MAY 2009

What does a college degree cost?

Comparing approaches to measuring "cost per degree"

By Nate Johnson

Delta Cost Project white paper series

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Contents

List of figures

Appendix 1: Detailed tables

What does it cost to provide a bachelor's-level education? This question arises with increasing frequency and urgency as pressure mounts on policymakers and education leaders to increase the education attainment level in the United States, to "Double the Numbers" in some cases.[1] At the same time, the two traditional sources of financing—state appropriations and private tuition payments—show signs of being stretched to their limits.

Yet determining the cost of a degree is not a simple question to answer in a system that has made enrollments—i.e., the credit hour, the FTE—the primary unit of accounting, rather than the completed degree. Even with credit hours, only a minority of state systems, such as Florida, Illinois and Minnesota,[2] routinely analyze instructional costs at a level of detail beyond institution and instructional level totals. While there has been considerable effort invested in analyzing college costs,[3] no consensus or common language has emerged to describe how the cost of a degree should be measured.

Consensus around a single method may be neither possible nor desirable, given the range of different policy contexts in which the question comes up. A common language, however, could help keep discussions of the issue more focused than they often are. This paper suggests the beginnings of that language by briefly outlining five approaches to degree costs:

1. Catalog cost
2. Transcript cost
3. Full cost attribution
4. Regression-based cost estimates
5. Student's cost of a degree

This paper explores the first three approaches using accounting data from the State University System of Florida (SUS), at different levels of detail. Much of this analysis derives from projects undertaken for the system's newly created Board of Governors as it sought to estimate the cost of ambitious degree targets in its first strategic plan.[4] Other systems or institutions will be able to replicate these with more or less detail depending on the data available.

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[1] See, for example, Kentucky Council on Postsecondary Education, *Double the Numbers: Kentucky's Plan to Increase College Graduates,* (October 2007); Arizona Board of Regents, *2020 Vision: The Arizona University System's Long Term Strategic Plan 2008-2020,* [no date].

[2] See, for example, Florida Board of Governors, "State University System of Florida Expenditure Analysis, 2006-2007," www.flbog.org/about/budget/expendanalysis.php (accessed November 25, 2008). The direct and indirect instructional cost per credit hour portion can be accessed interactively at Florida Board of Governors, "Expenditure Analysis in State University System Institutions," www.flbog.org/resources/iud/expenditure_search.php (accessed November 25, 2008). Minnesota's detailed cost analysis is used in its annual budget allocations as outlined at Minnesota State Colleges & Universities, "Allocation Framework," www.finance.mnscu.edu/budget/allocations/index.html (accessed November 25, 2008); a cost analysis dashboard is available for internal system use at Minnesota State Colleges & Universities, "Allocation Framework," www.finance.mnscu.edu/budget/managementtools/index.html (accessed November 25, 2008). For Illinois, see Illinois Board of Higher Education, "Discipline Unit Cost Study 2006-2007," and related materials, www.ibhe.state.il.us/Data%20Bank/costStudies/default.asp (accessed November 25, 2008).

[3] See, for example, Institute for Higher Education, *Higher Education Cost Measurement: Public Policy Issues, Options, and Strategies,* (March 2000).

[4] Board of Governors of the State University System of Florida, "State University System of Florida Strategic Plan 2005-13," (June 2005), www.flbog.org/about/_doc/strategicplan/StrategicPlan_05-13.pdf (accessed November 25, 2008).

The fourth approach is a statistical exercise, rather than an accounting analysis, that uses nationally available data on university expenditures. The weights derived from a regression analysis may help disaggregate instructional expenditures in states that do not do so in their accounting systems.

The last method—student cost—is probably the most familiar, and is the subject of any number of cost calculators and informational brochures. It is worth including here to distinguish the institutional cost of offering degree instruction from the student's cost of obtaining that instruction.

Each of the methods explored here reflect the most recent data available for the research conducted; cost estimates from the various methods using different years should not be compared without adjusting 3-5% annually for inflation. With that adjustment, the data are close enough in time that differences among the methods can be seen in the results. The main purpose of this paper, however, is not so much to answer the question, "what does a bachelor's degree cost?" as to outline a taxonomy and methodologies for different ways the question can be answered.

Credit hour expenditure analysis

The first three methods outlined use a statewide analysis of instructional costs by credit hour as their starting point.[5] In Florida, the annual system expenditure analysis uses centrally reported budget, personnel, and course-level data to allocate costs by institution, level (lower- or upper-division undergraduate, master's or doctoral-level graduate), and broad program area (two-digit Classification of Instructional Program codes such as engineering, education, or business). In addition to the direct costs of instruction, which are primarily personnel-related, the expenditure analysis allocates indirect costs—such as student support, academic administration, advising, university support, library services, financial aid, and plant operations—to each category of student credit hours. Some of these indirect costs—such as student support and advising—are tied entirely to student instruction, while others are shared with non-instructional activities for which the state provides support. The latter include research, public service, public broadcasting, museums, institutes and centers, agricultural extension, etc.

Table 1 shows the costs included in the expenditure analysis that are ultimately attributed to student credit hours and, in the first three analyses in this paper, to student degrees. Direct instruction accounts for about 40% of the expenditures included in the annual expenditure analysis, with other direct expenditures on mission-related activities (research, public service, stand-alone activities) at 19%. Academic support activities (advising, academic administration, libraries) account for another 14%, university support activities (accounting, technology) for

[5] Board of Governors of the State University System of Florida, Expenditure Analyses, www.flbog.edu/about/budget/expendanalysis.php (accessed November 25, 2008).

another 11%, financial aid for 1%,[6] student services for 5% and plant operations and maintenance for 10%.

Table 1

2006-07 State University System of Florida expenditure analysis categories, in millions (combined universities and special units)

	SUS expenditure analysis direct	% share	SUS expenditure analysis total allocated	% share
Instruction	$1,229	40%	$2,213	73%
Public service	$47	2%	$71	2%
Research	$335	11%	$510	17%
Stand-alone activities	$198	6%	$257	8%
Ac. Advising, administration, library	$429	14%		
University support	$327	11%		
Financial aid	$41	1%		
Student services, other	$138	5%		
Plant operations and maintenance	$307	10%		
Total	$3,051	100%	$3,051	100%

When fully allocated to the mission-related activities, 73% of the expenditures are direct and indirect instructional costs. Student services, academic advising, and financial aid are allocated entirely as indirect instructional costs, apportioned among different levels and CIP codes based on the credit hours generated. The other categories are allocated proportionally as indirect costs to instruction, research, public service and stand-alone activities based on full-time-equivalent personnel directly involved in each CIP code.

Note that both the magnitude and the proportions differ from what the same institutions report through the Integrated Postsecondary Education Data System (IPEDS), which includes expenditures from all sources, including contracts, grants, endowment income and gifts, among others. Neither IPEDS nor the expenditure analysis include auxiliary enterprises, athletics, or hospitals, but IPEDS shows nearly a half billion dollars more in direct instructional expenditures, and $400 million more in total educational expenditures than the system's own cost analysis. Some of the difference may be due to definitional issues, but for purposes of discussion or national comparisons, the true cost of a credit hour in the system, when all revenue sources are taken into account, may be 15-25% higher than the cost analysis suggests.

On average, in 2006-07, direct instructional costs in the SUS were $158 per credit hour, and total costs were $288 per credit *(see Table 2 on page 8)*. Total costs ranged from $188 for lower division to $275 for upper division undergraduate, and from $537 for master's level graduate to $849 for doctoral level instruction. University costs varied considerably, from $240 for an upper

[6] The financial aid expenditures captured in the expenditure analysis reflect a particular appropriation in the annual E&G budget, not everything a university or the state expends annually on financial aid.

division undergraduate credit at the 50,000+ student University of Central Florida to $677 at New College, the state's 700-student liberal arts college. While economies of scale account for some of the variation, much is also attributable to the different mixes of disciplines offered at each institution. *(Detailed tables are included in Appendix 1.)*

Table 2

State University System of Florida direct and indirect instructional expenditures per credit hour

	2001-2002	2002-2003	2003-2004	2004-2005	2005-2006	2006-2007
Lower	$164	$168	$173	$170	$182	$188
Upper	$237	$244	$243	$253	$259	$275
Grad I	$455	$466	$477	$492	$521	$537
Grad II	$724	$741	$739	$777	$761	$849
Total	$247	$255	$255	$263	$273	$288

System-wide costs for instruction range from $159 for an upper division credit in family/consumer sciences to $509 for a credit in natural resources/conservation. Discipline-level costs within institutions can range wildly, especially in small programs. At one mid-sized university, the cost per credit for upper division instruction in mathematics and statistics was $1,277 one year and $754 the next, an amount attributable to the number of credits increasing by the equivalent of one class of 32 students in a three-credit course, from 249 to 346. The total amount expended decreased by $56,946, equivalent to a single instructor's salary and benefits. Examples such as this one highlight the limited value of credit hour cost analysis—and by extension, degree cost analysis that depends on credit hour costs—for comparison purposes at a highly disaggregated level.

