The Economic Impact of Michigan's Public Universities

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ECONOMIC IMPACT OF MICHIGAN'S STATE UNIVERSITIES

EXECUTIVE SUMMARY

Although several public universities in Michigan have assessed the economic impact their activities have had on the local economy and on the state, to date no comprehensive study has been conducted to measure how Michigan's investment in its public universities contributes to the state's economy. The Michigan Economic Development Corporation (MEDC) and the Presidents Council, State Universities of Michigan, have recognized the value that such a study, using common measures and analytical methods to yield an aggregate result, would have for state policy makers and citizens. Consequently, SRI International was contracted through MEDC to prepare a relatively straightforward study that would yield clear and credible results that could be built upon in future efforts.

This assessment uses a model that calculates the direct and indirect economic impact of the public universities in Michigan in 1999 (the latest year for which the necessary data were available). The approach incorporates the primary elements of the universities' impact:

- The direct and indirect economic impact of spending by in-state public university graduates, over and above what they could have spent with only a high school diploma. For purposes of this study, the difference between the average earnings of high school graduates and the average earnings of university graduates at four levels of degree attainment (Bachelors, Masters, Ph.D., and Professional) is called the "education premium";
- Total expenditures by the university, its faculty, students, and visitors;
- The direct and indirect impact of university technology licensing and start-ups.

The net economic impact is the sum of these factors, less the state's financial support for the universities. The model uses elements of input-output (I-O) analysis involving the use of multipliers for certain expenditures, as well as standard algebraic calculations. The model also addresses the opportunity cost shortcomings (i.e., failure to account for investment alternatives to public universities) often associated with input-output models, and incorporates the sizeable impact of the education premium. *The economic impact of the state's investment in it public universities, as estimated by the model used in this study, is attributable largely to the education premium. This premium is a direct result of the opportunities to pursue advanced levels of education at Michigan's public universities, thus the universities are an integral part of the economic development equation.*

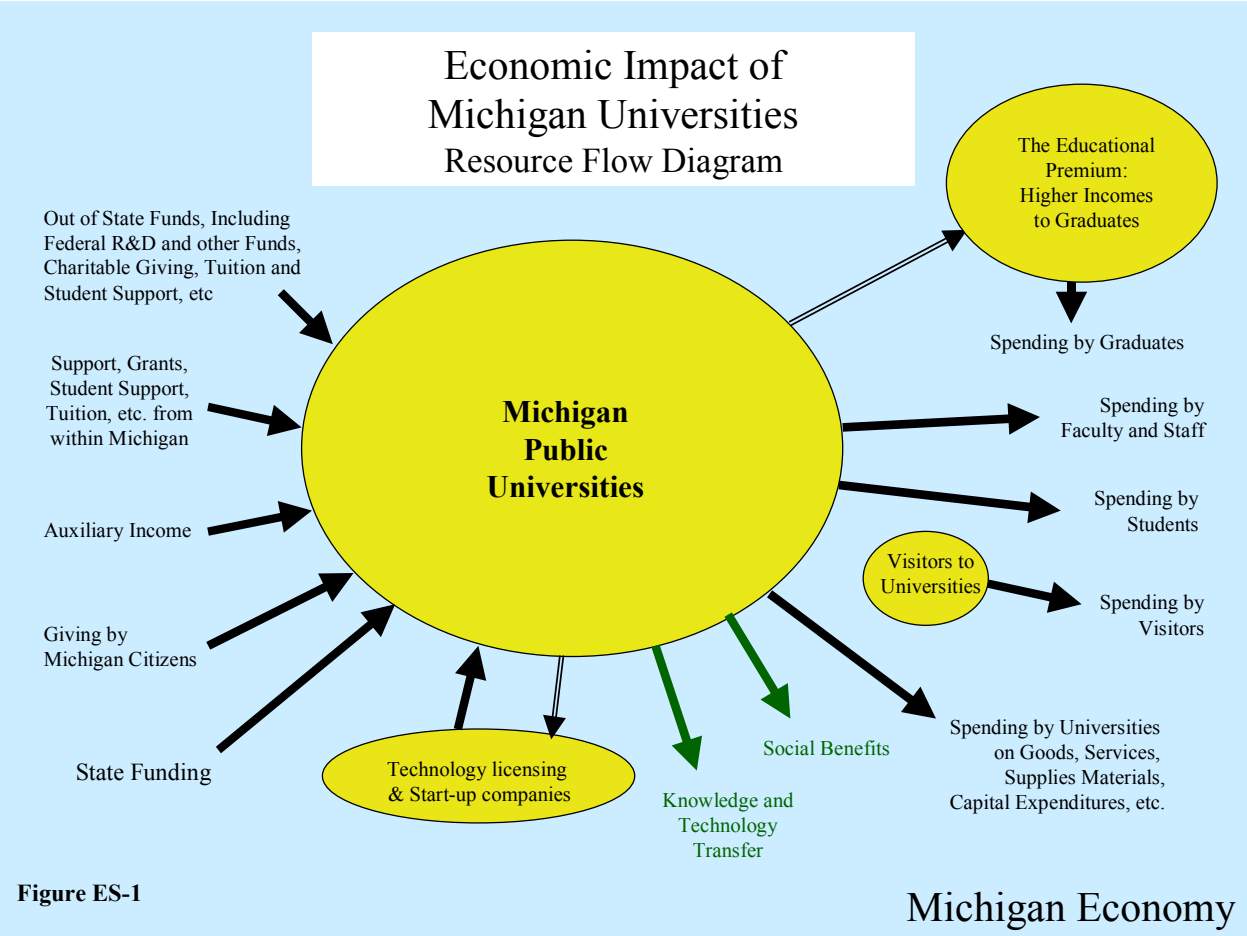


Figure ES-1

Figure ES-1 illustrates the significant money flows in the economic activity of Michigan's public universities. On the left are **inputs:**

- Total state and local funding, including grants, scholarships, and student support.
- Grants, tuition, and giving by Michigan citizens.
- Auxiliary income such as revenues from sporting events and payment for university services.
- Out-of-state support, including federal R&D and other funds, charitable giving, student support, etc.

On the right are **direct expenditures:**

- Spending by faculty and staff.
- Spending by students.
- Spending by the universities for goods, services, supplies, materials, etc.
- Spending by visitors to universities.

Indirect impacts of the state universities (not part of direct expenditures) are the **education premium**, **licensing** of university intellectual property, and university **start-up companies**.

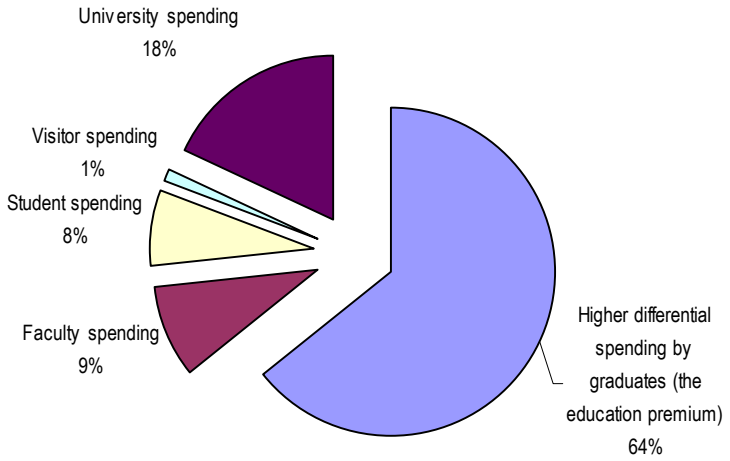
The calculations performed according to the model show that the direct and indirect economic impact of the 15 public universities in 1999 was almost $41 billion. This figure was calculated using a multiplier approach. The use of a multiplier accounts for both direct and the indirect impacts of spending. In this study, a multiplier of two is used, a factor used in similar studies. This impact was reduced by the state's $1.5 billion appropriation to the universities, resulting in a net impact of about $39 billion. The public

support represented 25 percent of the universities' total revenue of just over $6 billion in 1999. Other components of income included tuition payments of $1.3 billion (22 percent of total income), auxiliary enterprises of over $950 million (16 percent), hospital income of over $800 million (13 percent); and federal grants and contracts of almost $780 million (13 percent). The rest of the income was derived from multiple smaller sources, including private giving and sales of university services.

Even assuming the largest potential error rate, the net impact was at least $33 billion. **More specifically, for each dollar of state support, the universities collectively generated $26 of economic impact.**

As shown in figure ES-2, the education premium, the higher earnings and resultant spending by graduates of the universities, accounts for 64 percent of the economic impact. Direct university spending accounts for 18 percent, and spending by employees, students, and visitors accounts for the remaining 18 percent. Because the economic impact on Michigan from the state universities' technology transfer and commercialization activities during the study year was relatively small in comparison to the impact of the education premium, it is excluded from this figure.

