state student expenditures were estimated first by calculating per-capita expenditures by institution and program for five purposes: 1) tuition and fees, 2) books and supplies, 3) room and board, 4) transportation and 5) personal expenses. These per-capita expenditures were then multiplied by the number of full-time equivalent students at each institution to determine average per-capita expenses, by category, for community college, bachelor's, master's, doctoral and professional (primarily law and medicine) programs. The resulting estimated average per-capita expenditure, in each category, was then multiplied by the number of out-of-state and international students in the program in 2001 to determine total out-of-state expenditures (see Table 2.1).[17]

Probably the most difficult data to obtain for this portion of the study was out-of-state tuition and fees by institution and program. Unfortunately, there is no central source for this information. Since the Texas Higher Education Coordinating Board gathers only information on in-state and out-of-state, community college and undergraduate costs, information on out-of-state graduate and professional tuition and fees was collected from a wide range of disparate sources, including U.S. News' *America's Best Graduate Schools* and directly from the individual institutions.

Almost half, or $389 million, of the estimated $878 million in out-of-state and international student higher education-related expenditures are for tuition and fees. The bulk of the remaining expenses are for room and board. Multiplying these out-of-state tuition and fees, room and board and other expenditures by the appropriate multiplier yields a total economic impact on the state of about $2.6 billion.



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### Research and Related Expenditures

The Texas Higher Education Coordinating Board reports that Texas higher education institutions spent $1.8 billion on research and related expenditures in fiscal 2001. Well over half the total, or $991 million in funding, was supported by the federal government. Other major sources of research-related funding included state government ($357 million), private corporations ($333 million) and locally generated institutional funding ($129 million). See Table 2.2.

By far, the greatest beneficiary of higher education research-related expenditures is medical sciences. In fiscal 2001, higher education spent a total of $586 million on researching the cause, prevention and treatment of a wide range of diseases including cancer, heart and vascular diseases and diabetes (see Table

**Table 2.1**

## Economic Multiplier Impacts of Out-of-State Higher Education Student Expenditures, Fiscal 2001

| | Number of Students[1] | | | Average Expenses per Student | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Total | Int'l & Out-of-State | | Tuition & | Books & | Room & | Trans- | Personal | Total |
| **Institution** | **FTEs** | **Percent** | **Number** | **Fees** | **Supplies** | **Board** | **portation** | **Expenses** | **Expenses** |
| Community & Technical Colleges | 263,479 | 6.0% | 15,809 | $2,604 | $759 | $4,198 | $1,214 | $1,332 | $10,107 |
| Public Universities | | | | | | | | | |
| Bachelor's Programs | 296,411 | 10.5% | 31,123 | $9,006 | $759 | $5,746 | $1,360 | $1,643 | $18,514 |
| Master's Programs | 43,896 | 10.5% | 4,609 | $9,867 | $797 | $5,746 | $1,360 | $1,643 | $19,413 |
| Doctoral Programs | 12,102 | 10.5% | 1,271 | $7,082 | $835 | $5,746 | $1,360 | $1,643 | $16,666 |
| Professional Programs | 5,610 | 10.5% | 589 | $14,022 | $899 | $5,746 | $1,360 | $1,643 | $23,670 |
| Total University Programs | 358,019 | 10.5% | 37,592 | $9,125 | $768 | $5,746 | $1,360 | $1,643 | $18,643 |
| Health-Related Institutions | | | | | | | | | |
| Bachelor's Programs | 2,661 | 9.5% | 253 | $9,178 | $724 | $5,389 | $1,578 | $1,563 | $18,432 |
| Master's Programs | 2,445 | 9.5% | 232 | $7,521 | $790 | $5,389 | $1,578 | $1,563 | $16,841 |
| Doctoral Programs | 1,556 | 9.5% | 148 | $5,545 | $859 | $5,389 | $1,578 | $1,563 | $14,934 |
| Professional Programs | 5,945 | 9.5% | 565 | $20,429 | $2,036 | $5,389 | $1,578 | $1,563 | $30,995 |
| Total Health-Related Programs | 12,607 | 9.5% | 1,198 | $13,714 | $1,372 | $5,389 | $1,578 | $1,563 | $23,616 |
| **Institution** | | | | **Total Student Expenditures (Millions of $)** | | | | | |
| Community & Technical Colleges | | | | $41 | $12 | $66 | $19 | $21 | $160 |
| Public Universities | | | | $332 | $29 | $216 | $51 | $62 | $689 |
| Health-Related Institutions | | | | $16 | $2 | $6 | $2 | $2 | $28 |
| Total Higher Education | | | | $389 | $43 | $289 | $72 | $85 | $878 |
| Economic Multipliers | | | | 2.93 | 3.00 | 3.17 | 2.63 | 3.00 | 2.99 |
| **Institution** | | | | **Total Economic Impact (Millions of $)** | | | | | |
| Community & Technical Colleges | | | | $121 | $36 | $210 | $50 | $63 | $481 |
| Public Universities | | | | $972 | $87 | $685 | $134 | $185 | $2,063 |
| Health-Related Institutions | | | | $48 | $5 | $20 | $5 | $6 | $84 |
| Total Higher Education | | | | $1,141 | $128 | $916 | $190 | $254 | $2,628 |

(1) Because FTE estimates were not available, headcount used for public health institutions.Sources: Carole Keeton Strayhorn, Texas Comptroller of Public Accounts and Texas Higher Education Coordinating Board.

2.3). Other major expenditures during the year included research on biological and other life sciences ($383 million) and engineering ($264 million).

State and most institutional research-related funding is obtained from in-state sources.[18] Only the remaining $1.3 billion in federal and mainly out-of-state privately funded research-related expenditures can have a ripple effect on the state economy. Multiplying these direct out-of-state expenditures by the state research and development multiplier of 3.32 generated an estimated $4.4 billion annual economic impact in the state in 2001.[19]

### Health Care

In addition to educating the bulk of the state's doctors, dentists, nurses and other health-related professionals, the state's nine public health-related institutions provide valuable health care services to their communities, the state and the rest of the world. In fiscal 2001, state teaching hospitals and related physician services provided a total of $3.9 billion in health care services to their patients. Almost two-thirds of these services were provided at the University of Texas' two largest medical centers. During the year, the hospitals and physician services at the University of Texas' Medical Branch in Galve-

**Table 2.2**
## Economic Impact of Texas Higher Education Research & Related Expenditures, Fiscal 1999-2001
**(Amounts in Millions $)**

| Fiscal Year | Total Expenditures | Source of Funding: Federal | State | Institution | Private | Federal & Private | Economic Multiplier | Economic Impact |
|---|---|---|---|---|---|---|---|---|
| 1999 | $1,504 | $813 | $293 | $121 | $277 | $1,090 | 3.32 | $3,619 |
| 2000 | $1,648 | $895 | $324 | $134 | $295 | $1,190 | 3.32 | $3,951 |
| 2001 | $1,810 | $991 | $357 | $129 | $333 | $1,324 | 3.32 | $4,396 |

Sources: Carole Keeton Strayhorn, Texas Comptroller of Public Accounts and Texas Higher Education Coordinating Board, *Research Expenditures*, Annual Updates.

ston provided $992 million in health care services, while UT's MD Anderson Cancer Center provided $1.5 billion in medical care (see Table 2.4).

