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Full-cost models in higher education have long failed to account correctly for capital and financial aid expenditures. This chapter argues for a full accounting of all cost drivers that have an impact on expenditures in higher education.

A Guide to Measuring College Costs

Gordon C. Winston

In principle, measuring the average cost of providing a year of undergraduate education at a school is simple: add up its total undergraduate educational costs and divide by the number of undergraduates. But, in fact, several issues of concept and data make it anything but simple. Three things cause major problems: (1) the costs of using buildings, equipment, and land are both large (25 to 40 percent of total cost) and badly reported in college accounts; (2) it is not at all clear whether financial aid grants are a cost of education or a simple price discount (Bowen and Breneman, 1993; Rothschild and White, 1995; Winston, 1986); and (3) because colleges and especially universities do other things than educate undergraduates, major questions of cost allocation and joint costs have to be worked through to get to undergraduate costs. The capital cost and financial aid problems exist for all schools, whereas cost allocation is more a problem for complicated universities than for simple liberal arts colleges—in fact, Williams and Swarthmore and Carleton don't seem to have that problem at all.

The purpose of this chapter is to describe what has been learned in doing a fair amount of college cost estimation, both for individual schools from their own financial records and for the whole of higher education using U.S. Department of Education data from the Integrated Post Secondary Education Database (IPEDS) Finance Survey. Those estimates have both generated educational costs per se and provided a major raw material for the estimation of student subsidies. Many of the issues discussed here have been treated in greater detail in several discussion papers, and some subsequent publications, produced by the Williams Project on the Economics of Higher

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Education (see Winston, 1992, 1993a, 1993b, 1993c, 1994, 1996; Lewis and Winston, 1997; Winston and Yen, 1995).

Conceptually, it is surprisingly complicated to compute these costs, especially for those well trained in college fund accounting who find themselves confronted with a new and unfamiliar mental model. To sort the issues out, I had to go back to first principles and the economists of the 1930s and 1950s who were working carefully through the fundamentals of economic information (accounting) for for-profit firms—to Sir John Hicks (1939) and Henry Simons and Trgve Havaalmo and others—and merge that knowledge with the insights of recent students of nonprofit firms such as Henry Hansmann (1986). And my earlier incarnation as a capital theorist, during which I fretted about the way we understand the role of physical capital in for-profit production, proved unexpectedly helpful.

There are two kinds of problems in calculating college costs—understanding a conceptual framework that is different from both the familiar accounting in for-profit firms and the fund accounting that is only now being abandoned in nonprofits and, more pragmatically, finding the numbers that can actually be used to measure costs. People who have tried to generate reliable figures have found an audience whose conceptual hangups create serious barriers to accepting their figures, especially those describing the costs of the services of buildings and equipment and land, of physical capital. As is so often the case in the economics of higher education, what is sensible to even well-informed people can be dead wrong, whereas what is accurate is counterintuitive. So it may be most helpful to the presentation of my argument if I first briefly lay out the ideas that inform the methodology and then the procedures for getting the numbers. As regards those ideas, I shall try to suggest a way to describe the issues that might help skeptics appreciate why an unfamiliar framing is necessary to calculate college costs. And I include Table 3.1, the Statements of Activities page from Williams College's 1996 *Financial Report,* and Table 3.2, a spreadsheet that uses those numbers to generate the appropriate per-student costs, to make the issues more concrete.

Current operating costs obviously capture much of what is relevant, so I shall start there. In even the simplest school, however, they have to be adjusted by removing costs that are irrelevant to education. Some such costs are clear cut, but some are not. It is necessary to decide whether so-called financial aid costs are relevant or not—whether they are really costs of educational production, as in our accounting conventions, or, as is increasingly popular, simply price discounts that have nothing to do with real educational production. Then there are the entries that capture bits and pieces of the costs of using capital—interest payments and depreciation—but do it so partially and inconsistently that it is best to replace them with coherent and consistent estimates of the current cost of using buildings and equipment and land. Though this will become a bit more complicated under the new accounting standards of the Financial Accounting Standards Board

(FASB 117), as noted later, it will still have to be done. Furthermore, some costs are typically included in operating costs—under operations and maintenance—that are legitimate educational costs, but they describe capital investment for the future rather than current costs for the present year. Then there are the complicated issues of how much of these total costs should be allocated to undergraduate education and how much to other activities and, finally, how many full time–equivalent (FTE) undergraduates there are in a school with a significant part-time enrollment.

Operating Costs

Three modifications are needed to adjust the total operating expenses line in Table 3.1. First, some entries need to be subtracted either because they are irrelevant to undergraduate education (life income payments, for instance) or because they are to be replaced by more careful calculations (depreciation and interest on indebtedness). Second, scholarships and fellowships raise the question of whether they are costs of education or a price discount. Third, reported costs of operation and maintenance of plant usually reflect some spending that is strictly an operating cost along with some that are, instead, a capital investment.