Figure ES--2: Sources of the Economic Impact of Michigan's Public Universities



However, the modest size of the current impact of technology transfer activities clearly does not accurately reflect the longer-term economic significance of university-based research. This is because most of the economic value of technology transfer activity at Michigan universities is the result of (a) license fees and royalties from licensees outside the state and (b) the longer term effects of those start-up firms that will expand significantly, generating local spending for salaries, equipment, services, and facilities, and sometimes creating new industrial clusters.

This impact will continue to grow in the future. This will in part be due to the earnings of university graduates, which are increasing at a faster rate than the earnings of those without a university degree. Future growth will also result from greater enrollment in the state's public universities, allowing more Michigan citizens to receive higher education and graduate from a state public university. Finally, university graduates will benefit, in the form of increased future earnings, from specialized skills and knowledge attained through the universities.

In sum, the analysis reveals the very large economic impact on the state, in 1999, that is directly attributable to the 15 Michigan public universities. The state's investment of $1.5 billion in 1999 had a net impact of $39 billion, representing 12.6 percent of Michigan's gross state product for that year, roughly equal to the entire state budget. Few, if any, other public investments realize a rate of return of this magnitude.

CHAPTER 1 - INTRODUCTION

Institutions of higher learning have long been recognized as having unique and powerful impacts on the regions in which they are located. The educational and, more recently, research functions of universities are being credited with major roles in regional economic development. No state strategy for enhancing economic growth is complete without explicit consideration of how additional public investment in higher education can enhance the state's ability to influence business location decisions; generate indigenous, self-sustaining economic activity; and further raise the quality of human capital.

In Michigan, the link between the state's public universities and economic growth has been clearly recognized and acted upon in several ways. One of the most significant is the formation of the Partnership for Economic Progress, a collaborative initiative of the Michigan Economic Development Corporation (MEDC) and the Presidents Council of the State Universities of Michigan. Formed in 2001, the Partnership's focus includes "initiatives to attract and retain an educated workforce for Michigan businesses and to create the next generation of Michigan entrepreneurs through commercializing ideas created within the university environment". Although individual universities in the state have assessed their economic impact on their regional economies and on the state, to date no comprehensive study of how the state's investment in its university system contributes to the state's economy has been conducted. MEDC and the Presidents Council have recognized the value that such a study, using common measures and analytical methods to yield an aggregate result, would have for state policy makers and citizens. As a consequence, MEDC contracted with SRI International to prepare such a study. This report is the result of an initial assessment of the economic impact on Michigan of its fifteen state universities to serve this purpose.

TABLE 1: MICHIGAN'S PUBLIC UNIVERSITIES

Central Michigan University
Eastern Michigan University
Ferris State University
Grand Valley State University
Lake Superior State University
Michigan State University
Michigan Technological University
Northern Michigan University
Oakland University
Saginaw Valley State University
University of Michigan--Ann Arbor
University of Michigan--Dearborn
University of Michigan--Flint
Wayne State University
Western Michigan University

CHAPTER II - APPROACHES TO ESTIMATING THE ECONOMIC IMPACT OF UNIVERSITIES

Background

The approach used to estimate the economic impact of Michigan's state universities was shaped by a combination of MEDC's specific requirements and by SRI's determination of which analytical models, types of data, and data collection strategies would best meet those requirements. The goal was a "first cut" estimate of the state universities' economic impact, based on an economic impact model at once straightforward yet rigorous, relatively transparent, conservative, and able to be "fine-tuned" and built on with subsequent studies. The analytical model developed for this study acknowledges the contribution of all significant university activities. It also explicitly identifies the impact of new university-based economic development initiatives intended to promote the formation of start-up companies based in university research. Finally, the model attempts to quantify many of the economic impacts for which data are readily available, while acknowledging the existence and importance of other impacts for which data were unavailable within the constraints of the study, or for which quantification is problematic.

This approach draws upon the existing literature on the economic and social impacts of universities, a number of recent impact studies conducted by individual Michigan universities, and SRI's past experience conducting regional economic impact studies. For example, in September 2000, Enterprise Canada's Research Division published an extensive literature review prepared for the Council of Ontario Universities (Enterprise Canada Research, 2000); the review was conducted as background to the full study of the economic impact of Ontario's universities, which appeared the following year (Enterprise Canada Research, 2001). In addition, the National Association of State Universities and Land-Grant Colleges (NASULGC) conducted a survey-based study of the economic impact of its member institutions (NASULGC, 2001). Using Association of University Technology Managers (AUTM) data and input from individual Michigan universities, MEDC prepared a benchmarking study of the technology transfer activities of four of Michigan's research universities (MEDC, 2001).

Most system-wide and individual institution economic impact studies employ input-output analysis as their primary analytical approach. In these studies, typical inputs to the input-output model used (e.g., IMPLAN or the American Council on Education model) include institutional spending for salaries, goods and services, capital projects, and student spending. Most studies also consider separately the employment as well as economic impacts of university spending, some list licensing agreements and licensing revenues from university-generated intellectual property, and some estimate sales figures and jobs created by university spin-off companies. Income and employment multipliers used to account for the indirect effects of university expenditures vary considerably from study to study, but nearly all fall within the range of 1.5-2.5. With only a few exceptions, these impact studies do not consider the opportunity cost of investment in public universities. (Opportunity costs are the economic benefits foregone by not selecting an alternative way to use the funds that were used to support public universities). Thus universities typically are treated analytically as expenditure-creating and job-creating entities, basically undifferentiated in their role in the local economy from other public institutions or organizations whose products and services are sold in the marketplace.

A few studies consider, as part of the economic impact of universities, the incremental increase in state income and sales taxes due to graduates' increased earning potential (i.e., the education premium). These studies have the considerable virtue of recognizing and incorporating explicitly in their analyses this unique attribute of universities. The purpose of a university, after all, is not to create jobs or contribute to the gross state product, but to increase the quantity and quality of human knowledge and human capital.

Unlike studies of university economic impacts that expend much of their analytical resources on manipulating standard input-output models (sometimes completely ignoring the education premium), this study placed its analytical and data collection emphasis on estimating the education premium. The concept is valid, and the results of the few studies that have estimated the education premium have found that it exceeded, usually by a considerable amount, the economic impact of university expenditures (for example, see Kangas 1997; Bluestone and Boyden, 1993; Enterprise Canada Research, 2001; Kubursi, 1994).

This Study's Analytical Approach

Using 1999 (the most recent year for which all the data used in the study were available) as the study year, the model developed for the study calculates the direct and indirect economic impact of spending by the universities, their faculty, students, and visitors; the direct and indirect economic impact of spending by in-state graduates over and above what they would have spent in 1999 with only high school diplomas; and the direct and indirect impact of university technology licensing and start-ups. The net economic impact is the sum of the impact of these expenditures on Michigan's economy in 1999, less the state's total support for the university system in 1999. The model uses elements of input-output analysis (through the use of multipliers for certain expenditures) in addition to algebraic calculations. Details of the model are presented in Chapter III.

It is important to compare the approach taken here with alternative models. This analysis is a *one-year snapshot* of the economic impact of Michigan's 15 public four-year universities, taking into account the costs incurred and benefits realized in 1999. It does not attempt to incorporate costs incurred in previous years that contribute to present benefits. Nor does it attempt to estimate future benefits that may result from present costs, although this is a topic that merits consideration. It is not strictly a return on investment (ROI) or input-output (I-O) analysis, although some elements of both are employed.

An analysis of the economic impacts of public universities should recognize that investments in Michigan's universities and their students have been ongoing for over 150 years. Each year, the state has incurred costs to operate the universities, and in each year economic benefits from the universities were realized. These economic benefits accumulate as a more educated populace holds better jobs, enjoys greater earnings, and makes Michigan a more attractive place for business investment.

ROI analysis enables higher education, measured in terms of increased tax revenues generated by the increased income taxes paid by a better-educated populace, to be compared to alternative investments. However, an ROI analysis of this kind fails to capture the complexity of a university's economic impact. It would exclude, for example, the direct and indirect effects of university, employee, student, and visitor expenditures on economic growth and job creation, and the effects of university-generated business activity such as licensing of university intellectual property and university-based start-ups. The approach used here is a synthesis of both I-O and ROI methods. It measures the economic impact of university expenditures attributable to revenue sources other than state funding, addresses the opportunity cost shortcomings often associated with I-O models, and incorporates the sizeable impact of the education premium. *The economic impact of the state's investment in its public universities, as estimated by the model used in this study, is attributable largely to*

the education premium, something that would not have been possible without Michigan's public universities.