Although all of these public health-related institutions provide a vital service to Texans, MD Anderson Cancer Center in Houston is the only one that provides a significant amount of care to patients from other states and nations.[20] According to the University of Texas Office of Health Affairs, about 40 percent of MD Anderson's patients come from outside Texas.[21] Applying this percentage to the difference between $1.2 billion in teaching hospital revenues and the $466 million in nonreimbursed charity care, bad debt, and other deductions and allowances indicates that approximately $276 million in the net cash revenues received by the hospital during fiscal 2001 was from out-of-state patients.[22] Multiplying these out-of-state expenditures by the Texas health care multiplier of 3.51 indicates that MD Anderson has a total direct and indirect economic impact of about $969 million on the Texas economy.

### Federal Indirect Cost Recovery

As part of administering federally supported programs, higher education institutions and other state agencies are reimbursed by the fed-

**Table 2.3**
## Sources and Expenditures of Higher Education Research-Related Funding, Fiscal 2001
**(Amounts in Millions $)**

| Research Field | Source of Funding: Federal | State | Institution | Private | Total | Percent of Expenditures | Federal/ Private | Percent of Expenditures |
|---|---|---|---|---|---|---|---|---|
| Medical Sciences | $336 | $74 | $31 | $145 | $586 | 32.4% | $481 | 36.3% |
| Biological & Life Sciences | $217 | $72 | $28 | $66 | $383 | 21.2% | $283 | 21.4% |
| Engineering | $137 | $67 | $16 | $44 | $264 | 14.6% | $181 | 13.7% |
| Environmental Sciences | $89 | $20 | $4 | $10 | $123 | 6.8% | $99 | 7.5% |
| Physical Sciences | $72 | $21 | $5 | $19 | $116 | 6.4% | $90 | 6.8% |
| Agricultural Sciences | $23 | $28 | $9 | $14 | $73 | 4.0% | $37 | 2.8% |
| Computer & Math Sciences | $44 | $15 | $3 | $6 | $67 | 3.7% | $49 | 3.7% |
| Business & Social Sciences | $18 | $19 | $5 | $10 | $52 | 2.9% | $28 | 2.1% |
| Other Research & Development | $46 | $28 | $14 | $17 | $105 | 5.8% | $63 | 4.8% |
| Other Sponsored Activities | $10 | $14 | $13 | $3 | $40 | 2.2% | $13 | 1.0% |
| Total Research-Related | $991 | $357 | $129 | $333 | $1,810 | 100.0% | $1,324 | 100.0% |

Sources: Carole Keeton Rylander, Texas Comptroller of Public Accounts and Texas Higher Education Coordinating Board, *Research Expenditures*, April 2002.

**Table 2.4**
**Gross Patient Revenues of Texas Public Health-Related Institution Hospitals and Physician Practice Plans, Fiscal 2001**
**(Amounts in Millions $)**

| Health-Related Institution | Teaching Hospital Revenues(1) | Physician Services Revenues | Total Gross Patient Revenues |
|---|---|---|---|
| UT Medical Branch-Galveston | $724 | $268 | $992 |
| UT MD Anderson Cancer Center | $1,157 | $362 | $1,519 |
| UT Southwestern Medical Center-Dallas | | $557 | $557 |
| UT Health Science Center-Houston(2) | $36 | $259 | $295 |
| UT Health Center-Tyler | $102 | $29 | $131 |
| UT Health Science Center-San Antonio | | $229 | $229 |
| Texas Tech Health Science Center | | $130 | $130 |
| University of North Texas HSC-Fort Worth | | $24 | $24 |
| Texas A&M Health Science Center(3) | | $11 | $11 |
| Total Patient Revenues | $2,019 | $1,869 | $3,888 |

(1) Includes both in-patient and out-patient services.
(2) Teaching hospital revenues are for the Harris County Psychiatric Center.
(3) Includes Baylor College of Dentistry. Physician practice plan revenues are for fiscal 1999.

Sources: Carole Keeton Strayhorn, Texas Comptroller of Public Accounts, University of Texas System, and Public Health-Related Institutions.

eral government for overhead and other indirect program-related expenses. The 2002-03 appropriations bill currently allows health-related institutions to retain all of their $104 million per year in total "indirect cost recoveries."[23] Public universities, on the other hand, net only half of their $71 million in annual indirect recovery proceeds in their method of financing.[24] The remaining almost $36 million per year in revenues is offset by a general revenue appropriation reduction.[25]

***Thus, if the currently unallocated $36 million in federal cost recoveries were redirected to the public universities for research purposes, the overall state economy would gain almost $118 million per year.***

Although the current appropriation of these funds may help finance the general operations of state government, Texas may be bypassing a potentially greater economic return to the state. According to the Comptroller's input-output model, research and development expenditures produce $3.32 in economic output for every dollar invested in the original research. Thus, if the currently unallocated $36 million in federal cost recoveries were re-directed to the public universities for research purposes, the overall state economy would gain almost $118 million per year.

A recent report by the Rand Corporation further buttressed the case for the state redirecting all federal indirect cost recovery dollars to the higher education institution originally performing the research. Although they recover almost all the direct costs, the study found U.S. universities only recover about 70 to 90 percent of the facility and administrative expenses of performing federal projects. Nationally, universities are shortchanged between $700 million to $1.5 billion annually in overhead costs associated with federal research.[26] Even though specific figures are not published by the state, National Science Foundation statistics indicate Texas received $814 million out of a total of $15.1 billion in federally sponsored university research in 1997.[27] Therefore, the loss in facility and administrative cost reimbursement in Texas appears to be about $40 million to $80 million annually.✯

# III. Impact on Higher Earnings

The traditional approach used to measure the economic impact of higher education is by examining the earnings of its students. Our analysis indicates that the Texas higher education system increases the discounted present value of the earnings of its attendees and graduates by an estimated $12.6 billion. Of this total, just more than half, or $6.6 billion, in additional earnings is contributed by those who earn bachelor's degrees. The bulk of the additional gain is attributed to those who earn associate and professional degrees, along with those who attend college, but do not graduate.

**Theoretical Considerations**

Beginning with the work of Jacob Mincer and Theodore Schultz, economists long have investigated the relationship between a person's stock of educational knowledge, or "human capital," and future earnings capability.[28] Much like a business contemplating purchasing a particular piece of equipment, a rational individual compares the future earnings gained from a particular educational "investment" relative to its costs, then picks an educational program that maximizes the return on that investment. This return then can be compared to other non-educational long-term investments, such as the stock market, to see if the educational investment is a worthwhile pursuit.

Another way to measure the return from a particular educational investment is to compute the rate that equates the discounted gains in future earnings to the current direct and indirect costs of attending school. In calculating this "internal rate of return," however, only earnings realized from the additional educational knowledge may be included and not earnings that a person would have gained anyway because of higher intelligence, ability, and/or socioeconomic status.