The expenditure analysis accounts only for the system's education and general budget derived from state appropriations and student tuition fees. It does not analyze contract and grant expenditures, auxiliary (housing, parking, bookstore) activities, or expenditures from endowment income. The first two exclusions would not affect a reasonable calculation of cost per credit hour, since the activities are generally self-funding; the exclusion of endowment and investment funds, however, is a notable blind spot. While the analysis remains a credible analysis of state and student costs, it might not reflect the total cost—especially in the case of instructional faculty whose salaries or expenses are supplemented by endowment income. In Florida, unlike in states such as Texas, Michigan, or California, university endowments remain relatively small and would provide no more than 5%, on average, of the instructional budget if the entire income stream were dedicated to student instruction, which it is not. This amount, however, is not evenly distributed across institutions and disciplines, so the underestimate of costs is greater in some areas than in others.

For a useful point of reference, the expenditures included in the SUS expenditure analysis can be compared to those reported to IPEDS, as shown in Table 3. The differences between the values in this table and those shown in Table 1 stem from the broader range of revenue sources included in IPEDS as well as from the different definitions the two reporting systems use.

Table 3

State University System of Florida 2006-07 IPEDS finance expenditures, in millions

	SUS IPEDS finance direct (in millions)	% share	SUS IPEDS total allocated (in millions)	% share
Instruction	$1,705	38%	$2,636	59%
Public service	$239	5%	$341	8%
Research	$1,035	23%	$1,480	33%
Academic support	$466	10%		
Institutional support	$484	11%		
Student services	$198	4%		
Operation maintenance of plant	$331	7%		
Total	$4,457	100%	$4,457	100%

Another exclusion from the analysis, as well as from the IPEDS expenditures listed here, is the amortized cost or replacement value of university infrastructure. Capital costs over the 50-year life of a typical classroom or office building may be only a small fraction of operating costs, but can still be significant. In Florida, for example, state appropriations and student fees used for capital expenditures accounted for 12% of total appropriations and fee revenues over the last 25 years. Given the Florida system's rapid growth, this may overstate the ratio for a fully built-out institution or system.

1. Catalog cost estimates

Starting from the expenditure analysis, the catalog approach to cost is an estimate of what it costs to provide the published course requirements for a degree from the institution's perspective. The catalog cost is the sum of the credit hour costs to earn a given degree as outlined in the institution's published program requirements. It can be summarized as:

$$\text{Catalog cost of a degree} = \text{cost per credit hour} \times \text{catalog requirements}$$

$$\text{where cost per credit hour} = \frac{\text{Instructional expenditures (from IPEDS or defined internally)}}{\text{Credit hours}}$$

This approach calculates the cost using the assumptions implied by a typical course catalog, but does not necessarily line up with how students actually progress through a four-year degree at most institutions. It allows for no failed courses, changed majors, or credits in excess of the program requirements. It also does not discount for Advanced Placement or other credits that a student might bring to shorten the number of credits actually required to complete the degree, although a case could be made that the cost of those credits should also be included.

There are advantages to separating those additional costs from what could reasonably be defended as the cost of the degree program. A well-prepared, focused student can graduate without exceeding the degree requirements; no one is required to fail a course to complete a degree, or to take more than the 120 or 128 credits required. Those "extras" incur additional costs that perhaps should be accounted for separately, much as the base sticker price of a car does not account for the various options available, much less for the cost of repairs and maintenance over the life of the vehicle.

Prospective parents and students are also likely to think in terms of the sticker price or catalog cost of a degree, at least in terms of the tuition and fees they will have to cover over the course of the program. When state costs are factored in, it is easily explained to legislators, the media, or to students.

For the average 120-credit bachelor's degree, a simple version of the catalog cost uses 60 times the cost (direct plus indirect expenditures) of a lower-division credit plus 60 times the cost of an upper-division credit. Florida's strong 2+2 system includes a guarantee of 60 transferred lower-division credits for community college AA transfers, and maintains a relatively clear divide between upper and lower division coursework to ensure that community college students can always complete the first 60 credits of a degree without going to a university. Even if the assumption of a strict 60-60 split is not empirically precise, it closely reflects the state's postsecondary policy framework.[7]

Table 4

Cost of a 120-credit bachelor's degree using 2005-06 total cost per credit

	Lower division 60 credits	Upper division 60 credits	Total credits 60 + 60
Institution average	$12,465	$16,946	$29,410
Weighted average	$10,918	$15,568	$26,485
High	$22,440	$21,852	$43,817
Low	$8,787	$13,545	$22,332

Table 4 shows the average "catalog cost" of a 120-credit degree at $26,485. The weighted average cost is lower than the average institutional cost because the larger institutions generally have lower costs. The variation is essentially the same variation in the credit hour expenditure analysis. At the institution with the lowest expenditures per credit, the cost of a bachelor's degree is just over $22,000. At the institution with the highest cost per credit, it is nearly double that.[8]

In addition to looking at the average cost, the catalog approach can also be used to analyze particular program costs. In Florida, education, engineering and nursing were selected because of their importance in the Board's strategic plan for degree growth in targeted areas.

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[7] In the late 1990s, Florida severely curtailed the number of credits that institutions could require for most bachelor's degree programs. In most cases, a degree program is limited to 120 credits, unless there are specific reasons to extend it. Even then, few programs go beyond 128 credits.

[8] The highest cost institution was still in its early growth phase in 2005-06 and has experienced rapid declines in unit costs as enrollments grow at double digit rates. The next highest cost, at $36,000 is probably a better reflection of the range among mature four-year universities.

Within the broad areas of education and engineering, elementary education and mechanical engineering represent the largest and most prevalent programs within the system. Although the credit hour expenditure analysis does not provide program-level detail, the catalog requirements for those programs were multiplied by the credit hour costs for each institution at the broad discipline level to generate an estimated cost shown in Table 5.

Table 5

Cost of program requirements for selected bachelor's degrees

	Elementary education	Mechanical engineering	Nursing
Average credit hours required	125.6	127.6	123.9
Institution average	$29,681	$40,546	$33,818
Weighted average	$27,159	$37,970	
High	$42,499	$48,823	$48,755
Low	$23,257	$29,490	$24,363

The results show considerable variation in degree costs for mechanical engineering and nursing, relative to the system average noted in Table 4, while elementary education remains close to the average, despite having degree requirements in excess of 120 hours.

Some of the variation is attributable to program length. Mechanical engineering, for example, averaged 127.6 hours among the institutions offering the program, so the extended length of the program accounted for 6 percentage points of the degree's 43% higher-than-average costs. The rest is linked to the higher cost per credit hour, not only in engineering, but also in physical sciences and other fields required for the engineering degree.

Nursing costs are also higher, although the breadth of the "health professions" classification of instructional program (CIP) code in the expenditure analysis may not fully capture the differential costs of nursing. Other states, such as Minnesota, adapt the standard taxonomy depending on the level of detail required. In the allocation framework for Minnesota State Colleges and Universities, foreign languages are all grouped together as they are in Florida, but registered nurse programs are analyzed separately, as are a number of other health profession programs.[9]

Applying the catalog method in other states

The simplest version of the catalog method can be applied in almost any state or institution, provided data is available or reasonable assumptions can be made about how much was spent on instruction (direct and/or indirect), how many credit hours were generated with those funds, and how many hours are required for a degree. The more the expenditure information

[9] Information about Minnesota's allocation framework is available at: www.finance.mnscu.edu/budget/allocations/index.html (accessed November 25, 2008).

can be disaggregated (graduate vs. undergraduate, for example), the more precise the estimate will be for a given degree program.

Illinois produces an analysis at a level of detail similar to Florida's, although the data are collected at an aggregate level from the universities rather than generated from a centralized data system.[10] The categories of expenses included are also similar, with the exception of departmental research expenditures, which are allocated to credit hour unit costs in the Illinois analysis, but left as a separate cost center in Florida's report. The Illinois analysis may also include expenditures from a broader range of revenues than just appropriations and tuition.

As shown in Table 6, using the average statewide costs per credit for a 120-credit degree, the cost of a degree in the Illinois system would be $30,863. At University of Illinois Urbana-Champaign (UIUC), the costs would be slightly higher at $33,383.

