



REPORT
ON THE

**ECONOMIC
IMPACT
OF THE
UNIVERSITY
OF HAWAI‘I
SYSTEM**

DECEMBER 2000



Economic Impact of the University of Hawai‘i System

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Economic Impact of the University of Hawai‘i System

Introduction

Higher education has both individual and economy-wide impacts. It is well known that higher education yields financial benefits to students directly. Spending on education can be seen as an investment in “human capital” that potentially yields a return in higher lifetime earnings. This is because higher productivity of college-trained workers enables their employers to pay them higher wages. The growing differential in wages received by skilled and unskilled workers in America in the 1990s suggests that the benefit of getting a college education and/or more job-related training is growing. Cumulatively, the higher earnings of college graduates add up to higher future incomes and output for the entire economy. Also, research that leads to new knowledge and inventions can create new industries or improve productivity in existing industries. In other words, investment in higher education contributes to economic growth.

Beyond the strictly monetary benefits of education, investment in higher education has wider socio-economic impacts on the individual and the community. Education expands economic opportunities available to women and increases their cost of staying at home; hence, more women today choose to work outside the home for pay rather than work at home. Education levels the playing field in employment for minorities and the disadvantaged and promotes social justice. College-educated workers are more capable of searching, assessing, and taking job opportunities elsewhere, thus increasing their mobility. College-educated workers also have more flexibility to adapt to changing skill demands in job markets enabling them to hold or change jobs. Perhaps

most importantly, education produces a more informed body of consumers and literate electorate necessary for a well functioning democratic society.

In this report, we first measure the contribution of higher education to economic growth in Hawai‘i since statehood (1959). We then summarize the results of the first systematic attempt at measuring the economic impact of the University of Hawai‘i system (UH) on Hawai‘i’s economy. The study focuses on both the short-run and the long-run economic impacts of the University Hawai‘i. The short-run analysis assesses the economic size of UH in relationship to the rest of the economy and ascertains how UH education-related spending impacts the local economy. The long-run analysis assesses the rates of return to the student (private return) and to Hawai‘i taxpayers in their investment in a UH education.

Higher Education and Economic Growth in Hawai‘i since Statehood

In the three decades after Hawai‘i attained statehood (1959), Hawai‘i’s economy performed marvelously. Between 1959 and 1989, Hawai‘i’s economy grew at an average annual rate of 4.7 percent compared to 3.5 percent per year for the entire United States. The difference in the rates of growth seems small. Yet, one only needs to remember the value of compounding over a long period of time to appreciate the importance of even a 1 percent difference in the rate of growth. At 4.7 percent annual growth, an economy can double in size in about 15 years; the same doubling would take more than 20 years at 3.5 percent annual growth. In 1989 Hawai‘i’s economy, measured by its real gross state product, was more than four times its size in 1959. The 1990s were difficult years for Hawai‘i as the state’s economy stagnated.

What causes economic growth? Increases in the labor supply and capital stock contribute to economic growth. As well, increases in productivity—that is, the ability to produce more with the same amount of labor and capital—contribute to economic growth. Since WWII, productivity gains have become increasingly important in fueling the growth of the U.S. economy. Indeed, it has become the most important source of U.S. economic growth; by comparison, the contributions of labor and capital to post-war U.S. growth have declined.¹ This observed trend is expected to continue.

Education is an important source and a product of economic growth. In their recent study, Eric Hanushek and Dennis Kimko concluded that “labor-force quality differences are important for growth; that these quality differences are related to schooling; and that quality has a causal impact on growth.”² By increasing knowledge and flexibility instilled by the learning process, education improves the productivity of the workforce over time and expands the productive capacity of an economy.³ A recent study conducted at the University of Illinois estimated that about 8 percent of the U.S. annual economic growth between 1979 and 1999 could be attributed to college and university teaching and research.⁴

Similarly, Hawai‘i’s work force has been an important contributor to the state’s economic growth since statehood. Hawai‘i’s work force more than doubled between

¹ Jeremy Atack and Peter Passel, A New Economic View of American History, 2nd edition (N.Y.: W. W. Norton & Company, 1994), p. 19.

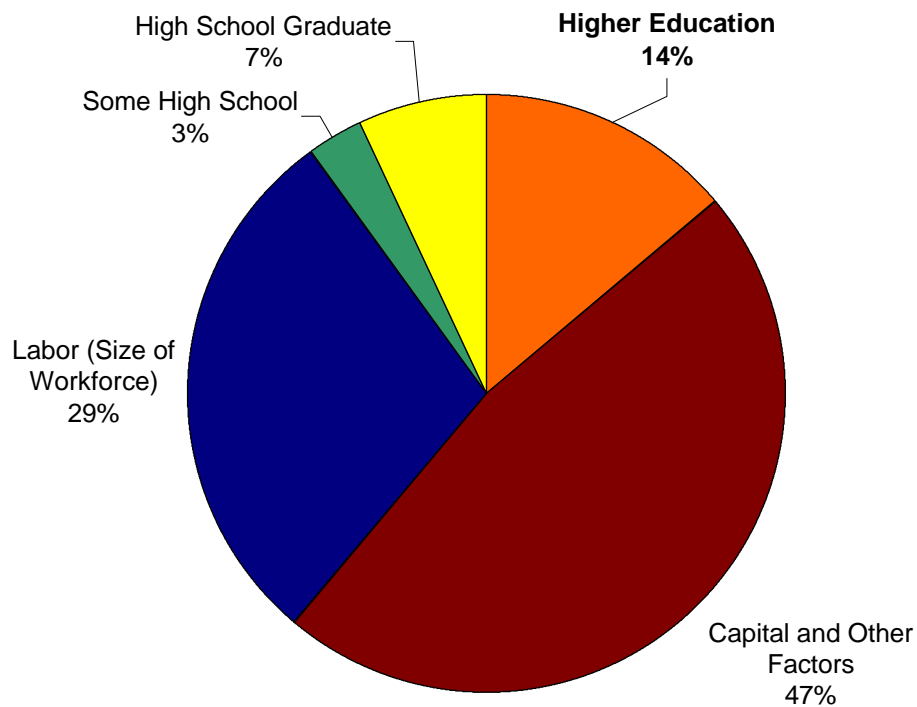
² Eric A. Hanushek and Dennis D. Kimko, “Schooling, Labor-Force Quality, and the Growth of Nations,” American Economic Review, vol. 90 No. 5 (December, 2000), p. 1204.

³ George Psacharopoulos, “Economic Impact of Education,” in Gerald M. Meier and James E. Rauch, Leading Issues in Economic Development, seventh edition (New York: Oxford University Press, 2000), pp. 223-226.

⁴ Robert W. Resek *et. al.*, Illinois Higher Education: Building the Economy, Shaping Society, (Urbana: Institute of Government and Public Affairs, 2000).

1959 and 1998, a significant source due to in-migration from other states and countries. In addition to their growing numbers, an increasing percentage of Hawai‘i’s labor force had graduated from college. In 1960, only 9 percent of Hawai‘i’s adult population, aged 25 and over, had a college degree; by 1998 the percentage of adults with bachelor’s degrees or higher had risen to 24%. Compared to the other 49 states, Hawai‘i ranks slightly above the median (rank=22) in higher education achievement.⁵

Figure 1: Higher Education's contribution to Hawai‘i’s economic growth, 1959-1989



⁵ The same holds for high school achievement. In 1960, less than half of Hawai‘i’s adult population (age 25 years and over) had completed 4 years of high school; by 1998 nearly 85% had completed high school (or more). State of Hawai‘i Data Book, 1999 (<http://www.Hawaii.gov/dbedt/>).

Using growth accounting methodology pioneered by Edward Denison⁶ and adapted by George Psacharopoulos,⁷ we estimate that Hawai‘i’s work force accounted for more than half (53 percent) of the state’s economic growth between 1959 and 1989. Capital and other factors accounted for the rest. Higher education’s effect on raising labor earnings in Hawai‘i alone accounts for 14 percent of Hawai‘i’s economic growth between 1959 and 1989 (Figure 1).⁸ The details of the calculations are presented in Appendix A of this report.⁹ The 14 percent number understates the contribution of higher education to Hawai‘i’s economic growth since it does not include, for example, the positive benefits of research or service provided by Hawai‘i’s higher education institutions to local businesses and industries. We next assess the economic contribution of the University of Hawai‘i.

University of Hawai‘i: A Brief History

The University of Hawai‘i had its beginnings in 1907 as a college of agriculture and mechanical arts, called the College of Hawai‘i, created under Act 24 of the Hawai‘i Territorial Legislature. The College of Hawai‘i became the territory’s Land Grant College, a designation that remains today. With the establishment of the College of Arts and Sciences in 1920, the College of Hawai‘i became a university. Enrollment growth in the early years was slow, but the close of World War II and increased educational

⁶ Edward F. Denison, *Sources of Economic Growth in the United States*, (Washington D.C.: Brookings Institution, 1962), and *Why Growth Rates Differ* (Washington D.C.: Brookings Institution, 1967).