This approach benefits from placing less emphasis on choosing and manipulating input-output models. Although the same input-output model could be used for each of Michigan's public universities, different coefficients, and therefore different multipliers, might be required to account for variations in local economic conditions around each university. The error bands associated with key input data such as the demographics of each university's graduates, their education premiums, and the proportion of graduates still alive and still living in Michigan, are sufficiently large that use of complex input-output models for this study would constitute an example of misplaced precision. In this case, the advantages of a basic, transparent algebraic impact model outweigh advantages of more sophisticated input-output models. For this effort to estimate the economic impact of all Michigan's public universities combined, conceptual validity and analytical clarity are more important than institution-specific parameters for input-output models. This decision does not, of course, preclude the future use of input-output models tuned to each university's local economic situation in more detailed impact analyses.

CHAPTER III - THE ECONOMIC IMPACT ANALYTICAL MODEL

Overview of the Model

The model of the economic impact of Michigan's state universities developed for this study is conceptually straightforward. The economic impact of these institutions in a given year is the sum of:

- The direct and indirect impact of *total expenditures* by the university, its faculty, students, and visitors in that year;
- The direct and indirect impact of *expenditures attributable to the education premium* in that year;
- The direct and indirect impact of expenditures associated with university technology licensing and start-ups in that year;

Less

- *State and local government support* for the university system in that year.

Details of the Model

Figure 1 details the principal flows that constitute the economic activity of Michigan's public universities. Listed on the left are **inputs:**

- Total state and local funding, including grants, scholarships, and student support;
- Grants, tuition, and giving by Michigan citizens;
- Auxiliary income such as revenues from sporting events and payment for university services;
- Out-of-state support, including federal R&D and other funds, charitable giving, student support, etc.

On the right are direct expenditures, the **outputs:**

- Spending by faculty and staff;

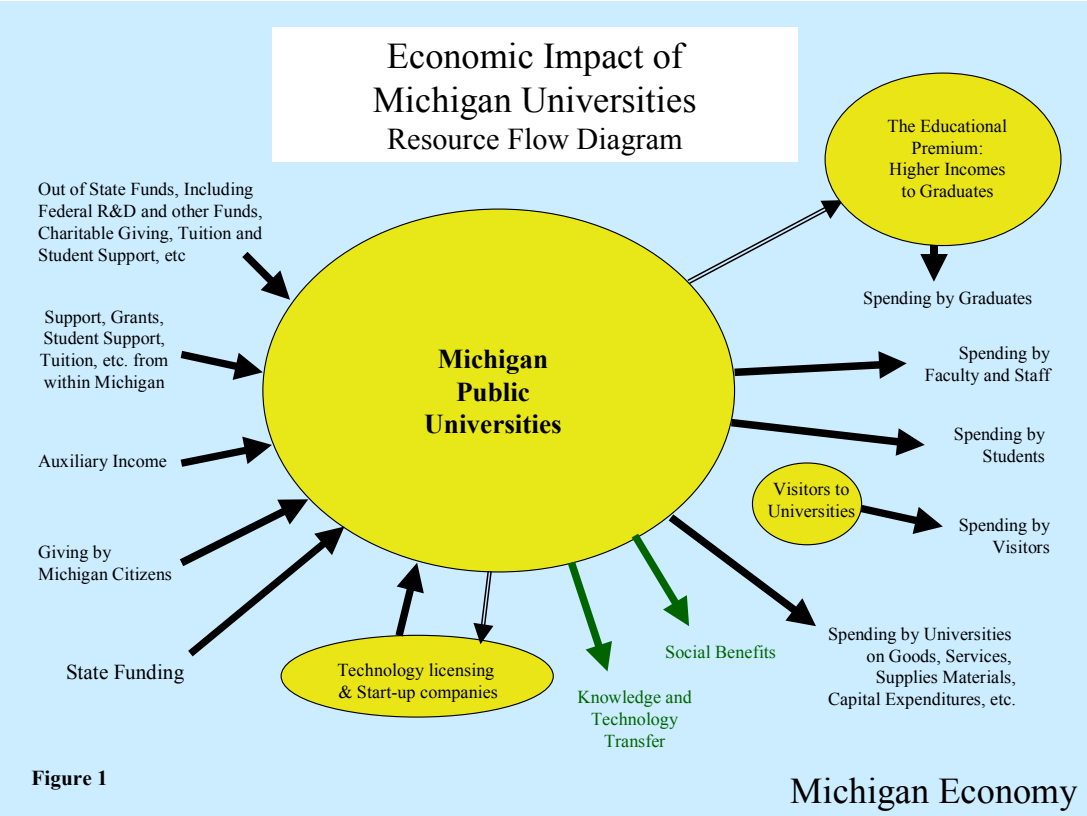


Figure 1

- Spending by students;
- Spending by the universities for goods, services, supplies, materials, capital goods, etc.;
- Spending by visitors to universities.

Additional expenditures related to the existence of the universities but not part of their direct expenditures are the **education premium**, **licensing** of university intellectual property, and university **start-up companies**.

University income originating from out of-state (e.g., out-of-state grants, R & D funds, private contributions, and student support) are important elements of a university's revenue stream that appear later as spending by the university and its students, where the model records their economic impact. Other revenue from non-government sources within Michigan, such as in-state giving and auxiliary income, also appear as expenditures by the university. State and local funding is treated separately because it represents the state's annual investment in its public universities, and must be subtracted from the total economic impact of these universities to yield the net economic impact of the state's investment.

Capital spending is another important part of overall university spending. Data from the National Center for Education Statistics' Integrated Postsecondary Education Data System (IPEDS) database indicate that capital spending by Michigan universities in 1999 was just under a billion dollars. On the other side of the ledger, funding for capital items comes from several sources: from direct state appropriations, from the proceeds of revenue bonds, from fund raising, and from diversion of current expenditures. In order to account fully for capital spending, it would be necessary to identify the multiple capital funding channels that were used in 1999, a task beyond the scope of this initial study. Since the sources of capital spending are not included, capital spending is not included as a university input or output. The universities' capital operations are, in effect, netted out. Had it been included in the study, this spending would have had two effects: (1) the level of state support would have been higher, by approximately $1 billion; and (2) university spending would have been increased by approximately $1 billion, which would then have been subject to the multiplier used on all university-related spending. Thus, the omission of capital spending from this analysis means that the actual annual impact of Michigan's public universities would have been somewhat greater than the amount estimated by this model.

The economic impact in Michigan of the education premium is a result of the incremental spending in 1999 by all university graduates living in the state and still in the labor force. It would be possible to calculate the education premium of a one-year cohort of university graduates, say those who graduated in 1998 and had earnings for the first time (as graduates) in 1999.[1] However, this approach, if used alone, would ignore the critical significance of the cumulative effect of a university education on graduates' earnings over time. The education premium was measured in terms of the increased spending from these incremental earnings so that these expenditures can be combined with student, visitor, employee, and net university expenditures. Through the use of a multiplier, the indirect effects can be added to the above direct measures.

Multiplier to account for indirect impacts of public universities. In this study, an integer multiplier is used to avoid introducing an unwarranted level of precision (given the relatively large error bands in the data). The integer value of 2 falls within the midrange of multipliers used in similar university-impact studies, and was thus chosen for use in this case.

[1] This was calculated, for example, in the Enterprise Canada Research study of the economic impact of Ontario's universities (Enterprise Canada Research, 2001), and could be done in future, more detailed studies of the economic impact of Michigan's universities. The Enterprise Canada Research study also calculated the education premium for all graduates in the labor force using an approach similar to the one used in this study.

Enterprise Canada Research reviewed a number of recent studies of the economic impact of universities. Included were both system-wide and individual institution economic impact studies. Table 2 summarizes the multipliers used in the studies reviewed.

Table 2: Multipliers Used in University Economic Impact Studies

STUDY DESCRIPTION	Economic impact multiplier	Employment impact multiplier
University of Massachusetts/Boston (1993)	1.341	N/A
Province of Ontario (1994)	2.04	1.88
University system of Georgia (2000)	1.56	2.8
San Diego State University (1995-96)	1.42	4.13
University of Washington (1997)	1.57	2.9
University of Wisconsin (1997)	2.34	N/A
West Virginia University (1998)	1.66	1.56
Connecticut independent colleges and universities (1996)	2.33	2.86

Source: Enterprise Canada Research, 2000

The economic impact in 1999 of the licensing of university intellectual property is the direct and indirect impact of the expenditures attributable to the increased sales and employment resulting from university licenses to in-state licensees. The economic impact of university start-ups is the direct and indirect expenditures in 1999 by all university start-ups still operating in the state. Operational definitions and calculations of each of the variables in the model are described in the next section.

Definitions and Calculation of the Variables

The variables in the model were defined and calculated as follows. All data were from the study year, 1999.