Table 6

Cost of a 120-credit bachelor's degree in Illinois using 2006-07 total cost per credit

	Lower	Upper	Total
Illinois statewide total instruction cost per credit	$212	$303	
System-wide cost of 120-credit degree (60 lower, 60 upper)	$12,699	$18,164	$30,863
UIUC total instruction cost per credit	$213	$343	
UIUC cost of 120-credit degree (60 lower, 60 upper)	$12,793	$20,591	$33,383

As in Florida, engineering would vary considerably from the average, both because of higher unit costs per credit and a longer program length. Mechanical engineering at the University of Illinois at Urbana-Champaign requires 132 credits for a bachelor's degree. Matching these requirements to the discipline level costs in the Academic Discipline Unit Cost Study generates a $46,021 cost for the degree, as shown in Table 7. *(Details of the data used in these calculations are included in Appendix 1.)*

Although engineering degree costs are slightly higher in Illinois than Florida, perhaps due in part to different methodologies in the two expenditure analyses, the variation in the UIUC estimate—at 38% higher than the standard 120-credit degree—is fairly similar to the results of the catalog analysis in Florida, which yielded a cost 43% higher than the average 120-credit degree. Using the statewide Illinois cost per credit (assuming other universities' catalog requirements are similar to UIUC's), the estimated cost of an engineering degree is only slightly lower than when using the UIUC cost per student.

The Illinois example demonstrates the ease with which the catalog method can be applied in other states, although the differences in methodologies between the Florida and Illinois expenditure analyses mean that the results are not strictly comparable.

[10] Illinois Board of Higher Education, 2006-07, "Academic Discipline Unit Cost Study," (May 2008).

Table 7

Estimated catalog costs of engineering degrees

	Lower	Upper	Total
UIUC (2006-07)	$19,002	$27,018	$46,021
Difference from average degree			37.9%
UIUC catalog requirements at Illinois statewide average costs (2006-07)	$19,783	$25,253	$45,035
Difference from average degree			45.9%
SUS of Florida (2005-06)	$10,918	$27,053	$37,970
Difference from average degree			43.4%

2. Transcript method

While the catalog cost is useful as a standardized template and as an easily understood estimate, it does not reflect actual student behavior. Some students will come close to the catalog cost, proceeding through the program in the most direct, linear possible way. Others, however, will take a meandering route to graduation, by way of two or three major cul-de-sacs, a dozen course withdrawals, and an array of optional elective credits. Still others will shortcut the route to graduation, entering college with advanced placement or other accelerated credit.

The cost of a particular group of graduates' degrees can be determined by calculating the cost of each credit on their transcripts. This approach produces the most accurate answer to the question, "what was the cost of the courses on a student's actual transcript?"

$$\text{“Transcript” cost} = \frac{\text{Total credit hours taken by graduates} \times \text{cost per credit hour}}{\text{Number of degrees awarded}}$$

Florida Board of Governors staff in 2005 conducted an analysis of costs based on a data file of courses taken by 2003-04 bachelor's degree graduates, excluding double majors and second bachelor's degrees.[11] A cost per degree was estimated by summing the credit hours in each CIP code taken by graduates in each degree program, multiplying by the expenditure analysis' cost per credit for 2003-04 (thereby avoiding the issue of inflation for students with academic histories going back many years), and dividing by the number of graduates.

While the "catalog" method assumed a standard number of credit hours per student, thereby avoiding the issue of widely divergent patterns of transfers in and transfers out among institutions, the transcript method's results are based on the actual number of hours taken. The

[11] Charlene Coles was the lead analyst for this project. Florida's university data system allows this approach to be conducted at the level of individual courses and degree programs, although the same basic formula could be used at an aggregated level. The data dictionary for the "Hours to Degree" file can be found at www.boghome.org/DataDict/ (accessed November 25, 2008).

results would not be meaningful in Florida, however, without at least separating graduates into those who started as freshmen (FTIC), those who transferred from community colleges with an AA degree (AATRAN), and all others. Graduates who started as freshmen are a minority in the State University System, so the average number of credits for all graduates would in many cases actually be less than the catalog requirements.

Table 8

"Transcript" cost per 2003-04 graduate

	FTIC	AATRAN	Other
All degrees	$31,763	$20,112	$21,746
Elementary teacher ed	$31,184	$19,618	$22,143
Mechanical engineering	$47,257	$35,296	$35,118
Nursing (R.N. Training)	$33,572	$18,368	$18,278
Average credit hours per graduate			
All degrees	131	71	83
Elementary teacher ed	134	72	84
Mechanical engineering	145	93	101
Nursing (R.N. Training)	131	59	60

While the catalog method assumed a standard 120-credit (or slightly higher) program, Table 8 shows that, on average, actual graduates who started in the SUS as freshmen ended up with 131 attempted credits. This includes failed or withdrawn courses as well as courses in excess of degree requirements, and it is net of any accelerated AP or dual enrollment credits brought in to reduce the number of hours required.

This difference also means the total costs are higher. The $31,763 transcript cost of a 2003-04 degree for an FTIC student would be equivalent to about $33,000 at 2005-06 credit hour costs. That is about 25% higher than the cost established through the catalog method, not just because of the higher number of credits, but because students in high-cost disciplines tend to take more credits than others and because, on average, FTIC students are more likely to major in high-cost areas than transfer students.

Course-taking differences among programs also lead to great variation in costs among programs. The transcript cost of the mechanical engineering degree is 48% above the average for an FTIC student, and 75% higher than the average for an AA transfer student, while the catalog cost analysis shows the mechanical engineering degree is only 43% above the average cost. In part, the explanation for this is that engineering students in Florida withdraw from and repeat courses more often than the average student, a fact that does not impact the catalog cost.

A similar analysis of costs for community college graduates is not available, but data published in a 2005 report by the state's Office of Program Policy Analysis and Government Accountability indicate that associate degree graduates in 2001-02 averaged 21 hours attempted in excess of program requirements.[12] If those 21 hours are added to the typical 60 hour associate degree and multiplied by the community college system's published $164 cost per credit hour for 2005-06,[13] the transcript cost of an associate degree for 2005-06 would be $13,824. The total transcript cost would be $33,396, slightly higher than the FTIC transcript cost. The difference does not seem sufficient to have implications for education policy without a more thorough exploration of the different methodologies in the community college cost analysis and the excess hours report than is practical here.

3. Full cost attribution

Even the transcript cost, however, does not account for the costs incurred by students who do not graduate. From a planning perspective, it is unrealistic to assume a 100% graduation rate for enrolled students. If an institution or state intends to award a certain number of degrees, a larger number of students will have to be enrolled than are ultimately expected to finish.

In 2004, the Florida Board of Governors engaged MGT of America to analyze degree costs using a "full cost" approach.[14] This approach involved allocating all direct and indirect instructional costs to the degree outcomes of the system. Every dollar expended was thus associated with a degree.

The advantage of this approach is that it realistically accounts for the systemic expenditures required for a certain aggregate level of degree completion. Attrition, failed courses, and excess hours are seen as a kind of "overhead" that cannot be avoided, to some extent, in a large academic enterprise. For system planning purposes, especially at the highest level of aggregation, it allows for more realistic projections of costs associated with increasing the numbers of degrees awarded in the state. The credit hour "overhead" associated with degrees but not included on students' transcripts might be reduced but is unlikely to be eliminated entirely.

One of the major criticisms of this approach is that it reduces the entire instructional function of universities to awarding degrees, and that to consider courses taken by non-graduates, or in excess of program requirements, as "overhead" is to devalue the educational experience. To the extent that non-degree-related courses are intended or worthwhile in and of themselves, the "full cost" method will overstate the cost of a degree by attributing all costs only to graduates.

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[12] Office of Program Policy Analysis and Government Accountability, "Excess Hours at Community Colleges Warrant Attention by the Department of Education and the Legislature (Revised)," (April 2005): Report #05-230 , www.oppaga.state.fl.us/monitor/reports/pdf/0530rpt.pdf (accessed November 25, 2008).

[13] Florida Department of Education, "The Fact Book: Report for the Community College System," (January 2007): Table 24. www.fldoe.org/arm/cctcmis/pubs/factbook/fb2007/fb2007.pdf (accessed November 25, 2008).

[14] Results and methodology are explained in MGT of America, *Design of a Model to Estimate Cost per Degree in Florida's State Universities,* (February 2005) and attendant working papers.

Another challenge of a "full cost" analysis is in taking it down to the level of individual programs within universities. Students move into, out of, and among universities; they change majors; and they often take many years to graduate; all of which make the allocation of credits to degree programs a significant technical and philosophical challenge. If a student does not graduate, or does not even declare a major, to which degree outcome should the cost of that student's courses be tied?

The approach taken in Florida was to generate estimates based on three years of costs, course-taking patterns by students with declared majors, and degrees awarded, on the assumption that the patterns and proportions would remain relatively stable when averaged over a three-year period. That assumption turned out to be flawed in many instances, but held up at higher levels of aggregation and for larger individual programs. Although in practice this method required matrices with thousands of combinations, a simpler version could be applied with relatively high-level data, using the same essential formula for full cost attribution:

$$\text{Fully attributed average cost of a degree} = \frac{\begin{array}{c}\text{All credits taken at an institution (in FL, over three years by level and student major)}\\ \times \\ \text{Three-year average cost per credit hour (in FL by institution, level and course discipline)}\end{array}}{\text{Three years of degrees awarded (in FL by institution, level and major)}}$$

In the analysis conducted in Florida, three years of expenditures from the credit hour expenditure analysis were aggregated by university, course level, and broad program area (two-digit CIP code).