⁷ George Psacharopoulos, *The Anatomy of a Rate of Growth: The Case of Hawai‘i, 1950-1960* (Honolulu: University of Hawai‘i, Economic Research Center, March, 1969).

⁸ Higher education as used here includes “some college” experience to post-graduate education.

⁹ Found on the UH-Manoa economics research organization at: <http://www2.hawaii.edu/~uhero/> as well as the Office of the Vice President for Planning and Policy website at: <http://www.hawaii.edu/ovppp> click on “Economic Impact”

demand fueled by returning GI's increased the University's enrollment to over 5,000 students in the 1950s. Statehood and the establishment of the University of Hawai'i as the "state university," under Article 10, Section 5 of the Hawai'i State Constitution in 1959, marked the beginning of a period of accelerating enrollment that resulted in the formation of a large, diverse system. In 1965, the State Legislature created a statewide system of community colleges and placed it within the University of Hawai'i. In 1970, the University of Hawai'i at Hilo was founded. In 1989, West Oahu College, an upper division institution opened in 1976, was renamed the University of Hawai'i-West Oahu. The flagship Manoa campus became the University of Hawai'i at Manoa.

The University was designated a Sea Grant College in 1972 and a Space Grant College in 1989, and currently is one of only twelve universities in the United States to have received all three designations. In the decade after statehood, the University of Hawai'i at Manoa achieved national recognition both in graduate education and research. It shares distinction among 70 American institutions designated Carnegie I Research University by the Carnegie Foundation for the Advancement of Teaching. Striving for economic development was an important reason why the State of Hawai'i wanted a Carnegie I Research University.¹⁰ As the economic development of the state has become increasingly dependent on knowledge and technology, government and industry have increasingly looked to the University as an essential partner to conduct basic and applied research in numerous key areas, such as agriculture, aquaculture, astronomy,

¹⁰ In 2000, the Carnegie Foundation for the Advancement of Teaching designation for this category of universities changed to "Doctoral/Research Universities—Extensive."

biotechnology, ocean resources, renewable energy, travel industry management, and others. Research also brings extramural money into the economy.

Today, the University of Hawai‘i system is comprised of 10 campuses—seven community colleges (four on Oahu and one each on Kauai, Maui, and Hawai‘i), University of Hawai‘i at Manoa, University of Hawai‘i at Hilo, and the University of Hawai‘i-West Oahu.

In Fall 1999, enrollment of credit students totaled 46,479, distributed by campus as follows:

<u>Campus</u>	<u>Number of Students</u>
Manoa	17,612
Hilo	2,790
West Oahu	687
Community Colleges:	25,390
Honolulu	4,769
Kapiolani	7,254
Leeward	5,570
Windward	1,514
Hawai‘i	2,279
Maui	2,862
Kauai	1,142

Eighty-seven percent of the credit students were undergraduates; the remaining 13 percent were graduate students. Hawai‘i residents comprised nearly 85 percent of all credit students enrolled at the University of Hawai‘i campuses. The community colleges enrolled more than half (55 percent) of all the students in the system.

The University of Hawai‘i serves a large percentage of college-bound Hawai‘i high school graduates. In 1996, the most recent data available, over 56 percent of that year’s high school graduates went to college right after graduation, and nearly two out of three went to one of the ten campuses of the University of Hawai‘i. Among Hawai‘i

colleges and universities, UH was the choice of nearly 9 out of 10 college-bound graduates who remained in Hawai‘i. While UH may not be the only higher education “game in town,” as often claimed, it is by far the biggest higher education game in town.

In addition to educating the 46,000 regular session credit students, in FY 1999 more than 18,000 students enrolled in the University of Hawai‘i summer sessions¹¹; among them 22 percent were out-of-state students. The Manoa campus led all campuses in summer session enrollment with nearly 60 percent of the total. As well, each year thousands of students take credit and non-credit continuing education courses offered by the University’s various campuses for personal growth and enjoyment.

The task of teaching thousands of students each year, to conduct research at the knowledge frontier, and to serve the needs of the community are assigned to over 7,800 University employees, about half of whom are faculty. The UH system generates more than 1 billion dollars worth of spending each year.

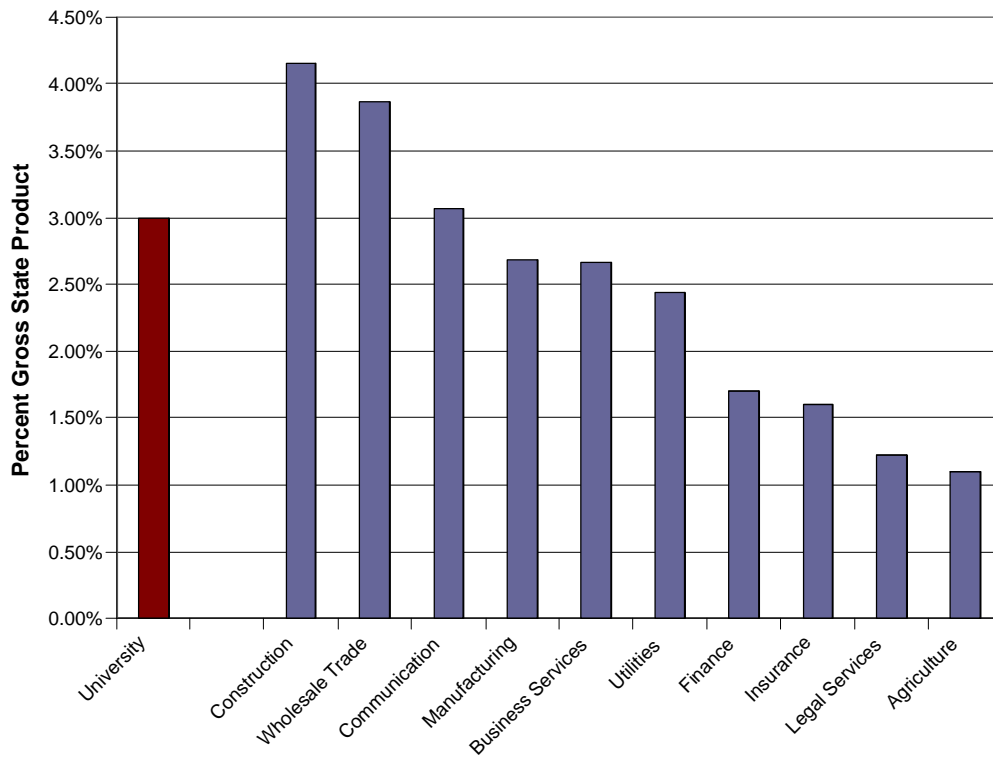
UH: A Major Economic Sector in Hawai‘i

Indeed, one can think of the UH system as if it were one of many businesses or industries in Hawai‘i. It produces education and research services as its primary outputs. In addition, it produces entertainment and sports services, consulting services, health care, housing, and food services. Its customers include students, visitors, private businesses, governments, and the general public. Significant portions of its services are exported worldwide to students, businesses, governments, and individuals abroad. It buys goods and services locally and abroad. In FY 1999, student spending (system-wide)

¹¹ A summer session student was counted twice if he/she was enrolled in both Manoa summer sessions.

for tuition, room and board, and other expenses; state and federal government-funded UH spending for goods and services; out-of-state visitor spending while attending UH sporting events and UH-sponsored conferences and professional meetings, totaled \$1.146 billion, after subtracting imports of goods and services. UH is a billion-plus-dollar business!

Figure 2: Relative size of UH in Hawai‘i’s economy



In 1999, UH represented about 3 percent of Hawai‘i’s economy (gross state product) of nearly \$40 billion. By comparison, agriculture’s contribution to Hawai‘i gross state product was only 1.1 percent¹²; the communications industry, 3.1 percent;

¹² Agriculture as used here refers to production at the farm level and excludes agricultural processing.

utilities, 2.4 percent; finance, 1.7 percent; insurance; 1.6 percent; business services, 2.7 percent; legal services, 1.2 percent; wholesale trade, 3.9 percent; and construction, 4.2 percent.¹³ Thus, the University of Hawai‘i is a major economic sector in Hawai‘i.

Creating Jobs and Generating Income

An important difference between the University and Hawai‘i and a private business is that the University gets a substantial part of its funding from taxpayers. In FY 1999, the University of Hawai‘i system spent \$730 million, net of spending and internal accounting transfers between units within the University, in support of its educational mission; the State General Fund paid \$379 million of the total. The difference between what the State General Fund paid for and the total amount spent by the University (\$730 million - \$379 million = \$351 million) was paid for by government research and training grants, revolving funds (e.g., bookstore revenues), special funds (e.g., tuition and fees), and federal matching grants (e.g., U.S. Department of Agriculture Hatch and Smith-Lever funds). Adding money spent by the privately funded University of Hawai‘i Foundation, the Research Corporation of the University of Hawai‘i (RCUH), spending by students on items other than tuition, fees, dorm fees, and books¹⁴, out-of-town visitor spending on UH athletic events (e.g., football, baseball, basketball, volleyball games, etc.) and UH-sponsored professional meetings and conferences, and University employee retiree benefits brings total UH-related expenditures to \$1.086 billion in FY1999. About \$983

¹³ Source: BEA – Bureau of Economic Analysis www.bea.doc.gov/bea/regional/gsp/. Data for all other industries are calendar year 1998.