Education premium. Calculation of the differential earnings due to graduation from one of Michigan's public universities required the use of data provided by the 15 universities as well as data obtained from the U.S. Census Current Population Survey and Michigan's Office of Labor Market Information's Web site.

Table 3, "Data Collection Form for Graduates From 1957-1996", on the next page, displays the form used for the data collection effort. Each university was asked to provide the numbers of graduates, by gender, by degree level, and by ten-year bands. The ten–year bands were chosen so that the graduates from those years would fall into the ten-year age bands frequently used by the U.S. Census to display data on individuals, i.e., 25-34; 35-44; 45-54; and 55-64. The most recent period for which graduate data were requested was 1987-1996. Assuming that most BA graduates were 25 years old by 1999, these 1996 graduates would be included in the 25-34 age group in 1999, the study year. As a result, the earnings of 1997-99 graduates are excluded.

In addition, universities were asked to provide a retention percentage for each of these groups of graduates, representing the proportion of graduates still residing in Michigan. Most universities were able to estimate this percentage by extrapolating from alumni databases, although some used other sources for the estimates. The data collection form permitted universities to report this percentage in a number of ways, depending on what data were available. Multiplying these two matrices together produced another matrix containing, for each cell, an estimate of the number of graduates remaining in Michigan.

Table 3: Data Collection Form for Graduates from 1957-1996

DATA COLLECTION FORM FOR GRADUATES FROM 1957-1996

Number of Degrees Conferred by Year, Degree, and Gender

	1987-1996		1977-1986		1967-1976		1957-1966	
	Male	Female	Male	Female	Male	Female	Male	Female
Bachelor's								
Master's								
Doctoral								
Professional								
TOTAL								

Percentage of Graduates Still in Michigan

BEST

Percentage of Graduates Living in Michigan by Year, Degree, and Gender

	1987-1996		1977-1986		1967-1976		1957-1966	
	Male	Female	Male	Female	Male	Female	Male	Female
Bachelor's								
Master's								
Doctoral								
Professional								
TOTAL								

BETTER

Percentage of Graduates Living in Michigan by Year and Gender

	1987-1996		1977-1986		1967-1976		1957-1966	
	Male	Female	Male	Female	Male	Female	Male	Female
All Degrees								

OR

BETTER

Percentage of Graduates Living in Michigan by Year and Degree

	1987-1996	1977-1986	1967-1976	1957-1966	1957 and earlier
Bachelor's					
Master's					
Doctoral					
Professional					
TOTAL					

OR

BETTER

Percentage of Graduates Living in Michigan by Year

	1987-1996	1977-1986	1967-1976	1957-1966	1957 and earlier
All Degrees					

GOOD

Percentage of All Graduates Still Living in Michigan

These latter figures were subjected to further operations to produce the education premium earnings figures, as follows.

Matrices of the same shape were created for two additional factors: (1) the workforce participation rate *of Michigan workers* by age, gender, and educational attainment; (2) the earnings differential *of national workers* by age, gender, and educational attainment.[2]

Multiplication of the graduates-in-state matrix by the workforce participation rate and the earnings differential yielded a matrix of the education premium by age, gender, and educational attainment. A summation of all the values in this matrix resulted in the education premium for each university. These were then totaled to obtain the education premium for Michigan public universities for the year 1999. Table 4, Education Premium Calculation, displays actual data from one of the universities as an example.

[2] Michigan-specific earnings data by educational attainment, gender, and age for 1999 were not available from the 2000 Census at the time of the study. Thus, national earnings data were used. Michigan observers indicated that the Michigan earnings data should not vary significantly from the national data.

Table 4: Education Premium Calculation

Education Premium									
		25 TO 34		35 TO 44		45 TO 54		55 TO 64	
		M	F	M	F	M	F	M	F
	BA	$150,461,001	$126,403,626	$204,632,823	$97,064,068	$230,372,512	$85,025,153	$64,128,905	$31,150,212
	MA	$101,310,563	$71,556,245	$141,960,734	$47,566,978	$106,394,675	$24,399,561	$19,339,968	$3,299,946
	Ph.D	$253,638	$297,621	$438,444	$60,442	$0	$0	$0	$0
	Profes	$0	$0	$0	$0	$0	$0	$0	$0
Earnings Differentials									
		25 TO 34		35 TO 44		45 TO 54		55 TO 64	
		M	F	M	F	M	F	M	F
	BA	$19,338	$14,724	$32,285	$15,502	$40,016	$15,873	$31,431	$14,922
	MA	$30,000	$21,454	$38,078	$24,251	$47,988	$27,067	$45,827	$26,901
	Ph.D	$41,175	$31,289	$80,689	$41,477	$61,987	$54,412	$82,435	$48,414
	Profes	$33,918	$40,135	$87,679	$48,004	$108,272	$42,609	$116,902	$36,884
Labor Force Participation									
		25 TO 34		35 TO 44		45 TO 54		55 TO 64	
		M	F	M	F	M	F	M	F
	BA	0.88	0.73	0.88	0.73	0.88	0.73	0.88	0.73
	MA	0.88	0.73	0.88	0.73	0.88	0.73	0.88	0.73
	Ph.D	0.88	0.73	0.88	0.73	0.88	0.73	0.88	0.73
	Profes	0.88	0.73	0.88	0.73	0.88	0.73	0.88	0.73
Remaining Graduates Living in Michigan by Year, Degree, and									
		1987-1996		1977-1986		1967-1976		1957-1966	
		Male	Female	Male	Female	Male	Female	Male	Female
	Bachelor's	8892	11841	7244	8636	6579	7388	2332	2879
	Master's	3859	4600	4261	2705	2534	1243	482	169
	Doctoral	7	13	6	2	0	0	0	0
	Professional	0	0	0	0	0	0	0	0
Number of Degrees Conferred by Year, Degree, and									
		1987-1996		1977-1986		1967-1976		1957-1966	
		Male	Female	Male	Female	Male	Female	Male	Female
	Bachelor's	12,703	16,916	12,073	14,394	10,612	12,314	3,533	4,499
	Master's	11,027	10,001	17,043	7,312	6,668	2,346	699	282
	Doctoral	32	32	23	3	0	0	0	0
	Professional	0	0	0	0	0	0	0	0
Percentage of Graduates Living in Michigan by Year, Degree, and									
		1987-1996		1977-1986		1967-1976		1957-1966	
		Male	Female	Male	Female	Male	Female	Male	Female
	Bachelor's	0.70	0.70	0.60	0.60	0.62	0.60	0.66	0.64
	Master's	0.35	0.46	0.25	0.37	0.38	0.53	0.69	0.60
	Doctoral	0.22	0.41	0.27	0.67	0.00	0.00	0.00	0.00
	Professional	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

The earnings differentials were calculated by subtracting the median earnings of high school graduates for each gender and age cohort from the median earnings of university graduates at each degree level, by gender and age cohort. The result represents the additional earnings of individuals who earned a university degree, over what they might have earned had they not received a degree.

The additional amount of spending was then calculated from the earnings differential. This is the amount of the *differential* earnings not saved or paid in taxes, but spent. To obtain this additional spending figure, the differential earnings were multiplied by the estimated propensity to spend additional income, resulting in the additional personal consumption created by the

education premium.[3] This spending is then subject to the multiplier used in the study to account for the indirect impacts of the differential spending.

Spending by the universities, their staff, students, and visitors. Total university spending and employee fringe benefits[4] data were obtained from the Integrated Postsecondary Data System (IPEDS) Finance file. The fields "Total current funds expenditures and trans(F9899_B)," "Employee fringe benefits-institutional(F9899_B)," and "Emp frng ben noninstitut included on 12(F9899_B)," were used for university spending. This field includes spending for instruction, research, student support, and a number of other categories of expenditure.

Spending by university faculty and staff was calculated using IPEDS university salary expenditure data. The field, "Sal&wages total current funds expenditur(F9899_B)," was used to represent total salary and wages expenditures. As with the graduate differential earnings figures (above), the propensity to consume was used to derive the level of consumption resulting from aggregate salary payment data. The result represents the amount that flows into the Michigan economy as the result of university salaries and wages. The same multiplier as above was used to account for indirect economic impacts.

Study Year spending by university students and visitors was estimated by each university, and reported to SRI on the data collection spreadsheet. Universities were invited to use the figures they reported to the IPEDS database for 1999 as the basis for their calculation of student spending. Universities estimated visitor expenses, based on their experiences with visitor spending. They were also asked to provide an error band for their estimates.