These expenditures were allocated to degree programs based on the level, declared major, and university of the student who took the course. To address the complexities introduced by student transfer, undergraduate students were broken down as well into those who started as first-time-in-college students, those who transferred from a Florida community college with an associate in arts degree, and all others.

Costs associated with courses taken by students with undeclared majors were allocated proportionally. For example, if social sciences majors accounted for 60% of the declared majors who took social sciences courses, and business majors accounted for 40% of declared majors who took social sciences, the costs associated with undeclared majors taking social science courses would be allocated 60% to social science degrees and 40% to business degrees.

Finally, the total costs incurred by program majors over a three year period were divided by the number of degrees awarded over a three year period.

The results in Table 9, as would be expected, show a higher average cost than either the transcript or the catalog method. At $37,757, which would be about $41,000 at 2005-06 credit hour costs, the attributed full cost is 53% higher than the catalog cost and 21% higher than the transcript cost.

Table 9

Summary of the cost per degree using the full-cost attribution method, 2001-2004

	FTIC	AATRAN	Other
Education	$40,323	$20,723	$27,278
Engineering	$69,888	$36,955	$36,526
Health professions	$39,974	$19,349	$22,352
All program average	$37,757	$18,673	$22,854
System-wide discipline high (multidisciplinary studies)	$170,831		
System-wide discipline low (parks and recreation)	$21,473		
Institution high	$112,889	$66,746	$53,663
Institution low	$26,865	$14,937	$13,535

Graduate/professional	Cost
JD	$33,425
MD	$259,781
Master's	$23,171
Doctorate	$121,725

The variations among disciplines and institutions in this analysis illustrate both the usefulness and the flaws of the full cost attribution approach when taken to the program level. At the institution level, for example, the highest cost institution was a new university still in its early growth phase, so the capacity was, by design, greater than its current productivity, and much of the instruction and costs incurred in years 2001-2004 would not result in degrees until after the study period.

The institution-level results also reflect the net "importers" and net "exporters" within the system. Net exporters have higher costs, as the credit hours of those who transfer out without graduating are attributed to the degree costs of those who did graduate from that institution.

At the program level, the effects were most pronounced where the unit cost of degrees in programs with high attrition rates, such as engineering, included all the costs incurred by the many students who started as engineering majors but changed to something else. Conversely, the unit costs of degrees in programs that tend to be net "importers" from other majors, such as business, had lower costs.

For example, an earlier analysis of State University System graduates showed that, among 2002-03 graduates in the State University System who started as freshmen, 17% of the graduates who initially declared an engineering major ended up with a degree in business, while just 0.4% of those who initially declared a business major ended up with a degree in engineering. Business majors were likely to remain business majors, but almost no one who graduated in area and ethnic studies started college with that intention. While this approach might accurately reflect what it takes to graduate engineering majors—including the cost of internal attrition from the major—it understates what it takes to graduate business majors.

Using the transcript method, there would be many business degrees that include the costs of science and engineering courses taken before students changed majors, while there would be very few engineering degrees that include the cost of early attempts at business.

Parks and recreation, with the lowest system-wide cost of any discipline in this analysis, presents an even more extreme example. Only nine percent of parks and recreation graduates started out in that field, while 91% switched from other disciplines, especially from life sciences, health professions, and education. As a result, very few costs are incurred by students with parks and recreation as a declared major, and the cost of the courses incurred by major switchers becomes an invisible "subsidy" of the cost of the parks and recreation degree. Here, Table 10 shows the percentage of graduates "inherited" from other disciplines as students switch majors.

Table 10

Percent of 2002-03 State University System of Florida graduates who had started in different majors, by final degree program (transfer students not included)

Engineering	17%
Life sciences	24%
Architecture & environmental design	28%
Health professions & related sciences	38%
Visual & performing arts	39%
Liberal/general studies	40%
Mass communication	42%
Business & management	45%
Mathematics	47%
Education	49%
Psychology	50%
Protective services	51%
Renewable natural resources	54%
Agriculture sciences	56%
Physical sciences	57%
Law	57%
Social sciences	60%
Computer & information sciences	60%
Library & archival sciences	65%
Letters	67%
Engineering technology	69%
Foreign languages	74%
Agribusiness & agricultural production	75%
Philosophy, religion, theology	76%
Multi/interdisciplinary study	78%
Human sciences	79%
Public administration and services	81%
Area & ethnic studies	83%
Parks, recreation, leisure & fitness	91%

Table 11 shows the percentage of initial majors that ended up in a different field. Business majors tend to stay in business, with only 23% switching out, while most initial math and science majors graduate in something other than what they initially declare. The multi-disciplinary and liberal studies categories are an anomaly, since some universities administratively "place" students in these categories for advising purposes until they formally declare a different major.[15]

Table 11

Percent of 2002-03 State University System of Florida graduates who changed majors, by initial major declared (transfer students not included)

Business & management	23%
Agribusiness & agricultural production	25%
Engineering technology	26%
Protective services	35%
Letters	36%
Law	37%
Public administration and services	38%
Mass communication	39%
Education	41%
Parks, recreation, leisure & fitness	44%
Engineering	44%
Social sciences	44%
Renewable natural resources	45%
Health professions & related sciences	46%
Human sciences	46%
Visual & performing arts	46%
Foreign languages	47%
Agriculture sciences	48%
Area & ethnic studies	50%
Psychology	51%
Philosophy, religion, theology	55%
Computer & information sciences	57%
Mathematics	59%
Architecture & environmental design	60%
Physical sciences	68%
Life sciences	72%
Library & archival sciences	78%
Liberal/general studies	88%
Multi/interdisciplinary study	90%

As a result of the attribution by major rather than by transcript, the full-cost attribution method produces a cost for an engineering degree that is 85% above the average bachelor's degree, while the transcript cost is only 47% above the average. This is, in effect, because for every 100 engineering graduates, there are also 47 engineering majors who incurred some costs attributed to the degree but graduated in something else.

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15 These administrative placements were another serious limitation of the full-cost attribution methodology at the institutional program level, but were less important in the aggregated state-level results due to the relatively small numbers involved.

How does this impact the validity or usefulness of the method? If the only object of the study were to evaluate the cost of graduating engineering majors, this might be a reasonable result, while, in this case, the transcript method might understate the cost. Yet, if the object of the study were to evaluate the cost of graduating parks and recreation students, this approach would miss the mark. Parks and recreation degrees, which cost 84% of the average using the transcript method, are only 58% of the average using the full-cost method. The fact that so few parks and recreation graduates started out as such means that much of the cost of their courses, in the full cost approach, would have been attributed to other majors. Further, if we wanted more graduates, we would need more majors in all the high-attrition majors that ultimately feed into the program but whose costs would not appear in the analysis.

Cost of attrition

Another way to account for full cost would be to analyze the costs of degree completion and the costs of attrition separately. Retrospectively, the students in a given year (such as 2001-02 in this example) can be separated into those who eventually graduated, or were still enrolled, and those who did not. (In the State University System, more than 90% of students still enrolled after six years will eventually graduate, so the "still enrolled" group is likely to become part of the "graduated" group in the end.) The credit hours taken and costs incurred by each group can then be broken out separately:

Table 12

Percent of 2001-02 student credit hours and instructional costs incurred by State University System of Florida undergraduates

	Left and did not graduate from SUS by 2006-07	Graduated from SUS by 2006-07	Still enrolled but not graduated from SUS by 2006-07
Lower division undergrad credit hours	23.5%	69.1%	7.4%
Upper level credit hours	11.5%	86.4%	2.1%
Graduate credit hours	8.1%	90.2%	1.7%
All levels credit hours	16.8%	78.8%	4.4%
Costs	15.6%	80.4%	4.0%

The average IPEDS six-year graduation rate for SUS institutions is 58%, and the rate including intra-system transfers is 63%, so an initial estimate of the cost of attrition made by someone outside the system might be between 37% and 42%.

Students who do not graduate, however, take fewer credits over their shortened careers than those who do. In this case, 16.8% of all credits taken by undergraduates were taken by students who dropped out or transferred elsewhere. These credits also tended to be earned in the less expensive, lower-level courses and in lower-cost disciplines, so those 16.8% of the total credits accounted for only 15.6% of the direct and indirect instructional costs devoted to undergraduates that year.