¹⁴ Money spent by students for tuition, fees, dorm fees, and books were received and spent by the University and show up in the UH system expenditure data. They were excluded to avoid double counting.

million of that was spent locally. Thus, for every dollar of taxpayer money spent on UH, the University was able to generate an additional \$1.87 (= \$1.086 billion / \$0.379 billion) of spending for a total of \$2.87. In sum, the University is a generator of spending and economic activity in and of itself. The methodology used to derive these numbers, and the other numbers in this section of the report, is described in Appendix B.¹⁵

The University of Hawai‘i generates economic activity in the community through its purchases from local businesses, its payment to its employees and retirees, and spending by its students and visitors. The total amount of economic activity generated in Hawai‘i can be estimated using the state’s 1992 input-output (I-O) model of Hawai‘i’s economy.¹⁶ The model is able to quantify the economic activity impacts of UH expenditures on 60 individual industries. We first distributed the \$1.086 billion spending among the 60 I-O sectors; then we multiplied the expenditures by their respective type II “multipliers” to arrive at their total sales, employment, and earnings impacts. The type II multipliers capture the direct, indirect, and induced effects per dollar of spending in each of the 60 sectors of Hawai‘i’s economy.¹⁷

¹⁵ See the UH-Manoa economics research organization website at: <http://www2.hawaii.edu/~uhero/>, as well as the Office of Vice President for Planning and Policy website at: <http://www.hawaii.edu/ovppp> click on “Economic Impact”

¹⁶ <http://www.Hawaii.gov/dbedt/iostudy.pdf>.

¹⁷ To illustrate the relationship between “direct,” “indirect,” and “induced” effects, consider the following example. I spend \$10 at a local grocery store; the “direct effect” of my expenditure on business sales in the economy is the \$10 received by the grocery store. In turn, the grocery store purchases \$5 worth of goods from its wholesaler. The “indirect” effect of my grocery purchase is the additional sale in the economy by the wholesaler to the grocery store. Both the grocery store and the wholesaler pay their employees, and with their pay the employees purchase goods and services in the economy. These are the “induced” effects. Similarly, the grocer and wholesaler pay rent, interest on loans, and take home profits; those incomes are eventually spent in the economy as well. Type II multipliers capture the “multiplier,” or sometimes referred to as the “ripple,” effects of any initial spending.

Table 1: Multiplier Effects per dollar of UH-Related Expenditures

	Amount (‘000\$)	Business Sales per \$ of Spending	Jobs per Million \$ of Spending	Earnings per \$ of Spending	State & Local Taxes per \$ of Spending
Total Expenditures	1,086,242	1.43	27	1.01	0.17
Organized Research (ORS)	190,308	1.59	37	1.18	0.20
Instruction (Non-ORS)	540,131	1.27	27	1.16	0.19
UH Foundation	13,594	1.34	21	0.87	0.15
RCUH	2,529	1.40	34	1.18	0.20
Student Spending	209,775	1.56	19	0.50	0.08
Visitor Spending	72,383	1.72	24	0.62	0.10
Retiree Benefits	57,522	1.60	20	1.42	0.24

Source: See Appendix B.

Table 1 shows that each educational dollar spent generates \$1.43 of total business sales, \$1.01 of employee earnings, and 17 cents of state and local tax revenues in Hawai‘i; and each million dollars of spending generates 27 full-time jobs in Hawai‘i. Not all dollars spent have the same impact on the economy. For instance, Table 1 shows that dollars spent by organized research units have higher multiplier effects on the economy than dollars spent by the instructional units. Spending by students and out-of-state attendees at UH-sponsored functions have large impacts (per dollar of spending) on sales of local businesses but low employment, earnings, and tax impacts.

Overall, the \$1.086 billion of education-related expenditures attributable to the UH system generated \$1.552 billion in local business sales, \$1.095 billion in employee earnings, \$183 million in state and local tax revenues, and 29,000 full-time (equivalent) jobs in Hawai‘i in FY 1999. They represent approximately 3.8 percent of total business sales, 3.9 percent of total employment, 4.7 percent of worker earnings, and 4.7 percent of total state and local tax revenues in the economy of Hawai‘i.

These numbers can also be used to illustrate the leverage effects of State General Fund higher education spending on the local economy. Every dollar of general fund spending on UH translates into \$4.10 of total business sales, \$2.89 of employee earnings, and 48 cents of state and local taxes in Hawai‘i.¹⁸ Every \$1 million of general funds spent on UH generates 77 full-time equivalent jobs in the economy.

The Value of a University of Hawai‘i Education

Each year thousands of Hawai‘i’s young people graduate from high school and face an important decision—to begin work full time immediately, or put off full-time employment and study towards a college degree. The decision they make has enormous implications for themselves, their families, and the state as a whole. This section of the report aims to quantify the benefits and costs of obtaining a bachelor’s and/or graduate degree for a *typical* University of Hawai‘i resident student. Obviously, every individual faces a different situation, but the results reported here are indicative of the returns to higher education for most Hawai‘i residents. Data limitations prevent us from estimating the benefits and costs of obtaining an associate (two-year) degree at one of Hawai‘i’s community colleges. This is because the U.S. Census data used in this study does not identify individuals with associate degrees, only individuals with “some college” experience.

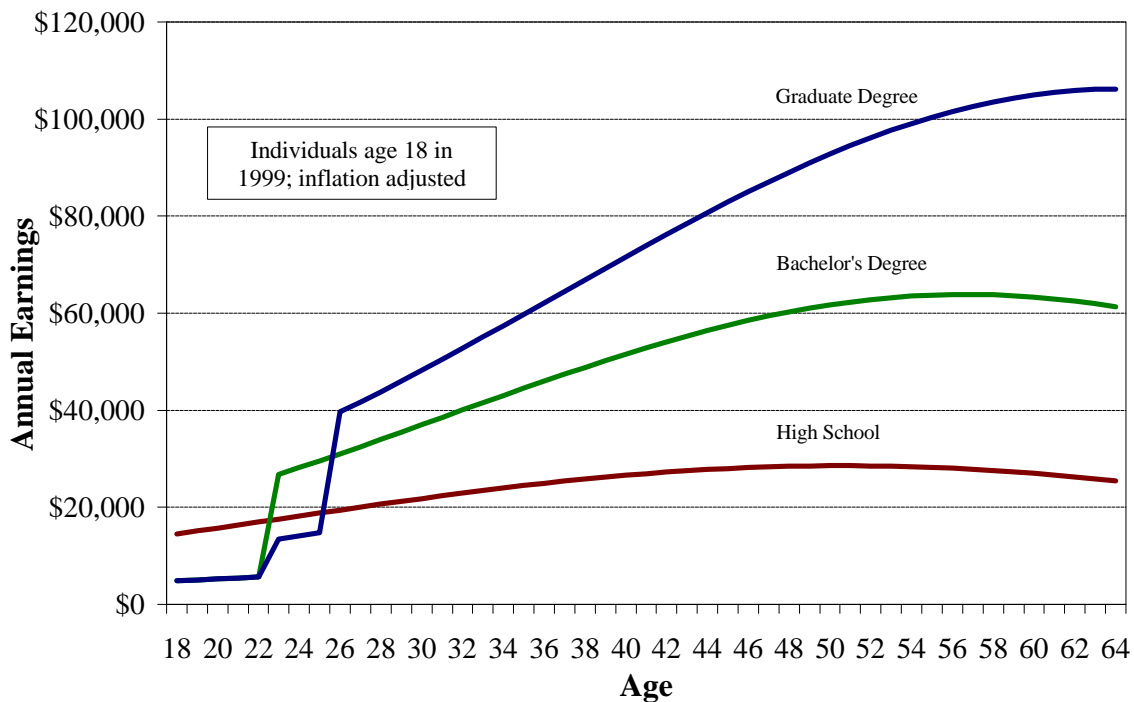
¹⁸ \$4.10 is calculated by dividing \$1.552 billion of total business sales by \$379 million appropriated from the State General Fund. Similarly, \$2.89 of employee earnings and \$0.48 are calculated by dividing \$1.095 billion in employee earnings and \$182 million, respectively, by \$379 million appropriated from the State General Fund.

We begin by focusing on the value of UH degrees to two typical 18-year-old Hawai‘i resident students in 1999—one getting an undergraduate degree and the other eventually obtaining a graduate degree. The “value” of the UH degree to the recipient is expressed as a rate of return to the investment in that education. This return is known as the “private return.” To the student, the investment in his/her own education is comprised of expenditures on resident tuition and fees and foregone earnings while attending school. At the University of Hawai‘i at Manoa, most undergraduate students require more than 4 years to complete a bachelor’s degree. We assume an average of 5 years for our undergraduate student. While attending school, students do not forego all earnings, as most students at the University of Hawai‘i—undergraduate and graduate—work at least part time. We estimate that for our typical undergraduate, the cost of 5 years spent at UH to get a bachelor’s degree is \$68,190; for the student eventually getting a graduate degree, the total cost would be an additional \$54,712 for a total of \$122,902 in foregone earnings, tuition, and fees.