Selectivity bias—where more intelligent and/or talented students generally undertake higher educational coursework—complicates this issue and makes it very difficult to separate the earnings gains attributable to only higher education. According to educational experts, roughly 79 percent of the earnings differential between baccalaureate and high school graduates is due to knowledge gained in college alone. This "alpha factor" increases with the level of education, reaching approximately 90 percent at the graduate level.[29]

Indirect expenses, such as foregone earnings, are another important consideration in calculating the costs of attending school. Lost earnings while attending college, averaging almost $26,000 per year for high school graduates are, by far, the most significant cost of pursuing a higher education degree.

Finally, for students who live away from home while attending school, careful considerations much be given to whether other expenses, such as room and board, should be included as a college-related expense. These costs are probably relevant for an undergraduate attending college outside of reasonable commuting distance from their parent's home. For most students, however, including undergraduate commuters and graduate/professional students, who would have been incurring these expenses anyway, the cost should not be included.

***Indirect expenses, such as foregone earnings, are another important consideration in calculating the costs of attending school.***

**Data Considerations**

In preparing these estimates, three data considerations are also important. First, because of its relatively small sample size, the U.S. Bureau of the Census's *Current Population Survey* national, rather then state-level earnings data was used to compute the rate of return (and present values) used in this study. Our implicit assumption, however, that Texas and U.S. earnings differentials are similar is not far off the mark. Table 3.1 shows that from 1991 through 2000, the earnings gain of Texas college graduates versus high school graduates has averaged only slightly more

**Table 3.1**
## Texas and U.S. Earnings from Bachelor's or Greater Compared to High School Degrees, 1991-2000 (Real 2000 $)

**Median Earnings**

| | Texas | | | United States | | | Texas Versus US Gain | |
|---|---|---|---|---|---|---|---|---|
| | HS | BA+ | Gain | HS | BA+ | Gain | Ratio (%) | 3-Yr Avg |
| 1991 | $19,722 | $40,456 | $20,734 | $21,980 | $41,408 | $19,428 | 106.7% | |
| 1992 | $19,631 | $39,263 | $19,632 | $21,867 | $41,546 | $19,679 | 99.8% | |
| 1993 | $20,259 | $38,135 | $17,876 | $21,673 | $41,454 | $19,782 | 90.4% | 99.0% |
| 1994 | $19,745 | $39,490 | $19,745 | $22,380 | $41,119 | $18,739 | 105.4% | 98.5% |
| 1995 | $19,204 | $39,453 | $20,249 | $22,852 | $41,077 | $18,226 | 111.1% | 102.3% |
| 1996 | $20,854 | $38,415 | $17,561 | $23,089 | $41,336 | $18,246 | 96.2% | 104.2% |
| 1997 | $20,485 | $38,984 | $18,499 | $23,394 | $42,276 | $18,882 | 98.0% | 101.8% |
| 1998 | $22,022 | $42,248 | $20,226 | $23,926 | $44,175 | $20,249 | 99.9% | 98.0% |
| 1998 | $20,674 | $41,451 | $20,777 | $24,630 | $44,857 | $20,226 | 102.7% | 100.2% |
| 2000 | $22,000 | $45,000 | $23,000 | $24,910 | $46,166 | $21,256 | 108.2% | 103.6% |
| Average | $20,460 | $40,290 | $19,830 | $23,070 | $42,541 | $19,471 | 101.8% | 100.9% |

**Mean Earnings**

| | Texas | | | United States | | | Texas Versus US Gain | |
|---|---|---|---|---|---|---|---|---|
| | HS | BA+ | Gain | HS | BA+ | Gain | Ratio (%) | 3-Yr Avg |
| 1991 | $23,108 | $45,569 | $22,461 | $24,236 | $46,340 | $22,104 | 101.6% | |
| 1992 | $22,717 | $43,875 | $21,158 | $24,127 | $47,299 | $23,172 | 91.3% | |
| 1993 | $22,964 | $45,169 | $22,205 | $24,649 | $51,093 | $26,444 | 84.0% | 92.3% |
| 1994 | $23,508 | $45,530 | $22,022 | $25,134 | $51,740 | $26,606 | 82.8% | 86.0% |
| 1995 | $23,736 | $50,721 | $26,985 | $25,897 | $50,318 | $24,421 | 110.5% | 92.4% |
| 1996 | $26,485 | $52,356 | $25,871 | $26,176 | $51,219 | $25,043 | 103.3% | 98.9% |
| 1997 | $25,682 | $54,926 | $29,244 | $26,440 | $52,435 | $25,996 | 112.5% | 108.8% |
| 1998 | $25,500 | $57,956 | $32,456 | $26,652 | $54,308 | $27,656 | 117.4% | 111.1% |
| 1999 | $24,968 | $55,403 | $30,435 | $27,418 | $56,267 | $28,849 | 105.5% | 111.8% |
| 2000 | $26,679 | $61,037 | $34,358 | $27,978 | $57,737 | $29,759 | 115.5% | 112.8% |
| Average | $24,535 | $51,254 | $26,720 | $25,871 | $51,876 | $26,005 | 102.4% | 101.7% |

Sources: Carole Keeton Strayhorn, Comptroller of Public Accounts; US Bureau of the Census, *Current Population Survey.*

than the same differential nationally. Given the relatively small size of the CPS sample in Texas (averaging 8,440 persons out of an estimated state population of 21.2 million), this difference is not significant.[30]

A second consideration in estimating higher education returns is whether median or mean earnings gains should be used. In the Comptroller's previous *The Impact of the State Higher Education System on the Texas Economy*, median earnings, where half the observations were above and half were below the central measure, were used to avoid distorting estimated earnings gains by a few, generally high observations. However, to accurately calculate total earnings gains by level of educational achievement (by multiplying the discounted gain by the number of graduates) the mean (or average) earnings gain, including those few very-high earners, is statistically more appropriate. This second approach is used in this study.[31]

## Table 3.2
# Estimated Rate of Return from Texas Higher Education Bachelor's Degree

**U.S. Mean Earnings Differentials by Sex and Educational Attainment, 1991-2000**
**Real 2000 $**
**Workers 25 Years and Older**
**Bachelor's vs. High School Degree**
**(Alpha Factor = 0.79)**

| | Male | | Higher Education Gain | | Female | | Higher Education Gain | |
|---|---|---|---|---|---|---|---|---|
| | HS Graduate or Equivalent | Bachelor's Degree | Difference 2000$ | Ratio BA/HS | HS Graduate or Equivalent | Bachelor's Degree | Difference 2000$ | Ratio BA/HS |
| 1991 | $30,384 | $49,754 | $19,370 | 1.64 | $17,673 | $29,289 | $11,616 | 1.66 |
| 1992 | $29,856 | $50,085 | $20,229 | 1.68 | $17,952 | $30,212 | $12,260 | 1.68 |
| 1993 | $30,796 | $53,485 | $22,689 | 1.74 | $18,052 | $31,090 | $13,038 | 1.72 |
| 1994 | $31,510 | $55,358 | $23,848 | 1.76 | $18,287 | $31,809 | $13,522 | 1.74 |
| 1995 | $32,140 | $54,009 | $21,869 | 1.68 | $19,106 | $31,199 | $12,093 | 1.63 |
| 1996 | $32,874 | $52,727 | $19,853 | 1.60 | $18,908 | $32,468 | $13,560 | 1.72 |
| 1997 | $32,953 | $55,271 | $22,318 | 1.68 | $19,295 | $33,245 | $13,950 | 1.72 |
| 1998 | $32,658 | $59,786 | $27,128 | 1.83 | $20,101 | $34,434 | $14,333 | 1.71 |
| 1999 | $34,195 | $61,488 | $27,293 | 1.80 | $19,955 | $34,914 | $14,959 | 1.75 |
| 2000 | $34,568 | $65,124 | $30,556 | 1.88 | $20,516 | $36,500 | $15,984 | 1.78 |
| Average | $32,193 | $55,709 | $23,515 | 1.73 | $18,985 | $32,516 | $13,532 | 1.71 |