Furthermore, some substantial fraction of that 15.6% will eventually end up as transfer credit elsewhere and should not be counted as a total loss, although the magnitude is hard to determine. In *Toolbox Revisited: Pathways to Degree Attainment,* Cliff Adelman describes the many different transfer patterns of students on their way to a bachelor's degree. Adelman estimates that 14% of students who start at four-year universities earn their degrees from a different four-year institution.[16] Coincidentally, 14% is also the proportion of the 2001-02 cohort of SUS students who left the system by 2006-07 in good academic standing (GPA>=2.0); another 14% left with grades below that level.

Summary of three approaches using State University System of Florida expenditure analysis

The differences in results among the three cost approaches used can be summarized, as shown in Table 13, by adjusting two of the three estimates for the increased cost of credits between the years used for analysis and the 2005-06 catalog cost estimate.

Table 13

Cost of a bachelor's degree for a first-time-in-college student: A comparison of results using three cost approaches

Unadjusted comparison	
Catalog cost—for 120 hours (2005-06)	$26,485
Transcript cost—(2003-04) for FTIC graduate (unadjusted)	$31,763
Full cost attribution—(2001-04) for FTIC graduate (unadjusted)	$37,757
Adjustment estimates	
Increase in average lower/upper undergrad credit hour cost from 2003-04 to 2005-06	6.0%
Increase in average lower/upper undergrad credit hour cost from 2001-04 to 2005-06	7.6%
Adjusted comparison	
Catalog cost—for 120 hours 2005-06	$26,485
Transcript cost—adjusted to 2005-06 cost per credit	$33,672
Full cost—adjusted to 2005-06 cost per credit	$40,645

4. Regression using IPEDS finance data

Even the most accurate accounting and student-credit based approach cannot fully resolve the issue of multiple products. Economists have used regression analysis to empirically estimate both economies of scale (i.e. to what extent are institutions that award large numbers of degrees more efficient than smaller institutions?) and economies of scope (i.e. are institutions with wider varieties of program offerings or more degree levels more efficient than more

[16] Adelman, C., *The Toolbox Revisited: Paths to Degree Completion from High School through College,* Washington, D.C.: U.S. Department of Education (2006).

narrowly focused institutions?), and have concluded that both types of economies do exist.[17] Such economies mean that the cost estimates generated by the three accounting approaches above may be valid within a system with the same size and structure as the State University System of Florida, but would be difficult to generalize to much larger, much smaller or to more or less specialized contexts.

A relatively simple regression analysis, using only award-level data from IPEDS—setting aside for the moment the hundreds of independent variables that would result from introducing program discipline—can be used as a reality check on the accounting methods presented. The results of such an analysis should be seen as suggestive of avenues of inquiry for specific types of degrees or institutions rather than definitive.

For this analysis, award-level data and instructional cost data for 2005-06 were taken from a database of IPEDS variables compiled by the Delta Project on Postsecondary Education Costs, Productivity and Accountability.[18] In this data set 504 public four year and higher institutions reported data separately (i.e., not as part of a system aggregate). Stepwise multiple regression was used to identify the degree award levels that were significantly associated with direct and attributed instructional costs. Attributed instructional costs include student services plus a share of academic support, institutional support, and plant operations costs proportional to the size of direct instruction expenditures relative to research and public service. A summary variable was created in the Delta project database to provide an estimate of the full instructional expenditure.

In this analysis, each type of degree award remained a statistically significant predictor of costs, while post-master's certificates were the only non-degree awards that were statistically significant. Among the statistically significant completions, doctoral degrees, bachelor's degrees and first professional degrees, in that order, had the strongest predictive value, while associate degrees, master's degrees, and post-master's certificates had a much smaller effect, in the aggregate, on full educational costs. *(The full results of the regression analysis are included in Appendix 2.)*

In the results shown in Table 14, each bachelor's degree is associated with $30,780 in direct and indirect instructional expenses, each doctoral degree with $451,781, and each first professional degree with $250,505. These are, in effect, "marginal costs," with baseline institutional funding the constant in the equation, starting at $22,374,688.

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[17] See, for example, "Economies of scale and scope in higher education: a case of comprehensive universities," *Economics of Education Review,* 18.2 (April 1999): 269-277, dx.doi.org/10.1016/S0272-7757(98)00035-1 (accessed November 25, 2008); Rajindar K. Koshal, Manjulika Koshal, "Multi-product total cost function for higher education: a case of bible colleges," *Economics of Education Review,* 20.3 (June 2001): 297-303, www.sciencedirect.com/science/journal/02727757 (accessed November 25, 2008).

[18] The data set includes 20 years of data and hundreds of reported and calculated variables in SPSS format, made available, along with a data dictionary, at The Delta Project on Postsecondary Education Costs, Productivity, and Accountability, www.deltacostproject.org/data/index.asp (accessed November 25, 2008).

Table 14

Results of regression analysis using 2005-06 educational costs and credentials awarded

Dependent variable	Independent variables remaining in stepwise regression	Unstandardized coefficients		Standardized coefficients	t	Sig.	Relative derived "cost" (bachelor's=1)
		B	Std. error	Beta			
Full educational costs with constant	(Constant)	$22,374,688	$3,327,589		6.72	0.000	
R-squared = .884	Doctoral degrees	$451,781	$37,605	0.38	12.01	0.000	14.7
	Bachelor's degrees	$30,780	$2,874	0.35	10.71	0.000	1.0
	First professional degrees	$250,505	$25,778	0.24	9.72	0.000	8.1
	Associate degrees	$33,818	$5,324	0.10	6.35	0.000	1.1
	Post-master's certificates	$257,166	$62,005	0.07	4.15	0.000	8.4
	Master's degrees	$16,673	$8,096	0.07	2.06	0.040	0.5

Doctoral-level awards here account statistically for a much higher proportion of costs when approached through a regression model than through a cost accounting model, perhaps because the presence of doctoral programs correlates with overall higher institutional expenditures at all instructional levels. Faculty at research-extensive universities are paid more, not only when engaged in graduate education, but also when teaching undergraduates. The discipline mix of institutions with more graduate programs may also be systematically different—and more expensive.

From a policy point of view, there is usually no legal or fiscal connection made between funding and degrees awarded. From a statistical point of view, however, the correlation is remarkably strong. The number of degrees and other credentials that institutions award explains 88% of the variation in direct and indirect instructional costs. In the most theoretically strict "pay-for-performance" system, in which institutions are funded based only on the number of degrees, that correlation would be 100%. But it is perhaps surprising how close the nation's public higher education system already is to that theoretical maximum. In most cases, students, institutions and states all want to see that degree completed.

The regression yields very high multiples of doctoral degree costs to bachelor's degree costs: 14.7 to 1 for direct and indirect instructional expenditures. This is a considerably higher multiple than any of the internal methods explored in Florida. Some of the difference may stem from the state's relatively low enrollments in high-cost doctoral programs in sciences, and relatively high enrollments in lower cost doctoral programs in education and psychology.

Overall, this model would predict total expenditures for Florida institutions of $3.066 billion, while the actual amount was $2.55 billion. If each degree awarded in Florida is converted to a multiple of the bachelor's degree using the coefficients derived from the equation, the "cost" per bachelor's degree is $25,142.

5. Student's cost of obtaining a bachelor's degree

The cost of offering or awarding a bachelor's degree from the institution's point of view has to be distinguished from the cost of obtaining a bachelor's degree from the student's point of view. For the student, another version of cost would come into play, one that has been the subject of more extensive public discussion and controversy than the kind of internal accounting exercise represented by a credit hour cost analysis. The recent reauthorization of the Higher Education Act, for example, focuses intensely on college costs incurred by students. Some of the best analysis of costs from the student's point of view is provided by the College Board.

The cost for a student of obtaining a degree, assuming (like the catalog approach) no detours or delays along the way, could be summarized using the national average data from the College Board in Table 15.

Although the College Board's figure for published tuition and fees for public four-year institutions was $6,185 for 2007-08, that was offset by an average of $3,605 in financial aid grants and scholarships that did not have to be repaid and did not require students to work, yielding a net tuition and fee figure of $2,580. The other figures are estimates for the typical college student budget. However, using the full tuition and fee amount of $6,185—on the theory that someone is paying the cost—the four-year student cost for a degree would be $69,344.

While parents and students often look at the total price tag of college—including room, board, books, and transportation as well as tuition—economists tend not to include cost of living expenses as part of the "cost" of education. There is a cost to providing food, shelter, health care, clothing, etc., to an eighteen-year old, whether or not enrolled in college. Instead, economists attempt to account for the opportunity costs of college—the foregone wages that would have been earned if a student had worked instead of enrolling.[19]

It is not reasonable to assume, as some opportunity cost analyses do, that college students have no wages at all. Based on data from the Florida Education and Training Placement Information Program (FETPIP), 2006-07 public high school graduates in Florida who did not continue their education the following fall earned an average of $2,868 in the last quarter of 2007, or $11,472 on an annual basis. High school graduates enrolled in the State University System earned $1,459 in the fourth quarter, annualized to $5,836. The estimated net annual opportunity cost, therefore, is the difference between $11,472 and $5,836, which is $5,636. That number could be adjusted upward for inflation, and may be slightly higher or lower nationally—Florida has lower average wages overall but perhaps better-than-average service industry opportunities for eighteen-year-olds. It is an adequate number, however, for purposes of illustration in Table 16.