The benefit of a college education is the present value of higher lifetime earnings a degree recipient can expect. Lifetime earnings by higher education attainment are estimated from the U.S. Census Current Population Surveys (1992 and 1999) and projected into the future. These earnings are for all individuals with college degrees, not necessarily individuals with UH degrees. Hence, we assume that a UH degree recipient has the same earnings profile over his/her lifetime as other residents of Hawai‘i who have earned similar degrees from other colleges and universities. The methodology used to calculate the benefits and costs and rates of return to higher education investments for our

two typical students are explained in Appendix C.¹⁹ Figures 3 and 4 illustrate the projected lifetime earnings of 18-year-olds with different levels of education and the costs and benefits of obtaining an undergraduate and/or graduate degree.

Figure 3: Relationship of age and earnings by level of educational attainment



Our estimates show that the average UH bachelor degree recipient can expect to earn \$1,045,456 more in his/her lifetime, after adjusting for inflation, than his/her high

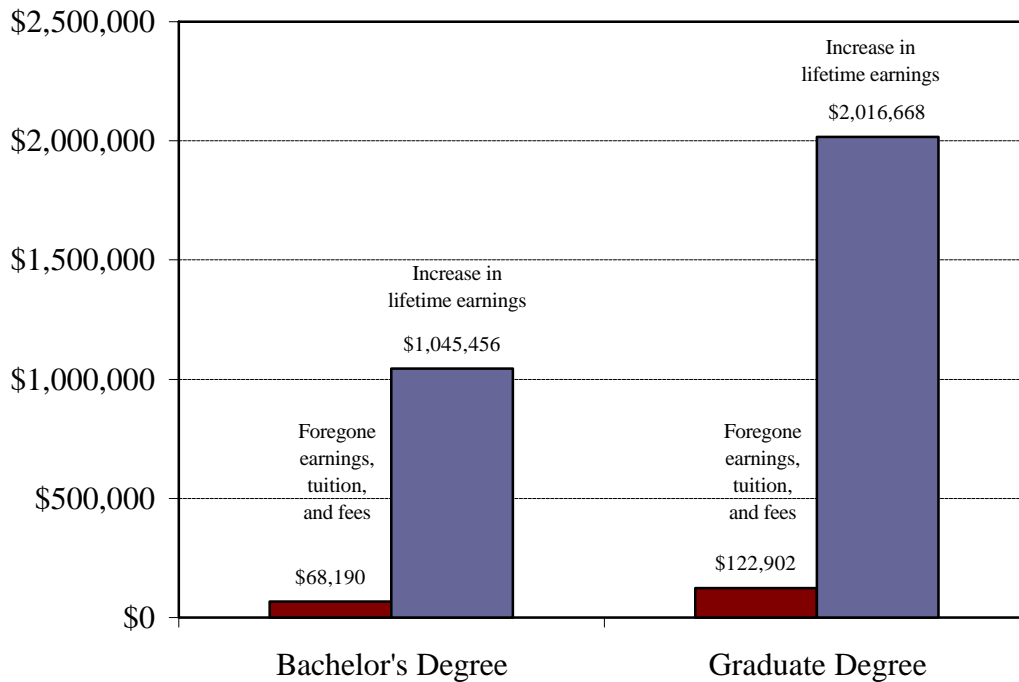
¹⁹ See UH-Manoa economics research organization at: <http://www2.hawaii.edu/~uhero/> or the Office of the Vice President for Planning and Policy website at: <http://www.hawaii.edu/ovppp> click on "Economic Impact"

school classmate who never went to college. The rate of return on investment in the bachelor's degree is 15.8 percent, after inflation.²⁰

The Hawai'i student earning a graduate degree from UH can expect to earn \$2,016,668 more, after adjusting for inflation, than his/her high school classmate with only a high school degree. The return on investment is 19.1 percent, after inflation. Indeed, for a Hawai'i student, a University of Hawai'i degree is a sound economic investment. For most students, there is no better long-term investment available.

²⁰A recent study by the University of Wisconsin found that a bachelor's degree from the University of Wisconsin system yielded an average rate of return of 22.67%, before correcting for inflation. William A. Strange, David L. Funk, and M. Matthew Onofrio, Economic Impact of the University of Wisconsin System, (Madison: University of Wisconsin, School of Business, April, 1997), p. 23. Psacharopoulos found that, in OECD countries, private rates of return to higher education average 12.3%, after correcting for inflation. George Psacharopoulos, "Returns to Investment in Education: A Global Update," World Development, vol. 22, No. 9, (1994) p. 1328.

Figure 4: Anticipated increase in lifetime earnings and costs by educational attainment beyond high school, Hawai‘i.



A University of Hawai‘i graduate does not bear the full cost of his/her college education. We estimate that Hawai‘i taxpayers contribute over \$53,000 toward the cost of his/her undergraduate education at the University of Hawai‘i. That subsidy is eventually returned to the state treasury during the lifetime of the graduate, assuming the graduate remains in Hawai‘i. Since the college graduate has a higher income over his/her lifetime than a high school graduate, he/she will pay more state and local taxes in the future. We estimate that a Hawai‘i resident who obtains a bachelor’s degree and remains in Hawai‘i will pay nearly \$137,000 more in state and local taxes over his/her lifetime (at current tax rates) than a resident with only a high school degree. The additional tax revenues collected from the graduate over his/her lifetime represent a 3.4 percent annual return on the initial public investment of \$53,000 in his/her UH education, after

accounting for inflation. Although the rate of return to Hawai'i's taxpayers is lower than the rate of return to the student from a UH bachelor's degree, this does not necessarily mean that society should value the University of Hawai'i less than the student. As noted above, there are other non-pecuniary benefits to society besides the additional tax dollars that a college-educated resident pays to the state treasury over his/her lifetime.

Besides raising the earnings potential of Hawai'i's residents, the University of Hawai'i serves as an important source of scientific, technical, and business expertise to local businesses and industries to help them solve difficult business problems. The University also acts as a catalyst and, in some cases, the creator of new businesses in Hawai'i. The following highlights a few examples of how the University of Hawai'i has helped to support local businesses and foster new economic activities in Hawai'i in recent years.

Supporting the Travel Industry

- Who doesn't love Hawai'i's beautiful, sandy beaches? And how do we keep them that way? UH researchers have found offshore sand deposits used to keep our beaches looking their best for visitors and Hawai'i residents.
- Imagine a year-round summer camp for grown-ups where people on extended vacations can learn things ranging from culinary arts to speaking English, lei making, and Hawaiian culture and history. That is what the **UH Community Colleges** call their Edu-tourism programs that reach out primarily to Asian visitors who are interested in combining learning and education with sun and fun.
- Every day thousands of tourists to Hawai'i board sightseeing buses and trolleys that take them on tours all over the state, visiting Hawai'i's many attractions and learning about the state's natural and cultural history. More than 500 of Hawai'i's tour bus drivers have been trained and certified by the **UH Kapiolani Community College's** tour driver certification program.
- Hawai'i is the home of Pan Pacific cuisine, blending the best of Asia/Pacific and European cuisine. **Kapiolani Community College's Culinary Institute of the**

Pacific trains many of Hawai‘i’s top chefs in the techniques, traditions, and influences of culinary arts from Asia and the Pacific, blending them with the classical styles of Europe. The program regularly attracts large numbers of students from Asia.

- **Honolulu Community College’s Airport Training Center**, the only one of its kind in the Pacific Basin, trains aeronautics maintenance technicians for the airline industry.
- **UH School of Travel Industry Management** undergraduate students each spend about 800 hours as paid and unpaid interns in Hawai‘i’s tourism industry. The school trains future executives and managers for the travel industry in Hawai‘i and throughout the entire Asia-Pacific region. Among its distinguished alumni are Andre Tabitouet, Founder and President of Aston Hotels and Resorts, and Paul Tang, general manager of the Hyatt Regency Waikiki Hotel.
- **University of Hawai‘i** operates the **Waikiki Aquarium**, which is visited by over 350,000 tourists annually.

Supporting the Agriculture Industry

- With more than 28 research farms, extension offices, and facilities on five islands, the **UHM College of Tropical Agriculture and Human Resources (CTAHR)** supports the development of diversified agriculture in Hawai‘i.
- In 1996, Kaua‘i taro growers were facing serious production problems with low yields and plant diseases like pocket rot, leaf blight, and soft rot. **CTAHR** scientists developed techniques of spacing and fertilizer usage in the fields that have increased crop quality and yields.
- Getting “Kamuela grown” vegetables to new markets has been a high priority for specialty produce farmers in Waimea on the Big Island. UH cooperative extension service agents stepped in to help farmers sell their fresh, high-quality goods at farmers markets on Oahu. The extension agents are also helping farmers develop plans to market their produce on the mainland.
- In addition, **CTAHR’s** Hawai‘i Grown from Farm to Restaurant workshop has brought closer relationships between chefs and farmers who are eager to promote locally grown produce in Hawai‘i’s restaurants.
- In the mid-1990s Hawai‘i-grown tropical flowers and foliage were refused entry to the U.S. mainland and foreign markets due to bug infestation. Using insecticide and heat-treatment methods developed by a **CTAHR** scientist for each of the 40 plant

species exported, the local industry regained access to those markets and added about \$40 million annually to Hawai‘i’s economy.