**College Costs**

| Year | Tuition/Fees | Books/Supplies | Room/Board | Transportation | Personal | Total Expenses |
|---|---|---|---|---|---|---|
| 2001-02 | $3,158 | $758 | $5,739 | $1,364 | $1,641 | $12,660 |

**Internal Rate of Return and Present Values**

| Year | Male All Costs | Lost Earnings & Direct Costs | Weighted Average | Year | Female All Costs | Lost Earnings & Direct Costs | Weighted Average |
|---|---|---|---|---|---|---|---|
| Freshman | -$44,853 | -$36,109 | | Freshman | -$31,645 | -$22,901 | |
| Sophomore | -$44,853 | -$36,109 | | Sophomore | -$31,645 | -$22,901 | |
| Junior | -$44,853 | -$36,109 | | Junior | -$31,645 | -$22,901 | |
| Senior | -$44,853 | -$36,109 | | Senior | -$31,645 | -$22,901 | |
| 1 | $18,577 | $18,577 | | 1 | $10,690 | $10,690 | |
| 2 | $19,134 | $19,134 | | 2 | $11,011 | $11,011 | |
| 3 | $19,708 | $19,708 | | 3 | $11,341 | $11,341 | |
| 4 | $20,300 | $20,300 | | 4 | $11,681 | $11,681 | |
| 5 | $20,909 | $20,909 | | 5 | $12,032 | $12,032 | |
| 40 | $58,834 | $58,834 | | 40 | $33,855 | $33,855 | |
| 41 | $60,599 | $60,599 | | 41 | $34,871 | $34,871 | |
| 42 | $62,417 | $62,417 | | 42 | $35,917 | $35,917 | |
| 43 | $64,290 | $64,290 | | 43 | $36,994 | $36,994 | |
| 44 | $66,218 | $66,218 | | 44 | $38,104 | $38,104 | |
| 45 | $68,205 | $68,205 | | 45 | $39,247 | $39,247 | |
| Resident/ Commute | 59.3% | 40.7% | | Resident/ Commute | 59.3% | 40.7% | |
| Return | 11.48% | 13.41% | 12.27% | Return | 9.90% | 12.51% | 10.96% |
| NPV (6%) | $200,317 | $230,615 | $212,648 | NPV (6%) | $95,052 | $125,351 | $107,384 |

Sources: Carole Keeton Strayhorn, Texas Comptroller of Public Accounts and US Bureau of the Census, *Current Population Survey*.

Finally, it was assumed that students at all levels of study, except the bachelor's degree, would not incur additional room and board, transportation and personal expenses because they would have been commuters or living away from home anyway. Based on data for public universities, the Comptroller's office was able to compute that just over 40 percent of students pursuing baccalaureate degrees attended high school in the same metropolitan area as the college or university they attend.[32] Thus, in the calculations presented in this chapter, it was assumed that 60 percent of baccalaureate students would incur room and board, transportation and personal expenses while attending college and 40 percent would not.

**The Return from Texas Higher Education**

Based on the alpha factors discussed above, the Census Bureau's national-level mean earnings data and the tuition, fee and other educational costs supplied by the Texas Higher Education Coordinating Board,[33] the combined male/female rate of return from earning a bachelor's degree from a Texas higher education institution is estimated to be approximately 11.5 percent (see Table 3.3). This estimate falls roughly in the range of the 10 percent to 14 percent return on a baccalaureate degree found in similar studies across the country.[34]

Also, probably because of diminishing returns to higher levels of study, the rate of return falls from nearly 15 percent for Texans who attend some college to just under 11 percent for those who earn a master's degree. But counter to other studies, our calculated returns do not continue to drop at higher levels of post-baccalaureate study.[35] The return was found to climb to 13 percent at the doctoral level and then to more then 18 percent for lawyers, medical doctors and other professionals (see Table 3.3).

Finally, in all cases the return for education equals, or in most cases greatly exceeds, the 10 percent long-term return generally expected from a diversified stock market investment.[36] Thus, in Texas, pursuing higher educational study generally appears to be a

**Table 3.3**

## Texas Discounted Earnings Gains from Higher-Education Degrees, Fiscal 2000

| Higher Education Degree | Avg Graduates Fiscal 1998-00 | In-State Percent | Rate of Return (%) | NPV Earnings Gain/Worker | Employment (Percent) | Total Earnings Gain (Mil of $) |
|---|---|---|---|---|---|---|
| Certificate | 15,454 | 94.0% | 12.34% | $31,522 | 77.6% | $355 |
| Some College(1) | 41,862 | 92.3% | 14.93% | $50,120 | 76.6% | $1,484 |
| Associate's | 24,054 | 93.9% | 13.43% | $74,370 | 76.4% | $1,284 |
| Bachelor's | 57,969 | 89.5% | 11.52% | $156,723 | 81.2% | $6,605 |
| Master's | 18,170 | 89.5% | 10.86% | $82,174 | 81.3% | $1,086 |
| Doctoral | 2,364 | 89.6% | 13.09% | $295,701 | 83.1% | $520 |
| Professional | 2,801 | 90.0% | 18.25% | $614,407 | 82.8% | $1,283 |
| Total-All Degrees | 162,674 | 91.3% | 12.83% | $107,454 | 79.1% | $12,618 |

(1) Estimated number of students who leave associate and baccalaureate programs without a degree per year.

Source: Carole Keeton Strayhorn, Texas Comptroller of Public Accounts.

good long-term investment. In this analysis, students are assumed to reap the benefits of their educational investment over a working lifetime of 45 years—generally from age 22 years to retirement at 67.

**The Present Value of Texas Higher Education**

Another way to examine the value of an educational investment is to calculate the present value of future earnings gains and subtract the current (direct and indirect) costs of that investment. Unlike the rate of return approach, however, the interest rate used to discount future earnings in this calculation is determined by external market conditions, rather than internally determined in the calculation.

One major disadvantage with present value, compared to rate of return calculations, is that the magnitude of a discounted present value is generally proportional to the value of the educational investment and, thus, the return from one type of educational investment cannot be directly compared to another. However, discounted present values can be aggregated over a wide class of educational pursuits to determine the total economic contribution of higher education.