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[19] See, for example, Sandy Baum and Jennifer Ma, *Education Pays: The Benefits of Higher Education for Individuals and Society,* (2007): 9-11, The College Board: Washington, D.C., www.collegeboard.com/prod_downloads/about/news_info/trends/ed_pays_2007.pdf (accessed November 25, 2008). Also see William A. McEachem, *Macroeconomics: a Contemporary Introduction,* 7th Edition, p. 28, (Thomson South-Western, 2005).

Table 15

Student cost of obtaining a four-year degree: out of pocket[20]

	Annual amount		Total
Net tuition and fees	$2,580		
Books and supplies	$988		
Room and board	$7,404		
Transportation	$911		
Other expenses	$1,848		
Total	$13,731	x 4 =	$54,924

Table 16

Student cost of obtaining a four-year degree: Net economic cost

	Annual amount		Total
Net tuition and fees	$2,580		
Books and supplies	$988		
Estimated wages lost while enrolled	$5,636		
Total	$9,204	x 4 =	$36,816

The total of $36,816 represents an estimate of students' net economic loss from attending public university for the standard four years required for a bachelor's degree—the tuition, fees, books and supplies they wouldn't have had to pay for and the additional wages they might have earned over four years. It is a loss that, as Baum and Ma illustrate in Education Pays, is quickly paid off by the increased wages of college graduates.[21]

Neither of these variations accounts for the state subsidy, just as the analysis of instructional costs from the offering institutions' point of view does not take into account students' lost wages or the cost of room and board.

Conclusion

With or without a detailed expenditure analysis, the question of degree costs is reasonable and should be taken seriously. It is also one that can be answered, though the answer will vary depending on the policy motivation and context for the question. Depending on how the question is framed, the direct and indirect cost of providing instruction for the average bachelor's degree at a public college or university is between $25,000 and $40,000, from a mix of public

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20 College Board, Trends in College Pricing 2007-2008. The amount for net tuition and fees is from page 17, while the other amounts are from the typical student budget on page 7. The gross tuition and fees figure on page 7 overstates what students, on average, actually have to pay out of pocket. www.collegeboard.com/prod_downloads/about/news_info/trends/trends_pricing_07.pdf.

21 Baum and Ma, Education Pays, p. 11.

subsidies and student tuition. Where it falls in the range depends on how the question is framed. No matter how the question is addressed, however, there will be wide variations around the average depending on the student's major and the institution attended. For a student, by contrast, the average cost of obtaining a degree from a public institution will fall between $35,000 and $70,000, depending again on which costs are included.

As cost and productivity issues continue to rise on the public agenda—both nationally with the reauthorization of the Higher Education Act and at the state level—policymakers should be sensitive to the challenges inherent in analyzing the costs of an enterprise as complex as American higher education while academics must recognize the legitimacy of their desire to do so. A shared vocabulary and framework for cost analysis may not resolve the issue, but can help to make the ongoing conversation more coherent and useful.

Appendix 1: Detailed tables

Table A-1

State University System of Florida direct and indirect instructional expenditures per credit hour (upper-division undergraduate)

	2001-2002	2002-2003	2003-2004	2004-2005	2005-2006	2006-2007
FAMU	$352	$357	$348	$356	$364	$408
FAU	$268	$282	$275	$296	$297	$319
FGCU	$370	$337	$319	$352	$356	$364
FIU	$208	$220	$222	$224	$247	$259
FSU	$232	$237	$224	$231	$239	$249
NCF	$399	$430	$498	$554	$548	$677
UCF	$199	$212	$207	$232	$226	$240
UF	$225	$231	$241	$253	$252	$273
UNF	$229	$238	$236	$243	$255	$267
USF	$237	$236	$232	$220	$233	$241
UWF	$283	$293	$314	$335	$354	$357
Total	$237	$244	$243	$253	$259	$275

Table A-2

State University System of Florida direct and indirect instructional expenditures per credit hour by discipline (upper division undergraduate)

	2001-2002	2002-2003	2003-2004	2004-2005	2005-2006	2006-2007
Agribusiness & agric. production	$406	$376	$416	$423	$398	$397
Architecture & environmental design	$366	$348	$355	$325	$392	$410
Area & ethnic studies	$229	$218	$249	$293	$374	$378
Business and management	$170	$178	$181	$190	$201	$214
Communications technologies	$387	$318	$366	$336	$392	$400
Computer & information science	$222	$269	$323	$343	$370	$364
Education	$259	$264	$260	$259	$248	$256
Engineering	$414	$415	$404	$421	$400	$437
Engineering technology	$304	$298	$288	$276	$307	$342
English lang/literature/letters	$202	$217	$217	$229	$236	$250
Family/consumer sci/hum sci	$195	$186	$166	$158	$148	$159
Foreign languages	$225	$235	$222	$233	$237	$263
Health professions & rel. sci.	$302	$295	$284	$314	$285	$313
History	—	—	$224	$235	$238	$239
Law	$198	$165	$151	$169	$205	$201
Liberal/general studies	$337	$345	$377	$378	$401	$440
Library & archival sciences	$229	$238	$180	$186	$226	$187
Life sciences	$270	$296	$265	$276	$309	$302
Mass communications	$193	$190	$192	$218	$249	$247
Mathematics and statistics	$211	$228	$269	$292	$242	$313
Multi/interdisciplinary study	$334	$295	$273	$263	$312	$322
Natural resources/conservation	$379	$398	$346	$435	$490	$509
Parks/recreation/leisure/fitness	$132	$143	$161	$193	$180	$187
Philosophy/religious studies	$205	$203	$213	$231	$232	$272
Physical sciences	$400	$419	$432	$424	$435	$474
Psychology	$198	$206	$195	$195	$210	$214
Public admin. & services	$258	$260	$237	$271	$281	$301
Security/protective services	$150	$156	$146	$150	$178	$180
Social sciences	$214	$215	$204	$202	$215	$232
Visual and performing arts	$348	$382	$361	$369	$363	$390
Total	$237	$244	$243	$253	$259	$275

Table A-3

Example of a single State University System of Florida institution's direct and indirect instructional expenditures per credit hour (upper-division undergraduate)

	2001-2002	2002-2003	2003-2004	2004-2005	2005-2006	2006-2007
Area & ethnic studies	$304	$124	$397	$334	$263	$198
Business and management	$327	$305	$279	$299	$331	$350
Computer & information science	$1,015	$922	$1,076	$920	$1,285	$1,047
Education	$328	$282	$346	$388	$304	$320
English lang/literature/ltrs	$315	$310	$282	$308	$335	$291
Foreign languages	$991	$1,111	$1,069	$1,466	$895	$1,303
Health professions & rel. sci.	$566	$457	$397	$450	$407	$430
History	—	—	$353	$357	$411	$435
Law	$725	$367	$253	$289	$273	$249
Liberal/general studies	—	—	—	$315	$405	$445
Life sciences	$412	$312	$347	$431	$494	$504
Mathematics and statistics	$602	$764	$571	$1,160	$1,277	$754
Multi/interdisciplinary study	$299	$258	$236	$258	$246	$258
Natural resources/conservation	$628	$688	$514	$685	$781	$808
Philosophy/religious studies	$239	$266	$206	$247	$264	$315
Physical sciences	$0	$803	$740	$967	$688	$993
Psychology	$397	$369	$332	$287	$355	$325
Public admin & services	$342	$288	$319	$542	$476	$569
Security/protective services	$258	$281	$258	$273	$333	$266
Social sciences	$396	$397	$449	$509	$595	$528
Visual and performing arts	$435	$451	$423	$533	$754	$961

Table A-4

Catalog requirements for Mechanical Engineering, University of Illinois at Urbana Champaign[22]

	Lower div. requirements	Upper div. requirements	Total required
Chemistry	8		8
Math (math and statistics requirements)	14	6	20
Physics	12		12
Computer science	3		3
Engineering	15	46	61
Economics (half of humanities and social sciences requirement)	9		9
Letters (half of 18-credit social sciences and humanities requirement plus 4-credit rhetoric requirement)	13		13
General electives (all discipline average)	6		6
Total	80	52	132

[22] Program description for Mechanical Science and Engineering, University of Illinois at Urbana-Champaign, (2008-2009), courses.UIUC.edu/cis/programs/urbana/2008/fall/undergrad/engin/mech_engin.html (accessed November 25, 2008).