Licensing of university intellectual property. The economic impact of university technology licensing was calculated using a technique used by the University of California system in the 1980s. Michigan public universities were asked to report each license for which *the licensee was located in Michigan*. For each of these licenses, the universities were asked to report the royalty rate, the running royalty income (i.e., periodic royalty payments based on sales or some other measure of commercial activity), and the North American Industry Classification System (NAICS) code of the licensee. From the royalty rate and the royalty income, one can calculate the sales on which the royalties are based. Using data from the Census that include total sales and total wages for each NAICS code, one can further calculate the number of workers responsible for the sales generated by each license. Finally, using the same Census data set, one can calculate the average wage in each NAICS code and then estimate the total wages generated by each license.

Several Michigan universities have relatively high royalty incomes from their technology licensing. However, most of the licensees are not located in Michigan (this is fairly typical of university licensing, which tends to be insensitive to geographic distance). Therefore, the amount of economic activity generated *within Michigan* by the technology licensing of Michigan universities was small compared to the other economic impact measures. However, the revenue from the out-of-state licensees is a significant source of income to the universities and their faculty inventors.

Technology licensing income is typically directed to faculty inventors, to their departments and schools, and to the university's general fund. Faculty recipients generally treat their share of royalties as income and it is saved, taxed, and spent like income from any other source. By law, the university must use their share of these funds to invest in research, research infrastructure, and education. Thus the university's share of this income eventually shows up in the university spending data.

[3] This propensity to spend ratio was provided to SRI by MEDC, and is the ratio used by MEDC in its Regional Economic Model Incorporated (REMI) analysis (customized by Michigan-specific data).
[4] It was decided to treat employee fringe benefits as part of overall university spending.

University start-ups. Universities that had generated start-up companies based on knowledge and technologies developed by the university were asked to list these companies, including data on employment, sales, etc. for each firm. While almost all of the start-up companies were located in Michigan, the effect of these relatively new and small firms was also small relative to the other impact measures.

State and local support for the university system. The amount of state funding was obtained from the Finance file of IPEDS database, and includes state and local appropriations, grants, and other public inputs to the 15 public universities.

CHAPTER IV - DATA SOURCES AND DATA COLLECTION

The data used in this study came from several sources: directly from the 15 Michigan public universities; the IPEDS database; the U.S. Census; and Michigan state government. The study year selected was 1999, as this was the most recent year for which all the needed data were available.

Data from Michigan's Public Universities

Collection of the data from the 15 public universities in Michigan was greatly facilitated by the cooperation of MEDC and the Presidents Council, State Universities of Michigan. Members of the Council's Analytical Studies Committee served as primary contact points for data collection at each of Michigan's fifteen state universities. Data were collected directly from universities through the use of an electronic data collection instrument created in Microsoft Excel. The e-mailed instrument was completed by all 15 public universities and appears in the Appendix. Four areas of data were requested:

1. Graduates by degree level, gender, and time period. To facilitate integration with U.S. Census data that were also used in this study's calculations, data on number of graduates were collected in four time periods: 1987-1996; 1977-1986; 1967-1976; and 1957-1966. Graduates in these periods roughly fit into the age bands frequently used in U.S. Census data reporting, i.e., 25-34; 35-44; 45-54; and 55-64. Data were not collected on those who graduated prior to 1956 because the majority of them were assumed to have reached the age of 65 and to have been retired by 1999. Removing this oldest cohort from the study results in a minimal reduction of the education premium, making the economic impact estimate slightly more conservative.

Universities were also asked to estimate how many of their graduates from the age cohorts described above were still living in Michigan. They were given three options for reporting the percentage: "good," "better," or "best". The "best" option was used by universities who had graduate address data (from their alumni data base or elsewhere) that could be broken down by gender, age, and degree level. The "better" option requested data for fewer categories (e.g., just by age and degree level), while the "good" option asked for a global percentage of all graduates still in the state. About half of the universities were able to provide data on the percentage of graduates living in Michigan for each of the "best" categories.

2. Spending by university students and visitors. All institutions were requested to estimate spending by university students. This was defined to include room and board, books, and other miscellaneous living expenses, but to *exclude* tuition, fees, and any other payments to the university. (Payments to the university other than state and local funding do not appear explicitly in the analytical model because they eventually show up as expenditures by the universities.) However, at institutions where dorms are university-operated, students who live in dorms pay some or all of their room and board to the university. In order to maintain comparability of data, these payments to university dorms were included in student spending. Since these funds did not flow directly into the Michigan economy, but to the universities, some "double counting" may have resulted, and the figure for student spending used in our analysis is slightly higher than it would have been if university-provided room and board were not included. Individual universities' student spending estimates ranged from nearly $9 million to over $370 million. (Using those figures and IPEDS enrollment data for 1999, spending per student in that year ranged from just over $3,000 to just under $10,000.)

Universities were also asked to estimate the spending by visitors to their campuses. Estimates ranged from nearly $190,000 to over $74 million in 1999. Some schools have very few visitors and no large special events. Others have large sporting and other events that can draw hundreds of thousands of visitors, all of whom spend money in the community.

3. Royalties received from university technology licenses. Universities receiving royalty income from licensing university-developed technology were asked to list their technology licenses that produced running royalties in 1999. In order to calculate the economic activity generated by licensing activity *in Michigan*, the list of licensees was limited to those located in Michigan. For each license to an in-state licensee, universities were asked for an arbitrary ID code for each licensee (to preserve confidentiality); the 1999 running royalty income; the royalty percentage rate for the license; if the licensee was located outside Michigan, the percentage of the license-dependent activity within Michigan; and the NAICS code (indicating the line of business) of the licensee.

In addition to licensing technologies, universities often license their insignia, logos, and other copyrighted items. At many universities, this is a significant income stream and, if the licensees are located within the state, can result in a significant level of state economic activity. However, in this study, royalty income was collected only from licenses of university-developed technologies. Income from non-technology licensing is included in university income data gathered from the IPEDS database, and is treated implicitly rather than explicitly in the model because it shows up in university expenditures.

4. Start-up companies. Universities with start-up companies based on university-developed knowledge or technology were asked to list these companies. For each start-up, universities were asked for an arbitrary ID code for each company (to preserve confidentiality); the 1999 running royalty income; the royalty percentage rate for the start-up's license from the university, if any; the state in which the start-up is located; the NAICS code (indicating the line of business) of the company; the number of employees; the 1999 sales; and the percentage of the company's equity owned by the university, if any.

Data from Other Sources

Data on university spending and faculty and staff salaries were obtained from the Finance file of the IPEDS "Institutional Data" database for 1999. (Available online at: http://www.nces.ed.gov/ipeds.)

Data on 1999 earnings by educational attainment, age, and gender were obtained from the U.S. Census Bureau, Current Population Survey (CPS) March 2000, Table 8. "Income in 1999 by Educational Attainment for People 18 Years Old and Over, by Age, Sex, Race, And Hispanic Origin," March 2000. (Available online at:

http://www.census.gov/population/socdemo/education/p20-536/tab08.txt.)

Data on Labor participation rates in Michigan were obtained from the Michigan Office of Labor Market Information's Web page at: http://www.michlmi.org/ .

The original source was the U.S. Census Current Population Survey (CPS) through the Bureau of Labor Statistics (BLS) of the Department of Labor. Labor participation rates for university graduates were available only by "Bachelors Degree or more." These rates were adjusted to obtain rates for men and women based upon a different table on the Office of Labor Market Information's Web site. This table shows that in 1999, the difference between labor force participation rates of men and women was 15%. By taking the overall rate for Bachelors and above (80%) and adding half of 15% for men and subtracting half of 15% for women, the participation rates for men and women were calculated.

Data on sales and employment of Michigan firms (to be used in the calculation of sales and resulting employment from licenses) were obtained from "Geographic Area Statistics" published by the U.S. Census in March 2002, and available at: http://www.census.gov/prod/2002pubs/m00as-3.pdf.

It should be noted that, while SRI reviewed all the data received from the universities and identified and resolved a few obvious anomalies, there was no way to audit or verify the data received. Therefore, the results of this study are based on the data as supplied by the universities. In addition, some of the university submissions are, of necessity, estimates. As noted, universities were asked to identify the level of precision of their estimates, and most did so. These estimates of the level of precision provided input to the sensitivity analysis that appears in a later section of this report.

Information gathered from the IPEDS database and from the U.S. Census are the best data that could be identified for the study. Some data that would have been preferable were not available. For example, 1999 *national* earnings averages by degree level, gender, and age were used to calculate the education premium. Using the 1999 *Michigan* averages would have been preferable, but they had not been released by the Census at the time this report was prepared.

CHAPTER V - RESULTS

Results of the Analysis

Calculations performed according to the model show that the direct and indirect economic impact of the 15 public universities in 1999 was almost $41 billion. Reducing this by the cost to the state in that same year, $1.5 billion, results in a net impact of about $39 billion. Even allowing for maximum potential error rate, on the conservative side, the net impact is at least $33 billion.