Table 3.3 shows that the discounted present value of the most costly educational endeavors, including professional ($614,400) and doctoral ($295,700) degrees, are much greater than those who earn only a one-year community college certificate ($31,500). For the most common bachelor's degrees, the net present value of the earnings gain, less direct and indirect expenses—including foregone income—averages approximately $156,700. Multiplying this earnings gain by: 1) the 90 percent of 58,000 BA and BS graduates from in-state sources and 2) the slightly more than 80 percent of bachelor's graduates who obtain jobs,[37] yields a discounted present value to the Texas economy of approximately $6.6 billion. Aggregating these calculations over all levels of study yields a net present value of the Texas higher education system of $12.6 billion. The lion's share, or about $9.7 billion, is gained by undergraduates (community college certificates, some college, associate's and bachelor's degrees), with the remaining $2.9 billion earned by those with more advanced master's, doctoral and professional degrees.

In this calculation, the interest rate used to discount future earnings can have a profound impact on the estimated net value of the educational system. Since higher discount rates place less value on future earnings compared to current educational costs, the higher the discount rate, the lower the net value of the educational system to society. Because education benefits not only the individual, but all members of society, and earnings gains are reaped over a relatively long period of time, the Comptroller's office used the current U.S. 30-year treasury rate of approximately 6 percent for those calculations.[38]

**Impact of State Economic Output**

Since earnings represent only a portion of the economy, this estimated $12.6 billion gain from Texas higher education graduates tells only part of the story. There are several theoretical and empirical issues measuring labor's share of the national economy.[39] Figures, however, from the U.S. Bureau of Economic Analysis indicate earnings represent almost 54 percent of Texas gross state product.[40] Dividing this $12.6 billion discounted earnings gain by 54 percent indicates that higher education produces a net discounted value of $23.5 billion of higher output annually for the Texas economy. Based on the earnings gains, 77 percent, or $18.1 billion, of the increased output is attributable to graduates with bachelor's and other undergraduate degrees. The remaining $5.4 billion is attributable to students with advanced degrees. ✯

# IV. Impact on Economic Productivity

One approach to measuring higher education's effects on the state's economy is by calculating the economic gains derived from improved productivity. This relationship directly addresses the crucial question of what higher education does to expand the productive capacity of the economy—quite apart from the dollars injected into the system that generate spending and re-spending through the multiplier effect.

This question may be the most crucial of all because much of the support higher education receives comes from the government. This means that there is no market mechanism to directly assess the value of this spending. The importance of this lack of a market allocation mechanism is best demonstrated by considering the dilemma of government-sponsored ditch digging. Public money spent digging a ditch will most certainly ripple through the economy creating many jobs directly and indirectly. The same can be said of public funds used to fill up the ditch when it is completed. But the telling question is how much the productive capacity of the overall economy increased after paying for this work?

***The primary economic impact of higher education is through augmenting the knowledge and skills of the workforce.***

**Productivity and Economic Growth**

According to traditional economic growth theory, growth occurs by employing more basic inputs—more labor, capital or land.[41] This approach, however, presents at least some circular logic. If we employ more basic inputs, we produce more output. The more fundamental question is how to get the additional resources to fuel the increased production?

One key to this process is utilizing the existing resources more efficiently. For example, if instead of taking 200 hours to build one car, a change in the assembly procedures enables the car to be built in only 100 hours, then the labor supply effectively has been doubled. Thus, streamlining productivity—getting more done each hour of work—has the effect of increasing the labor supply just as genetically engineering plants to produce more cotton effectively increases the "supply" of land.

Labor can become more productive if:

- there is more physical capital employed per worker (physical capital includes structures and equipment as well as public infrastructure);
- the health or skills of human beings increases—this is known as *human* capital; or
- the stock of accumulated abstract knowledge grows, thereby increasing *knowledge* capital.

The primary economic impact of higher education is through augmenting the skills of the work force, although institutions of higher education also serve as repositories and transmitters of knowledge capital. The chief distinction between human capital and knowledge capital is that human capital cannot be separated from the human who possesses it.[42]

Universities, colleges and other higher education institutions are crucial in improving productivity since they produce two kinds of capital—human capital and knowledge capital—reflecting their dual roles as both educational and research institutions. In practice, it is extremely difficult to measure separately the impacts of these two roles. For example, is it the technological sophistication and research skills of the faculty at a highly respected engineering school that draws industry to the area? Or is the real drawing card the skills and abundance of students at the institution that the industry hopes to employ? Undoubtedly, both matter. In most cases, however, the teaching and research functions of most universities are joint products and attempting to measure the effects of just one of these functions on the local economy likely will result in measuring some of both.

This analysis focuses on the role of Texas institutions of higher education in augmenting the amount of human capital in the economy. That role is particularly crucial for the state economy. If state institutions stopped educating students, the flow of human capital into the economy would diminish almost instantaneously, barring massive out-migration of Texas students to institutions in other states followed by reverse migration back into the state.

The impact of this imaginary shutdown of higher education on the amount of human capital available to the Texas economy contrasts to the longer-term effects it would have on the stock of knowledge or research spin-offs. Clearly, the sum of human knowledge would not evaporate if Texas' higher education institutions ceased operating. But over the long term, the Texas economy would surely suffer.

**Labor Productivity Responses to Education**

There have been a few studies in the United States attempting to measure the effects of human capital investments on economic output. And many of these stumble with subjective measures of output, making it difficult to generalize their results.[43] Other efforts, such as a study of training investments by Ann Bartel, have been able to measure more objective productivity gains from education and training. But a low, six percent survey response rate makes these estimates questionable.[44]

Recent investigations have employed a more substantial survey base, tying data from the National Center on the Educational Quality of the Workforce to output, sales and other firm-level data from the U.S. Bureau of the Census' *Annual Survey of Manufactures*.[45] This broad database generated responses from 3,358 business establishments, representing a 64 percent survey response rate. From this data, Sandra Black and Lisa Lynch of the National Bureau of Economic Research estimated that a 10 percent increase in the average educational level of workers resulted in a 4.9 percent to 8.5 percent increase in economic output in manufacturing and a 5.9 percent to 12.7 percent productivity improvement in non-manufacturing industries.[46] In this sample, manufacturing workers averaged 12.5 years and non-manufacturing workers averaged 13 years of education.[47]

**Productivity in Texas Higher Education**

For the purposes of this analysis, the Comptroller's office assumed that the productivity estimate appropriate for Texas higher education lies at the low end of Black and Lynch's calculations. That is, a 10 percent increase in the average education of a worker would result in a 4.9 percent economic gain in manufacturing or a 5.9 percent gain in non-manufacturing. The use of these lower productivity-response relationships is the result of three considerations.

First, the average education of the workers in the sample employed by Black and Lynch is below that of the average Texas higher education student. If Black and Lynch had estimated their models using a sample of just college-educated workers, their measured educational productivity would probably have been somehow lower because of declining marginal returns.[48] Accordingly, we expect a slightly lower impact than that found by Black and Lynch because we are applying it to a more highly educated population.

Second, Black and Lynch were concerned with *what* the productivity effects of increased education were and not *how* these effects were generated. The distinction, reflected in the "alpha factor" discussed in Chapter III, concerns how the effects of additional education are influenced by the institution, as opposed to the inate abilities of the students. In the same way estimates of the wage gains attributable to the institution of higher education must be lowered to reflect the natural abilities of the students.

Finally, in order to produce the most reasonable estimates, it is necessary to err on the conservative side in producing estimates of the effects of higher education on economic output.