Table A-5

Full cost per credit hour (2006-07), Illinois Board of Higher Education cost study

	UIUC	Statewide	UIUC	Statewide
Chemistry	$198	$201		
Math (math and statistics requirements)	$209	$193	$302	$277
Physics	$280	$266		
Computer science	$197	$264		
Engineering	$383	$400	$548	$513
Economics (half of humanities and social sciences requirement)	$137	$173		
Letters (half of 18-credit social sciences and humanities requirement plus 4-credit rhetoric requirement)	$176	$204		
General electives (all discipline average)	$213	$212		

Table A-6

Cost of Engineering Program requirements using the UIUC cost per credit

	Lower	Upper	Total
Chemistry	$1,581		
Math (math and statistics requirements)	$2,931	$1,815	
Physics	$3,355		
Computer science	$592		
Engineering	$5,744	$25,203	
Economics (half of humanities and social sciences requirement)	$1,234		
Letters (half of 18-credit social sciences and humanities requirement plus 4-credit rhetoric requirement)	$2,286		
General electives (all discipline average)	$1,279		
Total	$19,002	$27,018	$46,021

Table A-7

Cost of Mechanical Engineering degree requirements using the Illinois statewide cost per credit

	Lower	Upper	Total
Chemistry	$1,607		
Math (math and statistics requirements)	$2,704	$1,663	
Physics	$3,193		
Computer science	$793		
Engineering	$6,005	$23,589	
Economics (half of humanities and social sciences requirement)	$1,559		
Letters (half of 18-credit social sciences and humanities requirement plus 4-credit rhetoric requirement)	$2,652		
General electives (all discipline average)	$1,270		
Total	$19,783	$25,253	$45,035

Appendix 2:
SPSS scripts and output for stepwise regression analysis

```
USE ALL.
COMPUTE filter_$=(AcademicYear=2006 and IsGrouped=0 and sector=1).
VARIABLE LABEL filter_$'AcademicYear=2006 and IsGrouped=0 and sector=1 (FILTER)'.
VALUE LABELS filter_$ 0 'Not Selected' 1 'Selected'.
FORMAT filter_$(f1.0).
FILTER BY filter_$.
EXECUTE .
REGRESSION
/MISSING LISTWISE
/STATISTICS COEFF OUTS R ANOVA
/CRITERIA=PIN(.05) POUT(.10)
/NOORIGIN
/DEPENDENT fulledcost
/METHOD=STEPWISE associatedegrees bachelordegrees masterdegrees
doctordegrees firstprofdegrees awardslessthan1yr awards1yrto2yr
awards2yrto4yr postbacccertificates postmastcertificates
firstprofcertificates .
```

Regression notes

Output created		30-AUG-2008 23:59:58
Comments		
Input	Data	C:\Documents and Settings ate.johnson\Desktop\Delta Project Materials\delta truncated database.sav
	Active dataset	DataSet1
	Filter	IsGrouped = 0 and sector=1 and AcademicYear = 2006 (FILTER)
	Weight	<none>
	Split file	<none>
	N of rows in working data file	504
Missing value handling	Definition of missing	User-defined missing values are treated as missing.
	Cases used	Statistics are based on cases with no missing values for any variable used.
Syntax		REGRESSION /MISSING LISTWISE /STATISTICS COEFF OUTS R ANOVA /CRITERIA=PIN(.05) POUT(.10) /NOORIGIN /DEPENDENT fulledcost /METHOD=STEPWISE associatedegrees bachelordegrees masterdegrees doctordegrees firstprofdegrees awardslessthan1yr awards1yrto2yr awards2yrto4yr postbacccertificates postmastcertificates firstprofcertificates .

Variables entered/removed*

Model	Variables entered Number of degrees, certificates	Variables removed	Method
1	Doctoral degrees	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
2	Bachelor's degrees	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
3	First professional degrees	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
4	Associate degrees	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
5	Post-master's certificates	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
6	Master's degrees	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

*Dependent variable: Full educational costs

Model summary

Model	R	R square	Adjusted R square	Std. error of estimate
1	.892(a)	.795	.795	64105487.56140
2	.918(b)	.842	.842	56302677.88338
3	.932(c)	.869	.868	51316111.34112
4	.937(d)	.878	.877	49664525.03071
5	.940(e)	.883	.882	48672339.67941
6	.940(f)	.884	.882	48514380.78693

Predictors: (Constant), Number of

a. Doctoral degrees

b. Doctoral degrees, bachelor's degrees

c. Doctoral degrees, bachelor's degrees, first professional degrees

d. Doctoral degrees, bachelor's degrees, first professional degrees, associate degrees

e. Doctoral degrees, bachelor's degrees, first professional degrees, associate degrees, post-master's certificates

f . Doctoral degrees, bachelor's degrees, first professional degrees, associate degrees, post-master's certificates, master's degrees

ANOVA (Dependent variable: Full educational costs)

Model		Sum of squares	df	Mean square	F	Sig.
1	Regression	7985754003247210000.000	1	7985754003247210000.000	1943.236	.000(a)
	Residual	2058866281278201000.000	501	4109513535485432.000		
	Total	10044620284525410000.000	502			
2	Regression	8459624516105530000.000	2	4229812258052767000.000	1334.329	.000(b)
	Residual	1584995768419877000.000	500	3169991536839755.000		
	Total	10044620284525410000.000	502			
3	Regression	8730581986221300000.000	3	2910193995407103000.000	1105.133	.000(c)
	Residual	1314038298304103000.000	499	2633343283174557.000		
	Total	10044620284525410000.000	502			
4	Regression	8816270891355540000.000	4	2204067722838885000.000	893.578	.000(d)
	Residual	1228349393169871000.000	498	2466565046525846.000		
	Total	10044620284525410000.000	502			
5	Regression	8867228949541110000.000	5	1773445789908223000.000	748.606	.000(e)
	Residual	1177391334984295000.000	497	2368996649867798.000		
	Total	10044620284525410000.000	502			
6	Regression	8877212293528310000.000	6	1479535382254719000.000	628.614	.000(f)
	Residual	1167407990997098000.000	496	2353645143139310.000		
	Total	10044620284525410000.000	502			

Predictors: (Constant), Number of:

a. Doctoral degrees

b. Doctoral degrees, bachelor's degrees

c. Doctoral degrees, bachelor's degrees, first professional degrees

d. Doctoral degrees, bachelor's degrees, first professional degrees, associate degrees

e. Doctoral degrees, bachelor's degrees, first professional degrees, associate degrees, post-master's certificates

f. Doctoral degrees, bachelor's degrees, first professional degrees, associate degrees, post-master's certificates, master's degrees

Coefficients (Dependent variable: Full educational costs)

		Unstandardized coefficients		Standardized coefficients	t	Sig.
Model	Degrees, certificates	B	Std. error	Beta	B	Std. error
1	(Constant)	66569398.743	3071440.741		21.674	.000
	Doctoral degrees	1057010.200	23978.191	.892	44.082	.000
2	(Constant)	37834836.688	3577765.646		10.575	.000
	Doctoral degrees	755180.619	32448.952	.637	23.273	.000
	Bachelor's degrees	29062.025	2376.978	.335	12.226	.000
3	(Constant)	30239817.791	3345749.351		9.038	.000
	Doctoral degrees	494528.080	39178.646	.417	12.622	.000
	Bachelor's degrees	33244.303	2205.340	.383	15.074	.000
	First professional degrees	261945.691	25823.460	.248	10.144	.000
4	(Constant)	24659664.814	3373632.713		7.310	.000
	Doctoral degrees	480982.512	37987.280	.406	12.662	.000
	Bachelor's degrees	34792.379	2150.461	.401	16.179	.000
	First professional degrees	267150.936	25007.942	.253	10.683	.000
	Associate degrees	32037.665	5435.567	.093	5.894	.000
5	(Constant)	22552862.265	3337295.050		6.758	.000
	Doctoral degrees	452687.577	37724.947	.382	12.000	.000
	Bachelor's degrees	34817.924	2107.507	.401	16.521	.000
	First professional degrees	267454.328	24508.427	.253	10.913	.000
	Associate degrees	33173.459	5332.603	.097	6.221	.000
	Post-master's certificates	282691.150	60952.006	.075	4.638	.000
6	(Constant)	22374687.826	3327589.136		6.724	.000
	Doctoral degrees	451781.030	37605.093	.381	12.014	.000
	Bachelor's degrees	30779.584	2873.600	.354	10.711	.000
	First professional degrees	250505.028	25777.871	.237	9.718	.000
	Associate degrees	33817.832	5324.497	.098	6.351	.000
	Post-master's certificates	257166.164	62005.434	.068	4.147	.000
	Master's degrees	16673.073	8095.583	.067	2.060	.040