Based on an impact of $39 billion, Michigan's public universities generated a return of between $5.50 and $6.50 for each $1 of their operating cost, and a return of $26 for each $1 of state support. Few public investments realize such a rate of return. To provide some additional context for appreciating the size of the return on Michigan's investment in higher education, the education premium in 1999 of $39 billion represented 12.6 percent of Michigan's gross state product for that year, and is about the same size as the entire state budget.

Table 5, Summary of Total Economic Impact of Michigan's Public Universities in 1999, summarizes the results of the calculations. The education premium, that is, the higher earnings and resultant spending by graduates of the universities, is responsible for 64 percent of the economic impact. Direct university spending accounts for 18 percent, and spending by employees, students, and visitors accounts for the remaining 18 percent.[5]

The cost to the public in Michigan in 1999 through state appropriations, grants, and contracts, was $1.5 billion, which constitutes 25 percent of the universities' total income of just over $6 billion. The remainder of the income was in the form of tuition payments of $1.3 billion (22 percent of total income, both in-state and out-of-state – a breakdown was not available in the IPEDS data used for the study); auxiliary enterprises of just over $950 million (16 percent); hospital income of just over $800 million (13 percent); and federal grants and contracts of almost $780 million (13 percent). The rest of the income was divided among multiple smaller sources, including private giving and sales of university services.

Table 5: Summary of Total Economic Impact of Michigan's Public Universities in 1999

Summary of Total Economic Impact of Michigan's Public Universities in 1999
(In millions of dollars)

	Higher differential spending by graduates	Faculty spending	Student spending	Visitor spending	University spending	Total spending	Multiplier	Direct and Indirect Impact of Spending	Total State & Local Support	Total Impact
Total 15 Institutions	$13,128	$1,888	$1,569	$184	$3,724	$20,492	2	$40,984,874,714	$1,553,433,209	$39,431,441,505
Percentage of Total	64%	9%	8%	1%	18%	100%				

Table 5

[5] Additional in-state expenditures attributable to the technology transfer and commercialization activities of the state's research universities, including start-ups, are very small relative to other expenditures in the model, and therefore do not show up in this analysis.

Economic Impact of Michigan University Licensing and Start-Ups

Tables 6 and 7 below summarize the responses of Michigan's universities to SRI's requests for data on licensing income from Michigan licensees, and on start-ups based in university research. As is the case with most states, only a few of Michigan's public universities engage in significant amounts of research and related technology transfer and commercialization activity. Notable, however, are the University of Michigan's 1999 licensing revenues from in-state firms (a small fraction of total licensing income to the university in that year), and the number of start-ups based in Michigan State University's research, which have generated more than 475 in-state jobs to date (perhaps the most economically significant in-state result of Michigan universities' technology transfer activities). The modest levels of these impacts, plus the lack of complete data on lines of business and royalty rates, did not make it feasible to estimate the employment and earnings impacts of in-state licensing and start-ups. Data collected are displayed in Table 6 and 7, below.

Table 6: Licensing Income from Public University Licensees in Michigan, 1999

Number of MI Licensees	1999 Licensing Revenues (MI firms, in $)
28	421,131

Table 7: Start-ups from Michigan's Public Universities, 1999

Number of MI Start-ups	1999 Licensing Revenues (MI firms, in $)
47	131,353

The immediate economic impact on Michigan from the state universities' technology transfer and commercialization activities is modest, especially in comparison to the impact of the education premium of the graduates and university, staff, student, and visitor expenditures. However, the modest size of the impacts of technology transfer activities, as collected for this study for 1999, may present a misleading indication of the longer-term economic significance of university-based research. This is because most of the economic impacts of technology transfer activity at Michigan universities are generated by (a) license fees and royalties from licensees outside the state and (b) the longer term effects of those start-up firms that will expand significantly, generating local spending for salaries, equipment, services, and facilities, and sometimes creating new industrial clusters.

Moreover, as seasoned professionals in university technology transfer offices have repeatedly observed, the major payoffs to the university from technology transfer and related interactions with private industry take the form of increased amounts of sponsored research from industry and, eventually, of donations of equipment and funds for endowed chairs and facilities. Thus state investments in university research infrastructure and in technology transfer and commercialization activities are widely recognized as having long-term payoffs that easily exceed their costs.

Potential Sources of Error

This section addresses two questions: (1) how will errors and uncertainties in different elements of the model affect the overall results; and (2) what are the major sources and magnitude of errors and uncertainty in the specific data used in the model that might be reduced in future studies?

Errors in the education premium data. Table 5, Summary of Total Economic Impact of Michigan's Public Universities in 1999 (above), shows the relative contributions that expenditures attributable to the education premium, faculty spending, student and visitor spending, and direct university expenditures make to the total used in the model. If the education premium error band is ±10%, for example, (and all other data are assumed to be accurate), the error in the total impact estimate is ±6.4%, whereas if the error in faculty spending is also ±10% (and all other data are assumed to be accurate), the error in the total impact estimate is just ±0.9%. Thus the data used to calculate the education premium should be the first target for

future studies intended to refine the analysis in this study.[6]

Possible sources of inaccuracy in the data employed in the model are:

- Errors in estimates of the proportion of graduates in each demographic and age cohort that live in Michigan, as well as errors resulting from extrapolation of the limited graduate retention data provided by some universities to their entire alumni population;
- A possible double counting of those baccalaureate degree holders from Michigan public universities who went on to obtain graduate or professional degrees in Michigan;[7]
- Errors in estimates of the gender proportions by education level, particularly for the early years treated by the study;
- Errors caused by extrapolation of available Michigan labor force participation rates;
- Any differential between the national earnings by educational attainment, gender, and age and the Michigan-specific earnings for those same groups.

Universities were asked to report their best estimate of the precision of the graduate and residence data they reported; however, most universities did not provide an estimate of precision. The few that did reported a relatively low degree of error, plus or minus two to five percent. Not all universities were able to break down graduate numbers by gender in the early years covered by the study, and therefore some of the graduate data are based on estimates of gender proportions. Men and women have, on average, significantly different incomes, and this uncertainty in the graduate breakdown may introduce a significant but unknown error. In addition, several universities were able to report only a single retention percentage for all their graduates, rather than percentages based on degree level, age, and gender. In these cases, the single rate was extrapolated to the entire graduate population, again creating some (unknown) error rate in the final estimates of graduates who are still residing in the state.

Labor force participation rate data were gathered from the Web page of the Michigan Department of Career Development, Office of Labor Market Information. National earnings tables by educational attainment, gender, and age, rather than Michigan-specific tables, were used because the latter data from the 2000 Census had not been released by the U.S. government at the time of the study.

The individual university graduate data and graduate retention data on which the education premium calculation is based clearly have a modest but significant error rate. However, errors in data from different universities may well be in opposite directions and have a canceling effect. Quite simply, it is not possible to determine an exact error rate for the education premium without allowing the universities more time to search out and verify their graduate data, and to make better estimates of the error bands in these data. SRI estimates that there may be a 15% error rate in the education premium calculation.

Errors in the spending data. Data on direct spending by universities were obtained from the IPEDS database, which is based in turn on submissions by the universities. It is assumed that these data have a very low error rate. Likewise, university employee spending was based on salary data from the IPEDS database, and is similarly assumed to have a low error rate.

As with the graduate data, universities were also asked to report the best estimate of the precision of the university and student spending data. These estimates averaged ±8 % for student spending, and ±11% for visitor spending. The ranges were from five to thirty percent for student spending, and from five to forty percent for visitor spending. However, as noted above,

[6] Attention also could be directed in future studies to assumptions about what the (single) multiplier should be, whether different multipliers should be used for each university to account for differences local economies, and whether different multipliers should be used for the different elements of university-related expenditures.

[7] Data were not available to eliminate this double counting, and it is not certain that the universities could easily produce a count of all their graduate and professional degree holders whose baccalaureate degrees were also from Michigan public universities.

the impact from even large errors in student and visitor spending on the total impact estimate is minimal. For example, if the error in student spending were ± 30% (the largest reported), the effect on the total impact estimate would be just 2.4%.

Errors in the licensing and start-up company data. The problems identified with the use of these data and their small contribution relative to the other elements of the model are described elsewhere. Since a calculation of the economic impact of licensing and start-ups within Michigan would be very small relative to the education premium and university spending impacts, virtually any realistic error rate in these data would not have a significant effect on the overall economic impact estimate.

Population Groups Omitted from the Model

There are two post-high school groups that are not included in this study: individuals with "some college" but no degree, and graduates of the state's two-year institutions. Individuals who have "some college" education generally have higher salaries than those with just a high school education. However, they are not included in this study for two reasons: the study was designed to focus on *graduates* of the state's public institutions, and the data that would be required to determine how many of these "some college" individuals in Michigan obtained some or all of their college education at the public universities were not available.