**Increasing Texas' Human Capital Stock through Higher Education**

To translate Black and Lynch's calculations into an estimate of the economic effects of higher education on the Texas economy requires an estimate of the annual contribution of Texas' higher education system to the educational base of the state's employed labor force.

The top portion of Table 4.1 presents the enrollment figures in Texas' public higher educational institutions from fiscal 1999 to 2001. On average, during this period the Texas higher education system generated 621,000 school-years of education. Yet, not all of this added education could be counted on to stay in Texas. To adjust for migration of students, it is assumed that all out-of-state students would return to their place of origin and all in-state students would remain in Texas. Accordingly, it is estimated that the state's higher education system annually pumps 567,000 school-years of education into the Texas population over age 18. Since Texas' relatively strong economy allows it to retain at least some of the out-of-state students currently studying in the state, if anything, this assumption may be overly conservative.

Because Black and Lynch's productivity relationships measure the effects of increasing education on the employed work force, only that educational improvement provided to the employed work force should be considered to affect productivity. According to Texas-specific *Current Population Survey* estimates, approximately 80 percent of the civilian population with at least some college education is employed so the Texas higher education systems injects approximately 453,000 school-years of additional education into the employed workforce each year.

The middle section of Table 4.1 presents the Comptroller's estimated Texas resident population by age group in 2001 and the average number of school years attained by these groups. Combining these two data items indicates that the Texas population 18 years and older represents a combined 188 million school-years of education. Adjusting for non-workers indicates that the educational base of the employed workforce in Texas is 126 million school-years of education.[49] As such, the 453,000 school-years of education produced by the state's higher education system results in increasing the educational base of the employed work force by 0.36 percent annually.

Applying this gain to Black and Lynch's productivity estimates indicates that the Texas higher education system increases productivity by 0.18 percent in manufacturing and by 0.21 percent in non-manufacturing each year. These productivity gains applied to Texas manufacturing and non-manufacturing gross state product indicates that higher education adds $1.5 billion to the state's economy through productivity gains or $3,384 per full-time equivalent employed student (bottom of Table 4.1).

This gain, by itself, does not incorporate two important considerations. First, what is the public and private cost to the economy of procuring this gain? And second is the recognition that this gain, like other capital investments, does not represent a one-time phenomena, but generates a lifetime of returns.

To reflect the first consideration, Table 4.2 notes the two main components of the cost of education. First, are the earnings lost while in school, which from 1991 to 2000 averaged $25,600 per year. Table 4.2 also notes the average annual college costs for the 2000-01 fiscal year of $14,100. These costs include both those paid directly by the student and by state and local governments, based on direct educational all-fund appropriations in the 2000-01 General Appropriation Act and community college tuition, fees and property tax levies.[50]

Together these costs total $39,700 in the first year and more than offset the net productivity gain of almost $3,400 per student. But, since the productivity gains of increased education continue to produce economic gains throughout the student's 45-year working lifetime, these productivity gains produce a stream of income gains throughout the years that rises with inflation (assumed to be 3 percent annually). Discounting this stream of income gains over time at a rate of 6 percent indicates a net present value of almost $40,000 per student for a year of education. Considering the potential Texas work force of 453,000 working students taught by the Texas higher education institutions, this amounts to a total net gain to the Texas economy of $18 billion.

**Other Considerations**

This attempt to measure the impact of Texas' higher education system on the state's economy has considered the effects of higher education on the productivity of the Texas work force. Increased productivity effectively increases the supply of labor available to the economy, which allows the economy to expand. This effect relies on the ability of the educational system to augment the supply of human capital available to the economy.

But this analysis largely ignores the knowledge capital function that Texas' higher education system also performs. To the degree that the effects of increasing the stock of knowledge capital in the state is not included, this analysis of the economic effects of higher education in somewhat understated.

Clearly the knowledge function of Texas' higher educational system—basic and applied research—is important to the economy. There are numerous examples of discoveries, patents and technology transfers through Texas universities and colleges that have helped companies

## Table 4.1
## Estimated Impact of Higher Education on Texas Productivity

| | Fiscal Years 1999 | 2000 | 2001 | 3-Yr Avg | In-State (%) |
|---|---|---|---|---|---|
| Higher Education Enrollment (FTE) | | | | | |
| Community & Technical Colleges | 249,903 | 255,886 | 263,479 | 256,423 | 94.0% |
| Public Universities | 344,843 | 350,210 | 358,017 | 351,023 | 89.5% |
| Health-Related Institutions | 15,374 | 12,410 | 12,607 | 13,464 | 90.5% |
| Total Public Higher Education | 610,120 | 618,506 | 634,103 | 620,910 | 567,388 |
| Total Percent Employed | | | | | 80% |
| Total Number | | | | | 453,002 |

**Population, School Years and Workforce, 1999-2001 (thousands)**

| Age Group | Resident Population | School Years Per Person | School Years Total | Work force Percent | Work force School Yrs |
|---|---|---|---|---|---|
| 18 to 24 Years | 2,226 | 12.0 | 26,712 | 63.2% | 16,882 |
| 25 to 44 Years | 6,512 | 12.8 | 83,354 | 81.0% | 67,516 |
| 45 to 64 Years | 4,296 | 12.7 | 54,559 | 70.7% | 38,573 |
| 65 Yrs and Older | 2,909 | 11.3 | 23,617 | 14.7% | 3,472 |
| Total Population 18 Yrs and Older | 15,124 | 12.4 | 188,242 | 67.2% | 126,443 |

### Black and Lynch Texas Economic Gains

| | |
|---|---|
| Annual Educational Gain (thous) | |
| Employed Higher Education Students | 453 |
| Employed Population 18 Years and older | 126,443 |
| Annual Educational Gain | 0.36% |

| | Productivity – Response Function | | Texas Gross State Product, 2000 | |
|---|---|---|---|---|
| Productivity Gain/10% Schooling | Low | High | GSP (Mil of $) | Percent |
| Manufacturing | 4.9% | 8.5% | $101,105 | 13.6% |
| Nonmanufacturing | 5.9% | 12.7% | $641,169 | 86.4% |
| Total Economy | 5.8% | 12.1% | $742,274 | 100.0% |

| Estimated GSP Gain (Mil of $) | Low | High |
|---|---|---|
| Manufacturing | $177 | $308 |
| Nonmanufacturing | $1,355 | $2,917 |
| Total Economy | $1,533 | $3,225 |
| Per Employed Student ($) | $3,384 | $7,120 |

(1) Because FTE estimates were not available, headcount used for public health institutions.
Sources: Carole Keeton Strayhorn, Texas Comptroller of Public Accounts, Texas Higher Education Coordinating Board and US Bureau of the Census, *Current Population Survey.*

grow in the state and helped start new firms or even new industries. In a way, Chapter Two's efforts to account for research dollars flowing into the state captures part of the knowledge function. Also, to the extent that this knowledge function is truly a joint product with the human capital function, measuring one probably captures most of the effects of both.[51] Nonetheless, to the degree that the knowledge effects on the state's economy are missed by both of these two measurement efforts, this analysis underestimates the true impact of Texas' higher educational system on the state's economy. ✯