Partnering with Businesses to Train Workers for Emerging and Growing Industries

- When Continental Airlines was deciding where to locate its new \$24 million wide-body maintenance facility in the Pacific, the ability of the aeronautics maintenance program at **UH Honolulu Community College** to supply the necessary workers became a major factor in Continental’s decision to locate its facility in Honolulu. Since then, Continental Airlines has donated about \$1 million in instructional materials to the college to further the partnership.
- **Honolulu Community College’s** new commercial aviation program—in partnership with the University of North Dakota—makes it possible for students to “reach literally for the sky.” Students who dream one day of entering the booming global aviation industry can earn their private and commercial pilot licenses in Hawai‘i.
- Cisco Systems, Inc. designated the **UH Honolulu Community College** as one of its Regional Training Academies to train experts in computer networking. The Training Academies help high school students learn how to design, build, and maintain computer networks and prepare them for entry into this fast growing field.
- Need ultrasound tests? Local hospitals needed sonographers. **UH Kapiolani Community College** partnered with local hospitals to develop Hawai‘i’s first Diagnostic Medical Sonography (ultrasound) training program.
- **Hawai‘i Community College** on the Big Island developed training programs to supply workers for new, emerging industries such as call centers, forestry, and awa and noni production.

Supporting Biotechnology and High Tech Development

- UH-Manoa scientists, working with the University of California at Berkeley, founded the Marine Bioproducts Engineering Center (MarBEC), a research center that develops marine bioproducts for the chemical, pharmaceutical, nutraceutical, and life sciences industries. Through corporate partnerships with companies such as Monsanto and Cargill, MarBEC will explore and develop a wide range of bioproducts while also training a new breed of engineers and scientists for the growing marine bioproducts industry.
- In the mid-1990s, the state’s \$5 million banana industry benefited from the research of **CTAHR** scientists who employed biotechnology to develop varieties that are

resistant to the bunchy-top virus. This disease, which attacks banana crops in tropical regions, threatened more than two-thirds of the state's banana production.

- Papaya growing in Puna on the Big Island, home to 90 percent of the state's industry, was at a standstill caused by papaya ringspot virus. A team of **CTAHR** scientists and an alumnus engineered a new variety resistant to the disease. The new variety is credited with saving the industry, worth nearly \$16 million in 1999.
- **UHM College of Tropical Agriculture and Human Resources** scientists engineered an anthurium plant that is resistant to bacterial blight that had nearly destroyed the local industry.
- **University Connections** is a new partnership between the University of Hawai'i, the business community and the government to stimulate entrepreneurship in knowledge-based industries. Recently, it arranged to bring the Bio Asia Pacific Annual Conference to Hawai'i every other year for the next 10 years.
- **The University of Hawai'i at Hilo** manages Mauna Kea mountain on the Big Island and recently received a \$8 million grant from NASA to construct a planetarium and science-related center that will showcase astronomy.
- **The University of Hawai'i at Hilo** is developing a \$50 million International Village, in partnership with GEO International Employer Inc., which will include dormitories, a conference complex, and student services.

Companies Founded by UH Faculty

- **AdTech, Inc.**, a company founded by a UH professor of electrical engineering, designs and manufactures broadband test systems and datalink simulation equipment. Its latest innovation—the OC-192c POS interface, when used with other Adtech systems—can test data connections that move traffic at up to 150,000 simultaneous phone calls or 1,200,000 pages of information each second from a single network connection. AdTech is one of the state's largest high tech employers with over 300 workers.
- **Aquasearch, Inc.**, a publicly traded company that is headed by a UH scientist, uses photobioreactor technology to grow microalgae—a plant that grows 100 times faster than trees—using sunlight, water, carbon dioxide, and nutrients to produce pigments, proteins, enzymes, sugars, fats, amino acids, vitamins, and unusual bioactive compounds with many potential commercial uses. **Aquasearch** recently received a \$2.4 million grant from the U.S. Department of Energy to use its technology to capture and store gases that cause the “greenhouse effect.”

- Founded by a group of UH scientists and a business professor, **Hawai'i Biotechnology Group, Inc.**, capitalizes on the commercial potential of research being conducted in the biomedical and agricultural laboratories of Hawai'i. During the past 17 years, the firm has raised over \$28 million for research and development in molecular and recombinant gene technology.
- Research by a UH scientist, Professor Jaw Kai Wang, was instrumental in the founding of **Kona Bay Oyster & Shrimp Co.**, a producer of large shrimp, oysters, clams, and mussels in hatchery, nursery, and growth facilities in Keahole at the state's Natural Energy Lab of Hawai'i.
- **UH Information Technology Services** founded and operates the Hawai'i Internet Exchange (HIX), Hawai'i's only neutral interconnect point open to all Internet service providers in the state. HIX improves Hawai'i's Internet connectivity by keeping local Internet traffic in Hawai'i whenever possible. Without it, Internet services would have to travel to the mainland and back, thereby increasing cost and reducing performance.

Conclusion

A recent Honolulu Advertiser editorial (September 16, 2000) noted, "We support our university because it raises the intellectual level of society." Governor Ben Cayetano's 2001 State of the State address noted that "The University of Hawai'i is not just a place of higher learning; it is also a driving force for the economic development of this state." This report has also shown that the University of Hawai'i is a major factor in the current and future economic health of the state. The University assists existing businesses, fosters new businesses, and creates long-term job growth. The University contributes in a longer-term way to the overall health of the community through the development of our human resources and a basic knowledge infrastructure. The University promotes innovation and capitalizes on the state's unique natural and cultural attributes. The University is a laboratory for the creation of new knowledge and a warehouse for additions to the pool of knowledge. It is also becoming very clear that

integrating Hawai‘i into the global academic, business, and technology communities is not possible without the University. In sum, the University of Hawai‘i makes Hawai‘i a better place for all of us.

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Appendix A

Accounting for Higher Education's Contribution to Hawai'i's Economic Growth: 1959-1989

This Appendix summarizes the methodology used to estimate the relative contribution of higher education to the long run economic growth of the State of Hawai'i between 1959 and 1989. The calculations are based on the growth accounting method described in Psacharopoulos.²¹ This method separates the contribution to the economy's growth into three parts: a part due to capital, a part due to labor, and the rest (i.e. the "residual"). The labor part can be further decomposed to separate the growth due to increases in the quantity of labor from that due to improvements in the quality of labor stemming from higher levels of educational achievement. Whatever economic growth that is not explained by the growth of capital or labor (i.e. the "residual") is usually attributed to growth due to technological change and other factors.

Specifically, the contributions of capital and labor at five levels of schooling (less than high school, high school but no diploma, high school graduate, some college, and college and above) are estimated. The specific growth accounting equation takes the form:

$$g_y = k f_k + g_0 s_0 + g_1 s_1 + g_2 s_2 + g_3 s_3 + g_4 s_4 + R$$

²¹ George Psacharopoulos, *The Anatomy of a Rate of Growth: The Case of Hawaii, 1950-1960* (Honolulu: University of Hawaii Economic Research Center, March, 1969). See Chapter III for the derivation of the model.

where: g_y = average annual rate of output (i.e. real gross state product) growth
 k = investment/output ratio
 f_k = marginal product of capital
 g_o = rate of growth of the labor pool with 9th grade (or less) education
 s_o = share of earnings by 9th grade (or less) labor pool in total labor earnings
.
.
 g_4 = rate of growth of the college educated (and above) labor pool
 s_4 = share of earnings by college (and above) labor pool in total labor earnings
 R = the residual

The contribution of higher education is computed by ascertaining the growth in the population group with at least some college education and that group's income/earnings share of total income/labor earnings in the state. Because the census data used in this study do not identify which colleges residents attended, the results of this study therefore show the overall effects of higher education on aggregate incomes and economic growth in Hawai'i and not the specific contribution of the University of Hawai'i to the state's economic growth.

Data

Applying the growth accounting equation requires data on the investment/output ratio (k), the marginal productivity of capital (f_k), the number of workers and their income levels by educational achievement for 1959 and 1989. The investment output ratio was calculated using data on capital stock and real gross state product supplied by the State of Hawai'i Department of Business, Economic Development and Tourism (DBEDT). Information on the marginal productivity of capital was unavailable; we assumed an arbitrary value of 0.1. The arbitrary selection of a specific value for f_k has no impact on the estimate of labor's contribution to the aggregate growth of Hawai'i. It only affects the estimate of capital's contribution to Hawai'i's economic growth. The growth

accounting equation employed here estimates the contribution of education to growth by the earnings differentials of labor classified by the level of schooling. Data on the size of the labor force and incomes by educational achievements were obtained from the 1960 and 1990 U.S. decennial census for the years 1959 and 1989 respectively. For 1959, the Census Bureau reported median incomes; for 1989, it reported mean incomes. The data are summarized in Table 1.