Excluded variables (Dependent variable: Full educational costs)

						Tolerance
Model	Degrees, awards	Beta in	t	Sig.	Partial correlation	Collinearity statistics
1	Associate degrees	.060(a)	3.008	.003	.133	.996
	Bachelor's degrees	.335(a)	12.226	.000	.480	.421
	Master's degrees	.313(a)	11.513	.000	.458	.437
	First professional degrees	.179(a)	6.187	.000	.267	.454
	Awards less than 1 year	.056(a)	2.773	.006	.123	.999
	Awards of 1-2 years	.048(a)	2.371	.018	.105	.999
	Awards of 2-4 years	.029(a)	1.412	.159	.063	1.000
	Post-baccalaureate certificates	.028(a)	1.365	.173	.061	.984
	Post-master's certificates	.071(a)	3.369	.001	.149	.901
	First professional certificates	.006(a)	.283	.778	.013	.922
2	Associate degrees	.087(b)	4.984	.000	.218	.982
	Master's degrees	.175(b)	5.108	.000	.223	.257
	First professional degrees	.248(b)	10.144	.000	.413	.438
	Awards less than 1 year	.078(b)	4.423	.000	.194	.989
	Awards of 1-2 years	.074(b)	4.188	.000	.184	.986
	Awards of 2-4 years	.025(b)	1.436	.152	.064	.999
	Post-baccalaureate certificates	.001(b)	.081	.936	.004	.970
	Post-master's certificates	.070(b)	3.807	.000	.168	.901
	First professional certificates	.040(b)	2.167	.031	.097	.902
3	Associate degrees	.093(c)	5.894	.000	.255	.981
	Master's degrees	.081(c)	2.411	.016	.107	.232
	Awards less than 1 year	.081(c)	5.126	.000	.224	.989
	Awards of 1-2 years	.072(c)	4.469	.000	.196	.985
	Awards of 2-4 years	.033(c)	2.022	.044	.090	.998
	Post-baccalaureate certificates	.000(c)	-.004	.997	.000	.970
	Post-master's certificates	.070(c)	4.201	.000	.185	.901
	First professional certificates	.017(c)	1.009	.314	.045	.885
4	Master's degrees	.094(d)	2.901	.004	.129	.231
	Awards less than 1 year	.030(d)	1.328	.185	.059	.475
	Awards of 1-2 years	.024(d)	1.225	.221	.055	.627
	Awards of 2-4 years	.028(d)	1.772	.077	.079	.995
	Post-baccalaureate certificates	.003(d)	.200	.842	.009	.969
	Post-master's certificates	.075(d)	4.638	.000	.204	.899
	First professional certificates	.018(d)	1.088	.277	.049	.885
5	Master's degrees	.067(e)	2.060	.040	.092	.222
	Awards less than 1 year	.029(e)	1.295	.196	.058	.475
	Awards of 1-2 years	.024(e)	1.263	.207	.057	.627
	Awards of 2-4 years	.030(e)	1.944	.052	.087	.994
	Post-baccalaureate certificates	.007(e)	.455	.650	.020	.966
	First professional certificates	.028(e)	1.695	.091	.076	.872
6	Awards less than 1 year	.026(f)	1.166	.244	.052	.473
	Awards of 1-2 years	.024(f)	1.263	.207	.057	.627
	Awards of 2-4 years	.026(f)	1.654	.099	.074	.971
	Post-baccalaureate certificates	-.002(f)	-.146	.884	-.007	.885
	First professional certificates	.025(f)	1.540	.124	.069	.866

Predictors in the model: (Constant) Number of:

a. Doctoral degrees

b. Doctoral degrees, bachelor's degrees

c. Doctoral degrees, bachelor's degrees, first professional degrees

d. Doctoral degrees, bachelor's degrees, first professional degrees, associate degrees

e. Doctoral degrees, bachelor's degrees, first professional degrees, associate degrees, post-master's certificates

f. Doctoral degrees, bachelor's degrees, first professional degrees, associate degrees, post-master's certificates, master's degrees

Summary of alternative regression results using different dependent variables with and without constant for degrees and certificates

Dependent variable	Independent variables remaining in stepwise regression	Unstandardized coefficients		Standardized coefficients	t	Sig.	Relative derived "cost" (bachelor's =1)
	Full educational costs with constant						
		B	Std. error	Beta			
R-squared = .884	(Constant)	$22,374,688	$3,327,589		6.72	0.000	
	Doctoral degrees	$451,781	$37,605	0.38	12.01	0.000	14.7
	Bachelor's degrees	$30,780	$2,874	0.35	10.71	0.000	1.0
	First professional degrees	$250,505	$25,778	0.24	9.72	0.000	8.1
	Associate degrees	$33,818	$5,324	0.10	6.35	0.000	1.1
	Post-master's certificates	$257,166	$62,005	0.07	4.15	0.000	8.4
	Master's degrees	$16,673	$8,096	0.07	2.06	0.040	0.5
	Full educational costs without constant						
		B	Std. error	Beta			
	Bachelor's degrees	$44,408	$1,642	0.53	27.04	0.000	1.0
	First professional degrees	$298,381	$25,063	0.23	11.91	0.000	6.7
	Doctoral degrees	$340,423	$36,291	0.24	9.38	0.000	7.7
	Associate degrees	$42,476	$5,314	0.10	7.99	0.000	1.0
	Post-master's certificates	$355,988	$63,015	0.08	5.65	0.000	8.0
	Awards of 2-4 years	$257,613	$113,556	0.03	2.27	0.024	5.8
	First professional certificates	$582,189	$294,176	0.03	1.98	0.048	13.1
	Direct instruction expenditures with constant						
		B	Std. error	Beta			
R-squared = .898	(Constant)	$10,365,008	$2,144,905		4.83	0.000	
	Doctoral degrees	$387,200	$24,250	0.47	15.97	0.000	20.7
	First professional degrees	$182,279	$15,750	0.25	11.57	0.000	9.7
	Bachelor's degrees	$18,713	$1,355	0.31	13.81	0.000	1.0
	Associate degrees	$16,795	$3,428	0.07	4.90	0.000	0.9
	Post-master's certificates	$178,855	$39,172	0.07	4.57	0.000	9.6
	Direct instructional expenditures without constant						
		B	Std. error	Beta			
	Doctoral degrees	$342,860	$22,676	0.37	15.12	0.000	14.9
	Bachelor's degrees	$22,998	$1,028	0.42	22.36	0.000	1.0
	First professional degrees	$196,769	$15,664	0.24	12.56	0.000	8.6
	Associate degrees	$15,183	$4,315	0.05	3.52	0.000	0.7
	Post-master's certificates	$203,589	$39,500	0.07	5.15	0.000	8.9
	Awards of 1-2 years	$84,299	$36,420	0.04	2.31	0.021	3.7

Dependent variable	Independent variables remaining in stepwise regression	Unstandardized coefficients		Standardized coefficients	t	Sig.	Relative derived “cost” (bachelor’s =1)
	Gross tuition, state, federal, and local appropriations with constant						
		B	Std. error	Beta			
R-squared = .918	(Constant)	$20,060,541	$3,312,929		6.06	0.000	
	Doctoral degrees	$578,806	$37,714	0.41	15.35	0.000	13.7
	Bachelor’s degrees	$42,221	$2,844	0.41	14.85	0.000	1.0
	First professional degrees	$212,306	$25,630	0.17	8.28	0.000	5.0
	Associate degrees	$22,829	$6,606	0.06	3.46	0.001	0.5
	Master’s degrees	$16,597	$7,921	0.06	2.10	0.037	0.4
	First professional certificates	$779,347	$281,628	0.04	2.77	0.006	18.5
	Awards of 1-2 years	$122,687	$55,285	0.04	2.22	0.027	2.9
	Post-master’s certificates	$131,671	$61,939	0.03	2.13	0.034	3.1
	Gross tuition, state, federal, and local appropriations without constant						
		B	Std. error	Beta			
	Bachelor’s degrees	$50,316	$2,598	0.52	19.36	0.000	1.0
	Doctoral degrees	$487,874	$35,817	0.29	13.62	0.000	9.7
	First professional degrees	$241,138	$26,074	0.16	9.25	0.000	4.8
	Associate degrees	$29,328	$6,748	0.06	4.35	0.000	0.6
	Post-master’s certificates	$181,221	$63,565	0.03	2.85	0.005	3.6
	First professional certificates	$879,537	$291,074	0.03	3.02	0.003	17.5
	Awards of 1-2 years	$158,121	$56,917	0.04	2.78	0.006	3.1
	Master’s degrees	$18,171	$8,196	0.06	2.22	0.027	0.4

DELTA PROJECT
on Postsecondary Education Costs,
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MAKING
OPPORTUNITY
AFFORDABLE

INVESTING IN COLLEGE ACCESS AND SUCCESS