**Table 4.2**

## Texas Discounted Productivity Gains
## Real 2000 $

**Lost Wages of High School Graduate or Equivalent**

| Year | Males | Females | Average |
|---|---|---|---|
| 1991 | $30,384 | $17,673 | $24,029 |
| 1992 | $29,856 | $17,952 | $23,904 |
| 1993 | $30,796 | $18,052 | $24,424 |
| 1994 | $31,510 | $18,287 | $24,899 |
| 1995 | $32,140 | $19,106 | $25,623 |
| 1996 | $32,874 | $18,908 | $25,891 |
| 1997 | $32,953 | $19,295 | $26,124 |
| 1998 | $32,658 | $20,101 | $26,380 |
| 1999 | $34,195 | $19,955 | $27,075 |
| 2000 | $34,568 | $20,516 | $27,542 |
| Average | $32,193 | $18,985 | $25,589 |

**Average College Costs (1)**

| Year | Tuition/Fees(2) | Books/Supplies | Room/Board | Transportation | Personal | Total Expenses |
|---|---|---|---|---|---|---|
| 2000-01 | $10,892 | $775 | $1,605 | $382 | $459 | $14,113 |

Internal Rate of Return and Present Values

| Year | Cost/Return |
|---|---|
| 0 | -$39,702 |
| 1 | $3,384 |
| 2 | $3,486 |
| 3 | $3,590 |
| 4 | $3,698 |
| 5 | $3,809 |
| 40 | $10,717 |
| 41 | $11,039 |
| 42 | $11,370 |
| 43 | $11,711 |
| 44 | $12,062 |
| 45 | $12,424 |
| | |
| Rate of Return | 11.26% |
| NPV (6%) | $39,725 |

Total Economic Gain

| | $/FTE | Students | Gain (Mil of $) |
|---|---|---|---|
| Present Value | $39,725 | 453,002 | $17,995 |

(1) Room and board, transportation, and personal expenses included for only non-commuting bachelor's-degree students.
(2) State and local higher education all-funds appropriation, including community college, tuition/fees and property tax levy, per full-time equivalent student.

Source: Carole Keeton Strayhorn, Texas Comptroller of Public Accounts.

# Endnotes


1 Texas Higher Education Coordinating Board, *Texas Institutions of Higher Education* (www.thecb.tx.us/dataAndstatistics/institutions.htm).

2 Legislative Budget Board, *Fiscal Size Up: 2002-03 Biennium*, Austin, January 2002, pp. 1-10.

3 Legislative Budget Board, *Fiscal Size Up: 1986-87 Biennium,* Austin, January 1986, and *Fiscal Size Up: 2002-03 Biennium,* Austin, January 2002. To adjust for inflation, appropriations were divided by the U.S. gross domestic product deflator for state and local government expenditures.

4 Texas Higher Education Coordinating Board, *Statewide and National Perspectives on Higher Education in Texas*.

5 University of Texas at Austin, Graduate School of Business, Bureau of Business Research, *Economic Contribution of the University of Texas System: A Study in Three Parts*, Summer 1994.

6 Resources Economics, Inc., *Economic Return on Investment in College Degrees at the University of Houston*, Austin, December 1998.

7 Texas Comptroller of Public Accounts, *Texas Input-Output Study, 1986 Update*, Austin, December 1989.

8 Bureau of Business Research, *Economic Contribution of UT System*, pp. 2-4 to 2-5.

9 Denison, Edward P., *Sources of Economic Growth in the United States* (New York: Committee for Economic Development, 1962) and Gary S. Becker, *Human Capital: A Theoretical and Empirical Analysis with a Special Reference to Higher Education* (Chicago: University of Chicago Press, 1993), p. 210.

10 Bureau of Business Research, *Economic Contribution of UT System*, pp. 1-25 to 1-27. This report asserts that the economic impact of the training/educational function of higher education is about the same magnitude as that of the knowledge/research function. While this may be true when measuring higher education's impact for the nation as a whole, equating these national results to the state level is difficult. Regional measures of the level of investment in higher education often contain components of both the knowledge and the training functions so that whatever impacts are measured probably contain both aspects. Moreover, in an open regional economy there are many sources available to provide the societal knowledge function.

11 Resource Economics uses the "net" number of graduates after eliminating the doubled counting of advanced degrees. According to the study, approximately 8,400 students graduate annually from the UH system.

12 See "Texas Public Community Colleges," Texas Association of Community Colleges, Presentation to Governor's Office of Budget, Planning and Policy and Legislative Budget Board, Austin, September 4, 2002; and CC Benefits, Inc., *The Socioeconomic Benefits Generated by 50 Community College Districts in Texas*, Moscow, Idaho, May 3, 2002.

13 Another major focus of the Texas Guaranteed Student Loan Association study is the economic return to Texas from equalizing college attendance rates between minorities and whites. Texas Perspectives calculates that if African-American and Hispanic students attended and graduated college at the same rate as whites, the resulting increase in worker productivity would have added 4 percent to the state economy in 1996. See Texas Guaranteed Student Loan Association, *Economic Returns from Higher Education in Texas*, Austin, 1997, pp. 12-13.

14 See Chapter III of this report for a more complete discussion of these issues.

15 See William Miernyk, *The Elements of Input-Output Analysis* (New York, Random House, 1965).

16 Type II multipliers include both the industry output and household expenditures generated by increased demand for regional goods and services from outside the area. Type I multipliers, on the other hand, include only the impact of increased industry output that supply the exporting sector.

17 To allow for the statutory waiver of out-of-state in lieu of in-state tuition, tuition and fee revenue for 5 percent of public university students was reduced by the average 66 percent differential between out-of-state and in-state tuition and fees.

18 Telephone conversation with Dr. Linda Domelsmith, Division of Finance, Campus Planning, and Research, Texas Higher Education Coordinating Board, July 21, 2000.

19 The Comptroller's research and development input-output multiplier was originally calculated for the private sector, but it can be applied to public university research as well.

20 Telephone conversation with Mr. Tom Scott, associate vice-chancellor for Governmental Relations, University of Texas System, September 11, 2000.

21 Mr. Wayne Wilson, University of Texas MD Anderson Cancer Center, Houston, Texas, 2002.

22 Letter from Mr. Tom Scott, associate vice-chancellor for Governmental Relations, University of Texas System, August 7, 2002.

23 S.B. 1, 77th Legislature, Regular Session, 2001, Article III, Section 33, No. 3, p. III-241. Specific indirect recovery appropriations are shown in Goal B. for each health-related institution.

24 See Chapter 145.001 of *Education, Vernon's Texas Codes Annoted*.

25 For each public university, Goal A of S.B. 1 shows the one-half of total indirect recoveries that are reappropriated to each institution.

26 Charles A. Goodman, T. Williams, David M. Adamson and Kathy Rosenblatt, *Paying for University Research Facilities and Administration*, Santa Monica: Rand Corporation, MR-1135-1-OSTP, 2000 (www.rand.org./publications/MR/MR1135.1/).

27 National Science Foundation, *Federal Science and Engineering Support to Universities, Colleges, and Nonprofit Organizations*, *Fiscal Year 1997*, Washington, 1999, Table B-9 (www.nsf,gov/sbe.srs/nsf99331/tables/fssb9.xls).