The Role of Public Community Colleges in Michigan

Community colleges are an integral part of Michigan's postsecondary landscape. More than 400,000 students are enrolled annually in Michigan's 28 community colleges, seeking preparation for entry into the state workforce, or are preparing to transfer to a college or university to complete a bachelor's degree. Additionally, community colleges play a significant role in upgrading the skills of persons who are already working.

The scope of this study did not include the state's community colleges. Nonetheless, the students and graduates of two-year colleges have a positive financial impact on the Michigan economy in much the same way as students and graduates of the four-year institutions. The spending of community colleges is also important to the state and the communities in which these institutions are located. According to U.S. Census data, the median income for graduates of two-year institutions with Associates Degrees is more than $13,000 higher than median income for high school graduates. Clearly, the community colleges make a major contribution to Michigan's education premium.

A recent report on Michigan's community colleges, "IMPACT STATEMENT: An Abstract of Michigan Community College Information," published by the Michigan Department of Career Development, provides additional information on the state's community colleges. It can be found of the World Wide Web at:

http://www.michigancc.net/cci/reports/impact_S.pdf.

Economic Impacts Not Included in the Model

The university-related expenditures treated implicitly and explicitly in the model represent only a part of the full impact that state universities have on local and regional economies. For example, college-educated individuals tend to have lower mortality rates, higher philanthropic giving, and other factors attributed to being highly educated. However, it is difficult to determine the relative magnitude of these other impacts. The literature on the economic impacts of universities acknowledges the existence and significance of additional impacts, but in only a few cases have any been estimated quantitatively. In the case of the present study, limitations of time, resources, and data combine to preclude treatment of these factors. Some of the most important of these impacts, as in the case of the education premium explicitly considered in the model, derive from differences in earnings, spending patterns, and behavior between those who have university degrees from those who do not. The following excerpt from a relatively recent,

large-scale study of college-educated citizens in the U.S. summarizes these succinctly:

"Compared to those with less education, the college-educated tend to have a better overall health and a lower mortality rate, have smaller families and be more successful in achieving desired family size....They also tend to be more efficient in making consumer choices, save a greater percentage of their incomes, make more effective long-term investment of discretionary resources, and spend a greater proportion of discretionary resources and leisure time on developmentally-enriching activities (reading, participation in arts and cultural events, involvement in civic affairs and so forth)" (Pascarell and Terenzini, 1991: 584; quoted in Economics Canada Research, 1991: 43).

In addition, college-educated people are less likely to smoke, tend to be better informed about health matters, and are more likely to donate to philanthropic groups. Each of these differences has positive impacts on society and the economy and, in principle, could be measured and impacts estimated. In at least two cases, attempts were made to quantify the economic impact. In Canada, national surveys of volunteerism and philanthropic giving provided data on differences in both of these activities between citizens with a college education and those without. The Economics Canada Research study of the economic impact of Ontario's universities used differences between the average annual philanthropic donations of high school graduates and college graduates, and between the average number of volunteer hours (valued at the minimum wage) between high school and college graduates, to estimate a "philanthropic premium" of $420 million (Canadian) and a "volunteerism premium" of $147 million (Canadian) in Ontario in 1998 (Economics Canada Research, 2001).

Beyond the impact of this broader definition of the education premium, universities also add to the physical and intellectual infrastructure of the community by providing access to space, equipment, libraries, sports facilities, art galleries, and so on, for off-campus individuals and organizations. These facilities constitute a portion of the state's total economic, social, and cultural infrastructure, making it more attractive to external investment and in-migration, and in some cases represent cost avoidance for the universities' local communities.

Finally, Michigan's research-intensive universities contribute additionally to regional development. Beyond attracting sponsored research support from outside the state, which is accounted for through increases in university spending for facilities, equipment, student support, salaries, and overhead, university-based research activity is increasingly recognized as generating additional economic benefits. Some of these benefits are captured in the model as modest additional income to the university in the form of licensing revenues, and in jobs created through sales increases to in-state licensees and through start-up companies based in university research. However, recent research focusing on the economic payoffs to regions from the presence of research universities has shown that benefits extend well beyond these relatively immediate and explicit forms. The major channel by which these impacts occur is via research cooperation and collaboration with industry.

Over the past two decades, states (as well as the federal government) have recognized that industry-university cooperation in research yields positive local economic benefits, and have invested heavily in programs to facilitate such cooperation. Michigan is no exception. A full accounting of these positive economic benefits, however, would have to include the cost savings, value of access to faculty and students, new ideas, and other intangible benefits that accrue to companies that work cooperatively with universities. Research has shown repeatedly that these benefits, while difficult to document, are substantial (Cohen, et al., 1998; Roessner, 2000; Ailes, et al., 1997). As with the other impacts described above, future studies in Michigan could take some or all of these economic impacts into account through, for example, surveys of companies that cooperate regularly with the state's research universities through membership in university-industry research centers.

CHAPTER VI - CONCLUDING COMMENTS

In this initial effort to assess the economic impacts of Michigan's public universities, an economic impact model was developed that was at once rigorous yet straightforward, conservative yet conceptually valid, and designed to be elaborated and refined in future studies. After the most significant revenues and expenditures of Michigan's public universities were identified, the key elements that contribute directly and indirectly to Michigan's economy were focused upon. These included the education premium, total expenditures by the university system, and expenditures associated with the research universities' technology transfer and commercialization activities. The resulting model, which combined elements of input-output analysis and straightforward algebraic accounting, met the project's goals of acknowledging the contribution of all significant university activities, especially the education premium. The model quantified the economic impacts for which data were readily available, while noting the importance of other impacts for which data were unavailable within the constraints of the study. The analysis described in this report meets the desired goal of estimating the economic impacts of public universities that are attributable to the unique features of universities, impacts that to a substantial degree would not have occurred in the absence of those universities.

The analysis shows that there was a very large economic impact from Michigan's 15 public universities in the study year, 1999. Furthermore, there is every reason to believe that this impact has been growing steadily, and will continue to grow in the future. The growth will be partly due to the increased earnings of university graduates, which are growing at a faster rate than the earnings of those without a university degree. Future growth will also be the result of a steady increase in the numbers of Michigan citizens who will graduate from the state's public universities as enrollment grows.

Throughout the report, sources of error and uncertainty in the data have been identified, as well as gaps and either missing data or data that had to be estimated or extrapolated. Future studies might address the shortcomings and increase the accuracy of the overall economic impact estimate. However, there is very little likelihood that the improvements would alter the basic results of the analysis. Nonetheless, the following are some suggested improvements that would reduce sources of inaccuracy in the data and assumptions made in the model:

Improvements in estimates of the education premium:

- Increase the accuracy of estimates and fill in the gaps in the graduate retention data (i.e., the proportion of graduates in each demographic and age cohort that still live in Michigan);
- Account for the double counting of baccalaureate degree holders from Michigan public universities who go on to obtain advanced degrees from Michigan public universities;
- Obtain better data on gender proportions of graduates by degree, especially for earlier cohorts;
- Obtain more accurate data on labor force participation rates in Michigan;
- Obtain state-level data on earnings by educational attainment, gender, and age.

Improvements in university spending data:

- Increase the accuracy of estimates by each university of student and visitor spending;
- Incorporate information on how income from student payments for on-campus housing is treated in university accounts;
- Verify that the data submitted by the universities to IPEDS accurately reflect the income and spending needed for a study of this type.

Improvements in licensing and start-up company data:

- Obtain more accurate and more complete data on the individual royalty rates for licensees;
- Obtain more accurate and more complete data on the NAICS codes for licensees;
- Obtain more complete data on the sales, employment, and NAICS codes of start-ups.

Refinements in the economic impact multiplier:

- Employ different multipliers that account for each university's local industrial structure;
- Employ different multipliers for the indirect impact of different categories of university expenditures;
- Employ different multipliers for expenditures associated with individual university start-up and licensee expenditures.

Other refinements could be made in future studies that are not directly related to sources of error or uncertainty, but rather to initial assumptions made about the study's scope and to the level of resources available to collect and analyze additional primary data. For example, the education premium could be calculated by comparing the increased earnings of four-year university graduates with those of graduates with "some college" or with those of graduates of two-year institutions. Following the methodology used in the Ontario impact study, estimates of the philanthropic premium and the volunteerism premium could be developed and added to the education premium. Estimates could be made of the costs avoided by both Michigan residents and employers due to the greater health enjoyed by university graduates—a kind of "health premium". Also, savings to local governments due to the presence of university facilities that would otherwise have been built using local tax revenues could be estimated. Finally, surveys of research-intensive companies that interact cooperatively with Michigan universities' research faculty and staff use university facilities, or employ faculty consultants could be used to develop estimates of the increased sales and/or other benefits that result.