Table 1: Hawai‘i Labor Force by Educational Attainment and Mean Income, 1959 and 1989.

Labor Category	<u>1959</u>		<u>1989</u>	
	Number with Income	Median Income (real 1987 dollars)	Number with Income	Mean Income (real 1987 dollars)
Less than High School	92045	8886	52790	9153
High School, No Diploma	49418	10367	61931	12155
High School	100739	11385	190985	15366
Some College	30782	12313	147959	16982
College +	27935	19843	151747	28559
Total	<u>300920</u>		<u>605411</u>	

(1960 Census of Population, Volume I, Characteristics of the Population, Part 13, Hawai‘i, U.S. Bureau of the Census; 1990 Census of Population, Education in the United States, U.S. Department of Commerce, Economics and Statistics Administration, U.S. Bureau of the Census.)

Results

Summary of Results:

	% of Total Growth	
Average annual economic growth: 1959-1989	4.7%	100%
Contribution of labor:	2.5	53
Quantity of labor	1.4	30
Quality of labor	1.1	23
Did not graduate from HS	0.15	3
HS graduate	0.31	7
Some college	0.11	2
College degree +	0.55	12
Contribution of capital and other factors:	2.2	47

Results show that labor's contribution to Hawai'i's economic growth between 1959 and 1989 was 53%, and capital and other factors accounted for the remaining 47%. Labor force growth accounted for 30% of Hawai'i's economic growth, while improvements in the quality of labor accounted for 23%. The contribution of higher education (some college and college degree +) to Hawai'i's economic growth was estimated at 14%. The estimate of higher education's contribution is conservative, because our analysis does not attempt to estimate the spillover effects of higher education since only labor earnings are used to measure the contribution of higher education. A similar study performed for the University of Wisconsin system proposed that an additional one-fourth of the residual or productivity gain in the economy could be attributed to higher education, reflecting the university's role as a primary engine of knowledge creation.²² If a similar procedure were adopted here, the importance of higher education would be even greater.

²² William A. Strang, David L. Funk, and M. Matthew Onofrio, Economic Impact of the University of Wisconsin System (Madison: University of Wisconsin-Madison, School of Business, April, 1997).

Appendix B

IMPACT OF UH SYSTEM RELATED SPENDING ON HAWAI'I'S ECONOMY: FY 1999

This Appendix summarizes the methodology used to estimate the economy-wide impacts of education-related spending at the University of Hawai'i. Economic impact is defined here as the economic activities generated by the current (FY 99) operating and capital expenditures of the UH system as well as the associated expenditures by RCUH, UH Foundation, UH employees, students, out-of-state visitors spending while attending UH athletic events, meetings and conventions, and retiree benefits. Economic impact is expressed in terms of business sales, employment, labor income, and state & local taxes.

Methodology

The 1992 60-sector input-output (I-O) model of the State of Hawai'i is used to evaluate the short-term impact of the UH system and related expenditures.²³ Expenditure data are distributed to the 60 I-O sectors according to the appropriate standard industrial codes (SIC). The adjusted expenditure vectors (according to the 60 I-O sectors) are multiplied by the respective type II multipliers to arrive at the total sales, employment, and income impact. Type II multipliers include direct, indirect, and induced impact per \$ of final expenditure for each of the 60 I-O sectors. Only local purchases are included in the analysis; imports are netted out. We assumed the following about spending patterns of University employees, students, retirees, and out-of-state visitors.

²³ State of Hawaii, Department of Business, Economic Development and Tourism, The Hawaii Input-Output Study, 1992 Benchmark Report (Honolulu: December, 1998).

- Incomes received by regular employees are assumed to be spent according to the 1992 personal consumption expenditure pattern.
- Incomes received by student employees (graduate assistants, student helpers) are assumed to be spent according to student spending patterns.
- Incomes received by retirees are assumed to be spent in the same pattern as that for regular employees.
- Spending pattern for U.H. visitors is assumed to be the same as that for the average (typical) visitor to Hawai'i in 1992.

Data

Detailed expenditure data for the UH system are provided by the UH Budget and General Accounting Offices. Expenditures are broken into two major categories: Non-ORS (largely instruction) and ORS (Office of Research Services). A total of \$102,922,738 is added to general fund expenditures to reflect the fringe benefits and debt service paid by the State. Expenditures are sorted into in-state vs. out-of-state purchases according to vendor's address. Intra-university expenditures and transfers are netted out. The following tables summarize the revenue and expenditure data used in the estimation.

Source of Fund	Fund Expenditures FY 99 (\$)
General Fund	283,262,175
Additional Cost to the State	102,922,738
Subtotal	386,184,913
Special, Revolving, Federal Matching Funds	164,656,035
Non-ORS	550,840,948
ORS	205,997,190
TOTAL	756,838,138

UH System Expenditures Breakdown FY 99	Non-ORS (\$)	ORS (\$)	Total UH System (\$)
TOTAL LOCAL PURCHASES OF GOODS & SERVICES	78,455,864	69,897,638	148,353,502
LABOR INCOME	374,966,006	107,697,521	482,663,527
IMPORTS	86,709,532	12,712,859	99,422,391
TOTAL DIRECT EXPENDITURES	540,131,403	190,308,018	730,439,420
INTRA UNIVERSITY SPENDING/TRANSFER	10,709,545	15,689,172	26,398,718
TOTAL EXPENDITURES	550,840,948	205,997,190	756,838,138

(Note that in FY1999, the University spent \$730 million, net of intra-university spending and transfers.)

Expenditure data for RCUH and UH Foundation are taken from their annual income statements. Proportion of imports is estimated.

UH Foundation and RCUH Expenditures FY 99	UH Foundation (\$)	RCUH (\$)
TOTAL LOCAL PURCHASES OF GOODS & SERVICES	5,464,685	597,379
LABOR INCOME	4,929,217	1,602,579
IMPORTS	3,200,163	329,106
TOTAL DIRECT EXPENDITURES	13,594,065	2,529,064
INTRA UNIVERSITY SPENDING/TRANSFER	3,104,871	188,858
TOTAL EXPENDITURES	16,698,936	2,717,922

Student expenditures are estimated separately for resident and non-resident students from information on the price of UH attendance supplied by the financial aids office. Since these are suggested minimum expenditures, they understate actual student expenditures. Expenditures are estimated separately for students living in University dormitories, at home with relatives, or in off-campus housing. Dormitory cost, books and supplies, and tuition are taken out since they are already reflected in the expenditures by the UH system. Expenditures by student employees (graduate assistants, student helpers, scholarship and fellowship holders) are also subtracted from the total student spending to avoid double counting of spending.

Student Expenditures ('000 \$)	Original			Adjusted		
	Total	Resident Students	Non-Resident Students	Total	Resident Students	Non-Resident Students
Books and Supplies	43,794	36,963	6,831	0	0	0
Food	98,373	75,979	22,394	98,373	75,979	22,394
Housing	103,927	73,351	30,576	99,381	69,858	29,523
Personal Care & Medical	48,135	39,876	8,259	48,135	39,876	8,259
Ground Transportation	10,652	8,979	1,673	10,652	8,979	1,673
Interisland Airfares	639	639	-	639	639	-
Total	305,521	235,788	69,733	257,181	195,332	61,849

Visitor expenditures are broken into conferences, events, and athletics events as follows:

Visitor Expenditures	Visitor Days	\$/day	Total ('000 \$)
Conferences	160,204	202	32,380
Events	47,508	202	9,602
Athletics Events			30,400
UH Manoa (J. Suyderhoud)			27,000
UH Hilo (D. Hammes)	20,000	170	3,400
Total			72,382

Out-of-state visitor expenditures while attending UH athletic events are obtained separately from reports prepared by Professor Jack Suyderhoud (College of Business Administration, UH-Manoa)²⁴ and Professor David Hammes (Department of Economics, University of Hawai'i-Hilo)²⁵. The estimates are for 1998. The number of event and conference attendees and their visitor days are estimated from data supplied by provosts, deans and directors from the 10-campus system. We assume that their expenditures per day are the same as that for the average visitor to Hawai'i.

²⁴ Jack P. Suyderhoud, Economic Impact Analysis of the University of Hawaii Athletic Department (Honolulu: University of Hawaii at Manoa, School of Business, March 1999).

²⁵ David Hammes, The Annual Economic Impact of the UH-Hilo Athletics Program on the Economy of the County of Hawaii (Hilo: University of Hawaii at Hilo, no date).

Retiree benefits are estimated using the ratio of UH members to total state members of the state retirement system as follows:

State Retirement System	Total State	UH
Total Retirement Benefits (\$)	444,047,239	45,112,149
Total Medical (\$)	122,150,259	12,409,627
TOTAL (\$)	566,197,498	57,521,777
Total members (1998)	60,447	6,141
Total number of retirees	27,950	2,840

Results

Table 1 presents the type II multipliers by category of expenditures.