28 Jacob Mincer, "Investment in Human Capital and Personal Income Distribution," *Journal of Political Economy* 66 (1958), pp. 281-301 and Theodore Schultz, "Capital Formation by Education," *Journal of Political Economy* 86 (1960), pp. 571-583.

29 Larry L. Leslie and Paul Brinkman, *The Economic Value of Higher Education* (Phoenix: American Council of Education and the Oryx Press, 1993), pp. 43-44.

30 Over this period, the differential in the mean earnings of Texas college versus high school graduates relative to the U.S. has risen faster than the Texas-U.S. differential in median earnings. This apparent disparity indicates that, for the typical worker, the earnings differential between high school and college graduates in Texas is, in fact, about the same as in the U.S. as a whole, but for some very-high income workers, Texas college graduate school and professional graduates earn much more. These results are not atypical of fast-growing economies, such as Texas.

31 An even more accurate approach would be to compare earnings of workers with different levels of educational achievement over their lifetime. Unfortunately, data on "life-cycle" earnings are generally unavailable because the same individuals would need to be folllowed throughout their working life. Although a recent Census Bureau report, "The Educational Payoff: Educational Attainment and Synthetic Estimates of Work-Life Earnings, *Current Population Reports*, July 2002, p. 23-210, provides some intriguing cross-sectional estimates of U.S. earnings by educational attainment and age group, there was insufficient time to utilize these data in this analysis.

32 These data were supplied by Mr. Tom Scott, associate vice-chancellor for Governmental Relations, University of Texas System.

33 Texas Higher Education Coordinating Board, *2001-2002 College Student Budget*.

34 Leslie and Brinkman, *The Economic Value of Higher Education*, pp. 45-48, 71-75;

35 Leslie and Brinkman, *The Economic Value of Higher Education*, pp. 52-53.

36 Using the 45-year working-life period of analysis utilized in this study, the Standard and Poor's composite stock index increased approximately 8.5 percent per year from 1954 through 1999. According to Global Financial Data (www.globalfindata.com), this gain would had risen to 12.5 percent annually with reinvested dividends. Thus, the average stock market return over the past 45 years has been slightly over 10 percent per year.

37 Texas employment to population ratios by level of educational attainament were obtained from the US Bureau of Census, *Current Population Survey*.

38 According to data supplied by DRI/WEFA, over the past 45 years the 30-year treasury rate has generally followed inflation, ranging from a low of 2.6 percent in 1954 to a high of 13.4 percent in 1981. After excluding inflation, the real rate of return from 1954 through 1999 has averaged 2.8 percent. Adding today's predictions of roughly 3 percent inflation annually over the next several years brings us back to the 6 percent rate used in these calculations.

39 See Alan B. Krueger, "Measuring Labor's Share," *AEA Papers and Proceedings*, May 1999, pp. 45-51.

40 According to the BEA (www.bea.doc.gov/bea/regional/gsp), compensation of employees accounted for $403 billion of the $742 billion in Texas gross state product in 2000. During the same year, property-type income ($276 billion) and indirect business taxes ($63 billion) accounted for the rest.

41 The seminal reference to the neoclassical model of economic growth is Robert M. Solow, "A Contribution to the Theory of Economic Growth," *Quarterly Journal of Economics* 70 (Feb. 1956) pp. 65-94.

42 Gary S. Becker, *Human Capital: A Theoretical and Empirical Analysis with Special Reference to Education*, 3rd ed. Chicago: University of Chicago Press, 1993.

43 Some of these studies, for example, have used survey-based ratings based on questions such as "on a scale of 1 to 4, how has your productivity changed over the past year." See John Barron, Dan Black and Mark Loewenstein, "Employer Size: The implications for Seach, Training, Capital Investment, Starting Wages, and Wage Growth," *Journal of Labor Economics*, January 1987, pp. 76-89 and John Bishop, "The Impact of Previous Training on Productivity and Wages," in Lisa M. Lynch, ed., *Training and the Private Sector: International Comparisons*. Chicago: University of Chicago Press, 1994), pp. 61–99.

44 This study used firm-level Compustat data on productivity and financial performance. See Ann Bartel, *Formal Employee Training Programs and their Impact on Labor Productivity: Evidence from a Human Resource Survey*, Working Paper No. 3026, National Bureau of Economic Research, (Cambridge, Massachusetts), 1989.

45 Sandra E. Black and Lisa M. Lynch, "Human-Capital Investments and Productivity," *AEA Papers and Proceedings*, Vol. 86, No. 2, May 1996, pp. 263-267.

46 For the both manufacturing and non-manufacturing sectors, these higher estimates were the result of unconstrained Cobb-Douglas regression of (the log of) firm sales on (the logs of) capital stock, labor-hours, cost of materials, and average educational level of the workers. The lower estimates were based on the imposition of constant returns of scale and equal coefficients on the labor quantity and quality variables in the regressions. Both of these restrictions were supported by the data.

47 Lisa M.Lynch and Sandra E. Black, *Beyond the Incidence of Training: Evidence from a National Employers Survey*, Working Paper No. 5231, National Bureau of Economic Research (Cambridge, Massachusetts), 1995, Appendix D.

48 Evidence that there is a declining marginal effect of education is strong. On page 52, Larry Leslie and Paul Brinkman, *The Economic Value of Higher Education*, note that traditionally calculated private rates of return for bachelor's degrees are estimated at 11.8 - 13.4 percent; eight percent for for one year of graduate work; 7.2 percent for a master's degree; and 6.6 percent for a Ph.D.

49 Texas educational atainment and employment-population ratios by age group were calculated from the Texas sample of the U.S. Bureau of the Census, *Current Population Survey*.

50 All-funds, state and local appropriations are based on 2000-01 state higher education funding (including benefits) of $14.066 billion less Texas A&M University services ($646 million), and patient care at state health-related institutions ($1.783 billion), plus local community college appropriations from tuition and fees ($934 million) and property tax collections ($1.073 billion), during the two years. The resulting total state and local direct higher education appropriation of $13.644 billion then was divided by a combined full-time enrollment of 1,252,600 during both years to obtain a per-capita appropriation of $10,892. See Legislative Budget Board, *Fiscal Size Up: 2003-03 Biennium*, Austin, January 2002. Community college tuition/fee and property tax revenues were obtained from the Texas Association of Community Colleges.

51 In some cases it is impossible to untangle the effects the university system has on human capital from those on knowledge capital. For example, a company may relocate to tap the expertise of some academic department such as engineering or computer science. However, it is hard to envision a case in which such a company would benefit solely from the expertise of the faculty and not also from the availability of students trained by that faculty. So measuring the effects of the increased human capital simultaneously captures some of the attractive benefits of knowledge capital. For a discussion of some of the literature on the higher education's role in the knowledge function, patent generation, technology transfer and spin-off commercialization, see Walter W. McMahon, "The Contribution of Higher Education to R&D and Productivity Growth," in William E. Becker and Darrell R. Lewis, eds. *Higher Education and Economic Growth*, (Boston: Kluwer Academic Publishers, 1993), pp. 105–127. ✯