Efforts to produce more graduates from public universities, and to help individuals advance their level of academic achievement, will not only benefit the state through creation of an even larger education premium in the future; the graduates will also make Michigan a more attractive place for firms to consider in their expansion and location decisions. In the modern knowledge economy, a supply of highly educated workers is the most important factor for growth, one that the state can nurture. As the universities grow, their spending (as well as that of their employees, students, and visitors) will also grow, generating increased direct and indirect contributions to the state's economy and drawing more resources to the state's universities from beyond Michigan's borders.

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APPENDIX: DATA COLLECTION INSTRUMENTS

MICHIGAN UNIVERSITY IMPACT STUDY

DATA ON GRADUATES

Instructions: Enter the number of graduates by degree level, gender, and for the periods indicated. If possible, each institution should enter the percentage of graduates remaining in Michigan at each degree level, gender, and for the periods indicated. If you can produce these data (the "best" option) it will permit the most precise analysis.
If the above level of detail is not possible, then data on any of these variables, in one of the "BETTER" matrices, will suffice. If the most you are able to provide is a global estimate of the percentage of all graduates still in the state, enter that in the "GOOD" box.
The year bands have been chosen to match the year bands used by the Census to produce data on income and labor force participation that will be used to calculate earnings from the information provided here.

DUE DATE: MARCH 22
Return by e-mail to carr@wdc.sri.com

Name of Institution:

Individual Completing Form: **Phone:** **E-mail:**

Number of Degrees Conferred by Year, Degree, and Gender

	1987-1996		1977-1986		1967-1976		1957-1966		1957 and earlier*	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Bachelor's										
Master's										
Doctoral										
Professional										
TOTAL	0	0	0	0	0	0	0	0	0	0

* The number of graduates requested for 1957 and earlier are only for graduates known (or estimated) to be still living.

Percentage of Graduates Still in Michigan

BEST

Percentage of Graduates Living in Michigan by Year, Degree, and Gender

	1987-1996		1977-1986		1967-1976		1957-1966		1957 and earlier	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Bachelor's										
Master's										
Doctoral										
Professional										
TOTAL	0	0	0	0	0	0	0	0	0	0

BETTER

Percentage of Graduates Living in Michigan by Year and Gender

	1987-1996		1977-1986		1967-1976		1957-1966		1957 and earlier	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
All Degrees										

OR

BETTER

Percentage of Graduates Living in Michigan by Year and Degree

	1987-1996	1977-1986	1967-1976	1957-1966	1957 and earlier
Bachelor's					
Master's					
Doctoral					
Professional					
TOTAL	0	0	0	0	0

OR

BETTER

Percentage of Graduates Living in Michigan by Year

	1987-1996	1977-1986	1967-1976	1957-1966	1957 and earlier
All Degrees					

GOOD **Percentage of All Graduates Still Living in Michigan**

Level of precision: If the percentages provided in the box(es) above are estimates, please provide an idea of their precision, e.g., plus or minus 10%.

Comments:

MICHIGAN UNIVERSITY IMPACT STUDY

DATA ON STUDENT AND VISITOR SPENDING

Instructions: All Institutions should fill in all the boxes, according to the information or estimates you have available. Give the best estimate you have for the amounts spent by students and visitors. See definitions below.

DUE DATE: MARCH 22
Return by e-mail to carr@wdc.sri.com

Name of Institution:

Individual Completing Form:

Phone:
E-mail:

Estimate of Spending* by Students in 1999	Precision of estimate (e.g., plus or minus 10%)	Estimate of Spending* by Visitors to Campus in 1999	Precision of estimate* (e.g., plus or minus 10%)

* Spending by students includes living expenses, and all other expenses except university tuition, fees, and other university costs.
* Spending by visitors to campus includes lodging, food, and any other expenses made by visitors.
* If the percentages provided in the box(es) above are estimates, please provide an idea of their precision, e.g., plus or minus 10%.

Comments:

For additional information, or for clarification, contact SRI International, Robert Carr (703) 247-8592 <carr@wdc.sri.com> or David Roessner (703) 247-8550 <roessner@mindspring.com>.

MICHIGAN UNIVERSITY IMPACT STUDY

DATA ON LICENSING INCOME

Instructions: All Institutions with licensing *income* in 1999 should fill in the boxes, according to the information you have available. The "best" response will be to list all licenses that were producing revenue in 1999 (inserting new rows on the spreadsheet as necessary). For each licensee include the company's name or some identifier, which may be some code you select to preserve confidentiality. Enter the running royalty (see definition below) figure for 1999. Use the amount that was included in the calculation of the running royalty amount submitted to AUTM for 1999. Enter the percentage rate of the license. Finally, enter the percentage of the licensee's activity in Michigan. This latter percentage will be 100%, for firms entirely located in Michigan, and 0% for those entirely outside the state. If some licensees have activity deriving from licenses in multiple states, enter the percentage of the global activity in Michigan. Finally, enter the 3-digit NAICS code of the licensee. A list of NAICS codes is also attached to this email. Alternatively, if you want SRI to determine the NAICS code,
be sure that you have included the name, city and zip of the licensee.
If the level of detail described above is not available, then, in the "GOOD" row, enter the total running royalty for 1999 (the figure submitted to AUTM for the 1999 survey) and the university's average rate for running royalties across all its licenses. Finally, estimate the percentage of all royalty income coming from licensees in Michigan.

DUE DATE: MARCH 22

Return by e-mail to carr@wdc.sri.com

Name of Institution:

Individual Completing Form:

Phone:
E-mail:

	Licensee Identification* (name or letter code, e.g. "A", "B")	Licensee address: city and zip (required only if SRI is to look up and enter the NAICS codes)	1999 Running Royalty* Income ($)	Percentage Royalty Rate for this License	Percentage of Licensee Activity in MI	NAICS Code of Licensee (3-digit)
BEST						
	Totals		$0			

Insert new rows as necessary.

	1999 Total Running Royalty* Income (AUTM Submission) ($)	Average Percentage Rate for all of the University's Royalty Producing Licenses.	Estimate the Percentage of all Income from Activity in MI
GOOD			

* If confidentiality is a problem, just identify each startup with a code name. If this may still risk revealing confidential information, please call one of us (numbers below) and we will help resolve the problem.

Definitions:

* Running royalties are those royalties that are received periodically based on sales related to the license. They specifically *exclude* "up front" royalty payments and other payments not related to sales of products or services.

* Percentage royalty rate is the percentage of sales or other income that is used to calculate the royalty due the university.

* NAICS (North American Industry Classification System) codes are a product classification system that describe economic enterprizes that have replaced the old SIC codes. A list of codes is attached. For further information about NAICS see http://www.census.gov/epcd/www/naics.html. Most establishments know their NAICS code.

Comments:

For additional information, or for clarification, contact SRI International, Robert Carr (703) 247-8592 <carr@wdc.sri.com> or David Roessner (703)

MICHIGAN UNIVERSITY IMPACT STUDY

DATA ON START UP COMPANIES

Instructions: All Institutions with start up companies should fill in the boxes, according to the information you have available. List companies that have started up later than 1980, based on university technology or other university-based activity, whether licensed from the university or not, and that are still in business. (Insert new rows as necessary.) To qualify for inclusion, a company must have had a substantial university input, which might include university-developed technology or other university-developed knowledge. The company must have been started by persons involved with the university, including faculty and students who left the university to participate in the start up.

DUE DATE: MARCH 22

Return by e-mail to carr@wdc.sri.com

Name of Institution:

Individual Completing Form:

Phone:

E-mail:

Start up Identification* (name or letter code)	1999 Running Royalty* Income, if Any	Percentage Royalty Rate	State Where Firm is Located (MI or XX for firms outside Michigan)	NAICS Code* of Start Up (3-digit)	Number of Employees	1999 Sales*	Percent Equity Owned by the University, if Any

Insert new rows as necessary.

* If confidentiality is a problem, just identify each startup with any code. If this may still risk revealing confidential information, please call the number below and we will help resolve the problem.

Definitions:

* Running royalties are those royalties that are received periodically based on sales related to the license. They specifically *exclude* "up front" royalty payments and other payments not related to sales of products or services. Equity in lieu of royalties are also excluded from running royalties.

* Percentage royalty rate is the percentage of sales or other income that is used to calculate the royalty due to the university.

* NAICS (North American Industry Classification System) codes are a product classification system that describe economic enterprizes. NAICS codes have replaced the old SIC codes. A list of codes is on a separate worksheet. For further information about NAICS see http://www.census.gov/epcd/www/naics.html. Most establishments know their NAICS code.

Comments:

For additional information, or for clarification, contact SRI International, Robert Carr (703) 247-8592 <carr@wdc.sri.com> or David Roessner (703) 247-8550 <roessner@mindspring.com>.