Table 1 -- Implicit Multipliers by Source of UH Expenditures

Source of Impact	Direct Expenditures ('000\$) [1]	Sales (per \$ of expenditure) [2]	Employment (jobs per million \$ of expenditure) [3]	Income (per \$ of expenditure) [4]	State & Local Taxes (per \$ of expenditure) [5]
Non-ORS					
Total In-State Expenditures	453,422	1.51	32	1.38	0.23
Total Expenditures	540,131	1.27	27	1.16	0.19
ORS					
Total In-State Expenditures	177,595	1.70	40	1.26	0.21
Total Expenditures	190,308	1.59	37	1.18	0.20
UH Foundation					
Total In-State Expenditures	10,394	1.75	28	1.14	0.19
Total Expenditures	13,594	1.34	21	0.87	0.15
RCUH					
Total In-State Expenditures	2,200	1.61	39	1.35	0.23
Total Expenditures	2,529	1.40	34	1.18	0.20
Student Spending	209,775	1.56	19	0.50	0.08
Visitor Spending	72,383	1.72	24	0.62	0.10
Retiree Benefits	57,522	1.60	20	1.42	0.24
TOTAL					
Total In-State Expenditures	983,290	1.58	30	1.11	0.19
Total Expenditures	1,086,242	1.43	27	1.01	0.17

For example, it shows that in FY 1999, total education related expenditures at the University of Hawai‘i were \$1.086 billion dollars of which \$983 million were spent in-state and the rest were purchases out-of-state. For each dollar spent in-state, it generated \$1.58 of business sales, \$1.11 of household earnings, and 19 cents of state and local taxes. As well each \$1 million spent in Hawai‘i generated 30 full-time equivalent jobs. For every dollar spent, in-state or out-of-state, \$1.43 in total business sales, \$1.01 in household earnings and 17 cents in state and local taxes were generated; and each \$1 million spent generated 27 full-time equivalent jobs.

Table 2 summarizes the economy-wide impacts of the \$1.086 billion spent at the University of Hawai‘i.

Table 2--Economy-wide Impacts of University of Hawai‘i Related Spending by Source of Funds

Source of Fund or Impact	Direct Expenditures ('000 \$) [1]	Sales ('000\$) [2]	Employment (jobs) [3]	Income ('000 \$) [4]	State & Local Taxes ('000 \$) [5]
General Fund	378,676	480,840	10,252	437,713	73,098
Revolving, Special & Fed Match	161,454	205,012	4,371	186,625	31,166
Federal Grants and Trust	190,308	301,646	7,117	224,496	37,491
Total UH System	730,438	987,498	21,741	848,834	141,755
UH Foundation	13,594	18,189	290	11,818	1,974
RCUH	2,529	3,537	86	2,976	497
Student Spending	209,775	326,629	3,994	104,978	17,531
Visitor Spending	72,383	124,266	1,768	44,896	7,498
Retiree Benefits	57,522	92,168	1,169	81,675	13,640
TOTAL	1,086,241	1,552,288	29,048	1,095,177	182,894
Impact per \$ of General Fund	2.87	4.10	77	2.89	0.48
Impact as a % of State Total		3.77	3.88	4.74	4.74
Total other than General Fund	707,564	1,071,448	18,795	657,463	109,796
Impact per \$ of General Fund	1.87	2.83	50	1.74	0.29
Impact as a % of State Total		2.61	2.51	2.84	2.84
UH System Total	730,438	987,498	21,741	848,834	141,755
Impact per \$ of General Fund	1.93	2.61	57	2.24	0.37
Impact as a % of State Total		2.40	2.90	3.67	3.67
UH Total Excluding General Fund	351,762	506,658	11,488	411,121	68,657
Impact per \$ of General Fund	0.93	1.34	30	1.09	0.18
Impact as a % of State Total		1.23	1.53	1.78	1.78

The most important findings can be summarized as follows:

- Taking into account the multiplier effects, the \$1.086 billion education-related spending at UH generated \$1.552 billion in business sales, 29,048 full-time equivalent jobs, \$1.095 billion in household earnings, and \$183 million in state and local taxes. These represented approximately 3.77% of total business sales, 3.88% of total number of jobs, 4.74% of household earnings, and 4.74% of state and local taxes in the entire state.
- The University is able to leverage money spent by the State on UH so that for every dollar of General Funds spent on UH, the University generates another \$1.87 of direct education related spending in the economy for a total of \$2.87 (=\$1.086 billion divided by \$379 million in general fund expenditures) in direct higher education related spending in the state.
- Taking into account the multiplier effects of education related expenditures, our results show that every \$1 of General Fund spending on UH-- augmented by spending by students, visitors, external research and training grants, etc.-- generated \$4.10 in total business sales, \$2.89 in household income, and 48 cents in state and local taxes in Hawai'i. And \$1 million in General Fund spending generated 77 full-time equivalent jobs.

In sum, the University of Hawai'i is a significant economic force in Hawai'i.

Appendix C

The Return on Investment in a University of Hawai‘i Education

This Appendix summarizes the methodology used to quantify the benefits and costs of obtaining a bachelor’s and/or graduate degree for a *typical* University of Hawai‘i (UH) student. Obviously, every individual faces a different situation, but these results are indicative of the returns to higher education for most Hawai‘i residents. We begin by focusing on private benefits and costs, and then turn to the benefits and costs to the state taxpayer of investing in higher education in Hawai‘i. It is important to note that when possible, we have tried to follow a conservative approach and adopt assumptions that may bias the rates of return downward. Consequently, the rates of return presented here should be very realistic, and in fact, for some individuals it may be substantially higher.

Private Benefits

Calculating the benefits of a University of Hawai‘i education requires that we project the future earnings path of those with different levels of educational attainment. To do this, we draw on the 1992 and 1999 U.S. Current Population Surveys and estimate a variant of Mincer’s human capital earnings function²⁶ for those with a high school degree, bachelor’s degree, and graduate degree, where:

$$\ln \text{Earnings} = B_0 + B_1 \text{Age} + B_2 \text{Age}^2 + B_3 \text{HI} + B_4 \text{Year99}$$

²⁶ Jacob Mincer, Schooling, Experience, and Earnings (New York: National Bureau of Economic Research, 1974). David Card, "The Causal Effect of Education on Earnings," in Orley Ashenfelter and David Card eds., Handbook of Labor Economics, vol. 3 (N.Y. and Amsterdam: Elsevier Science, 1999), pp. 1801-1863.

Earnings is labor earnings, *Age* is the age of the individual, and *HI* is a dichotomous variable that is equal to one if an individual is living in the State of Hawai‘i. *Year99* is also a dichotomous variable that is equal to one if the year is 1999 and zero if it is 1992. The equation is estimated for those likely to be in the labor force, that is, those ages 18 to 75 with positive earnings. The 1992 sample includes 155,796 individuals (1466 from Hawai‘i), and the 1999 sample contains information on 132,324 individuals (1240 from Hawai‘i). Combining the two surveys and eliminating those with no earnings and those under age 18 and over age 75 yields a representative sample of the labor force in the United States and Hawai‘i. There are 8,163 individuals with some education beyond college, 16,453 with a college degree, and 30,334 with a high school degree.

The estimated earnings functions are presented in Table 1. B_1 and B_2 determine the shape of the profile for each level of educational attainment and B_3 is a shift factor that adjusts the age-earnings profile for individuals who live in Hawai‘i. Generally the Hawai‘i coefficients are not significantly different from zero, indicating that Hawai‘i earnings are not significantly different from other individuals in the samples.

Table 1: Estimates of Human Capital Earnings Functions for Different Levels of Education Achievement, Hawai‘i, 1992-99.

	High School Degree	Bachelor’s Degree	Graduate Degree
Intercept	8.5541 (0.0503)	8.6403 (0.0886)	8.8554 (0.1539)
<i>Age</i>	0.0619 (0.0018)	0.0765 (0.0034)	0.0723 (0.0059)
<i>Age</i> ²	-0.0006 (0.0000)	-0.0008 (0.0000)	-0.0007 (0.0001)
<i>HI</i>	-0.0681 (0.0537)	-0.0950 (0.0698)	-0.0822 (0.1151)
<i>Year99</i>	0.1899 (0.0357)	0.2449 (0.0577)	0.2762 (0.0867)

Notes: Dependent variable: $\ln Earnings$.
Standard errors in parentheses.

Once the age-earnings profile is determined, we then project how this age-earnings profile will shift over time for different levels of education. To do this, we rely on past patterns to predict future trends. B_4 reflects the nominal rate of growth of earnings among those in each education group between 1992 and 1999. After adjusting for inflation, the real earnings of those with a bachelor’s degree grew by 1.04 percent per year over the period 1992-99, and the real earnings of individuals with a graduate degree grew by 1.49 percent annually over the same time-period (Bureau of Labor Statistics, 2000). In contrast, among those with a high school degree, real earnings grew by only 0.26 percent. For the purposes of this analysis, we assume that the 1992-99 changes continue into the future, and thus the returns to higher education are increasing over time.

Private Costs

There are two primary costs that most students incur when attending the University of Hawai‘i – tuition and fees, and foregone earnings. A typical full-time undergraduate student (Hawai‘i resident) at the UH Manoa campus paid \$3,142 for the 1999-2000 academic year. Graduate students (non-professional programs) paid \$4,150. Although tuition varies across campuses, and is substantially lower in many cases, for the purposes of this analysis we assume the typical student pays these amounts annually (Institutional Research Office, 1999).

Students also take different lengths of time to complete their education. According to the Spring 1999 Survey of Graduating Seniors at the University of Hawai‘i at Manoa (SGS), 38.7 percent finished in four years or less, 33.5 percent finished in five years, and 27.9 percent took six or more years to complete their undergraduate degree. We assume that the typical student takes five years to finish his or her undergraduate studies. The amount of time required to complete a graduate degree also varies widely depending on the field of study and the degree received. For this study, we adopt a standard of three years (Office of the Vice President for Planning Policy, 1999).

While students are attending school, they also forgo the earnings that they would have received if they had worked full-time. That said, 89.7 percent of the respondents to the SGS indicated that they had worked while attending UH Manoa, so they certainly did not forgo all possible earnings. Of this group, the largest proportion (31.4 percent) reported working 16 to 20 hours per week. Taking the fact that many students work into account, we assume that a typical undergraduate forgoes $2/3$ of the earnings he or she would have received from working full-time with a high school degree. We also assume

that the typical graduate student forgoes 1/2 of the earnings he or she could have earned working full-time with a bachelor's degree.

Private Rates of Return

Earning a bachelor's or graduate degree entails some costs, but generally results in higher future earnings. Although higher education yields other benefits besides increased earnings, here we treat investment in higher education as any other long-term investment, including stocks, bonds, government securities, etc. If one accepts our estimates of future earnings and the costs of getting a bachelor's or graduate degree at UH (above), and assuming that an individual remains in the labor force from graduation until retirement at age 64, the annual (real) return on investment for a typical Hawai'i resident in a University of Hawai'i education is likely to be very high – 15.8 percent for those who receive a bachelor's degree and 19.1 percent for a graduate degree. Table 2 compares these rates of return on investment to other long-term investments, and shows that it is not even close – a University of Hawai'i education is an outstanding investment for most Hawai'i residents.

Table 2: Long-term Real Return on Alternative Investments.

Investment	Stock Market (1949-99)	Long-term Government Bonds	Bachelor's Degree	Graduate Degree
Annual Rate of Return	8.8%	1.5%	15.8%	19.1%

Source: Council of Economic Advisors, Economic Report of the President, (Washington D.C.: Government Printing Office, Feb 2000, Chart 2-11.)

Return to Hawai‘i Taxpayers

While it is clear that individuals attending the University of Hawai‘i receive a substantial private return on investment, what does the Hawai‘i taxpayer get out of his or her investment in UH? People generally agree that society benefits in many ways from having an educated population. It is also important to note that well-educated individuals earn higher incomes, and thus pay more taxes over their lifetime. Consequently, even if a state taxpayer and his or her family members have no direct association with the University, he or she still receives a return on his or her “investment” in the University of Hawai‘i in the greater taxes paid by UH graduates over their lifetimes. This section estimates the rate of return for this taxpayer.

To evaluate the amount of state and local taxes that different individuals are likely to pay over their lifetimes, we must first find a hypothetical couple and then estimate how much they pay in state and local income, property, and sales taxes. For our hypothetical couple, we draw on the couple used in Money Magazine’s January 1996 issue that compares local tax burdens among U.S. states. This hypothetical couple earns \$86,263 per year. According to the 1999 Hawai‘i Tax Table this couple pays \$6,453 (with no deductions) in income taxes. Money Magazine assumes that this couple has a four-bedroom house and pays \$1,949 in property taxes. Those numbers are clearly too high for Hawai‘i; to be conservative side, we assume that the property tax is half of Money Magazine’s estimate, i.e. \$974.50. Finally, we assume that \$50,000 of this couple’s income is subject to a five percent effective sales/excise taxes (\$2,500), inclusive of pyramiding of Hawai‘i’s general excise tax. The total state tax burden for this couple is \$9,927.50 for an average tax rate of 11.5 percent. For couples with higher or lower

incomes, we assume that the income tax rate varies with the 1999 Hawai‘i Tax Table and property and sales tax rates remain constant as a percentage of total income. Table 3 shows the estimated tax burden and average tax rate for married couples filing jointly in \$10,000 increments.

Table 3: Estimated State Tax, Hypothetical Married Couple Filing Jointly, Various Income Levels.

Taxable income	Income tax	Property tax	Sales tax	Total tax	Tax Rate (average)
\$10,000	\$358.00	\$112.97	\$289.81	\$760.78	7.61%
\$20,000	\$1,054.00	\$225.94	\$579.62	\$1,859.56	9.30%
\$30,000	\$1,792.00	\$338.91	\$869.43	\$3,000.34	10.00%
\$40,000	\$2,566.00	\$451.87	\$1,159.25	\$4,177.12	10.44%
\$50,000	\$3,386.00	\$564.84	\$1,449.06	\$5,399.90	10.80%
\$60,000	\$4,206.00	\$677.81	\$1,738.87	\$6,622.68	11.04%
\$70,000	\$5,056.00	\$790.78	\$2,028.68	\$7,875.46	11.25%
\$80,000	\$5,906.00	\$903.75	\$2,318.49	\$9,128.24	11.41%
\$90,000	\$6,781.00	\$1,016.72	\$2,608.30	\$10,406.02	11.56%
\$100,000	\$7,652.00	\$1,129.68	\$2,898.11	\$11,679.80	11.68%

We use the longitudinal age-earnings estimates (described above) and the estimates from Table 3 to calculate the total tax liabilities from married individuals with different levels of educational attainment. We assume that couples pay an average tax rate that increases with income according to Table 3. Those with a joint income of over \$100,000 pay the highest average tax rate of 11.68 percent. Because individuals with higher levels of educational attainment earn more and face a higher income tax rate, it is not surprising that they pay more in state tax than those with a high school education. In fact, they pay \$136,563 more over their lifetimes than their counterparts with a high school degree. Those with a graduate degree pay \$252,484 more over their lifetimes than those with a high school degree. We assume that the couple have the same age and have

the same level of educational attainment and thus share the same longitudinal age-earnings profile.

Taxpayer Costs

Over the past several decades, state taxpayers have made a substantial capital investment in University of Hawai‘i. In addition, each year money is spent on UH from the General Fund. Table 4 summarizes these contributions and calculates the annual state taxpayer investment per student at UH. In FY1999 State General Fund expenditures on the University of Hawai‘i system was \$378,676,00 (see Appendix B). The total value of capital improvements at UH, including the buildings, equipment, books, etc., on all of the University of Hawai‘i campuses is estimated at \$1,253,537,993. Assuming a real interest rate of three percent, we calculate that the cost of forgoing alternative uses of this capital is \$37,606,140 annually. These resources also deteriorate. We assume 30-year straight-line depreciation for land improvements and buildings and 10-year straight-line depreciation for equipment and books. Given these assumptions, total annual depreciation is \$71,348,115. Adding the general fund expenditures, interest cost, and depreciation, and then dividing by the number of students enrolled at UH yields the average annual state taxpayer investment per student of \$10,491. If the typical undergraduate attends UH for five years, state taxpayers invest \$52,455 (on average) in their education, and if he or she continues through graduate school, the investment is \$83,938. The public cost figure for the undergraduate degree is probably too high. The cost per year to educate an undergraduate student at UH is believed to be much less than that for a graduate student; unfortunately, the precise difference is unknown.

Table 4. Hawai'i State Taxpayer Investment in the University of Hawai'i.

General fund:	\$378,676,000
Interest:	
Land Improvements	\$82,882,368
Buildings	\$725,715,128
Equipment	\$328,342,178
Library and other books	\$115,606,473
Construction in progress	\$991,846
 Sum	 \$1,253,537,993
 Sum x 3 percent real interest rate	 \$37,606,140
 Depreciation:	
Land Improvements (30 year straight line)	\$2,762,746
Buildings (30 year straight line)	\$24,190,504
Equipment (10 year straight line)	\$32,834,218
Library and other books (10 year straight line)	\$11,560,647
 Sum	 \$71,348,115
 General Fund + Interest + Depreciation	 \$487,630,255
 Students – (Fall 1999)	 46,479
 Annual state taxpayer investment per student:	 \$10,491

Taxpayer Rate of Return

In general, state taxpayer's investment in the University of Hawai'i is a good long-term investment. On average, state taxpayers could receive a 3.4 percent real rate of return annually on their investment on each undergraduate student who obtains a bachelor's degree, and an 11.32 percent real rate of return on each student earning a graduate degree. The rate of return to taxpayer investment in an undergraduate degree at UH is probably understated and the return to the graduate degree is probably overstated.

The returns would be much higher if the taxpayer also went to and received a degree from U.H. The returns do not include the wider social benefits that a taxpayer gets from living in a more highly educated community.