Irrelevant Expenditures and Those to Be Calculated More Carefully. Life income payments, as noted, have little to do with the current costs of producing education, however much they may serve its future financing. Similarly, interest on indebtedness is a matter of financial management (and a complicated and interesting one involving arbitrage income for wealthy institutions). To the extent that such interest charges represent part of the real cost of funds, or opportunity cost of physical capital that is a legitimate current cost of production, they are captured in the more systematic estimates of those capital service costs described later. Therefore, their partial reporting is eliminated from current costs to replace it with the complete estimate of capital costs described in the next section.

Scholarships and Fellowships. If a school uses financial aid grants to increase student demand and fill seats and beds, they are clearly a price discount and should be eliminated from costs and subtracted from gross tuition and fee revenue to reflect what the school actually earns in tuition and fees. Financial aid is not a cost. This is contrary, of course, to what college accounting does, which is to charge all students the full sticker price and then, in effect, hand some of them money with which to pay all or part of that charge. A car dealer, in contrast, sensibly recognizes as sales revenues only what he actually gets from his customers as sales revenues, after—that is, net of—any price-shading.

But for some schools, however, it is not that simple. Rothschild and White (1995) and Winston (1996) have recently argued that quality higher education operates in an environment where peer effects contribute importantly to a student's education: good students educate good students. In

Table 3.1. Williams College Statements of Activities for the Year Ended June 30, 1996

	Unrestricted ($)	*Temporarily Restricted ($)*	*Permanently Restricted ($)*	*Total ($)*
Operating revenue, gains and other				
Student tuition and fees	41,042,563			41,042,563
Sales and services of educational departments	1,489,249			1,489,249
Auxiliary enterprises	15,196,359			15,196,359
Special-purpose grants expended	975,287			975,287
Gifts and grants	9,632,606	5,611,832		15,244,438
Investment income	17,161,361	2,707,613		19,868,974
Realized gains spent	3,139,440	126,328		3,265,768
Interest on loans receivable	8,926			8,926
Other	822,929			822,929
Net assets released from restrictions	10,956,056	(10,956,056)		0
Total operating revenue, gains, and other	100,424,776	(2,510,283)		97,914,493
Operating expenses and other				
Instructional research	25,524,118			25,524,118
Academic support	3,970,229			3,970,229
Student services	6,979,599			6,979,599
Institutional support	12,870,573			12,870,573
Operation and maintenance of plant	6,891,072			6,891,072
Scholarships and fellowships	9,099,760			9,099,760
Auxiliary enterprises	13,059,803			13,059,803
Interest on indebtedness	1,826,303			1,826,303
Depreciation	8,409,626			8,409,626
Life income payments	2,238,097			2,238,097
Other	151,359			151,359
Total operating expenses and other	91,020,539			91,020,539
Change in net assets from operating activities	9,404,237	(2,510,283)		6,893,954

those schools, therefore, financial aid is much like faculty salaries in that it pays for student quality, which is an input to educational production. To the extent that this is true, financial aid payments are indistinguishable from any other payment to a productive input such as heating oil or administrative or faculty salaries. Thus, fellowships and scholarships should be counted as a cost of education.

Unfortunately, either assessment of the true financial nature of scholarships and fellowships can be right, depending on the role that financial aid plays in the functioning of the school—they can represent a pure price discount, or they can be payment for a factor of production. For the IPEDS

Table 3.1. (*continued*)

	Unrestricted ($)	*Temporarily Restricted* ($)	*Permanently Restricted* ($)	*Total* ($)
Nonoperating				
Realized and unrealized gains on investments	7,063,520	53,096,489	3,076,958	63,236,967
Other losses	(191,558)			(191,558)
Present value of future life income fund payments	0	(683,903)	(763,464)	(1,447,367)
Life income and endowment gifts	0	1,168,100	1,975,473	3,143,573
Gifts further designated	(40,448)	(54,568)	95,106	0
Provision for loan guarantee	(8,500,000)			8,500,000
Change in net assets from nonoperating activities	(1,668,486)	53,526,118	4,383,983	56,241,615
Total change in net assets prior to cumulative effect of accounting changes	7,735,751	51,015,835	4,383,983	63,135,569
Cumulative effect of change in accounting principles		888,765	23,888,781	24,777,543
Total change in net assets	7,735,751	51,904,600	28,272,764	87,913,115
Beginning net assets	168,518,696	237,432,107	163,652,080	569,602,883
Ending net assets	176,254,447	289,336,707	191,924,844	657,515,998

Note: The accompanying notes are an integral part of these financial statements.

Finance Survey, which covers all sorts of schools, I have assumed that financial aid more often than not represents a price discount, so I have always subtracted it from legitimate educational costs, and I think that is probably the right thing to do. But among selective schools with long queues of applicants, financial aid improves the average quality of their students through the power of peer effects. In this case it can be considered a legitimate cost that buys an important input to their production of education. Note that treating financial aid as a cost of production also implies that grant aid is a legitimate income payment to the financial aid student—that he or she *earns* the financial aid by providing the college with something it uses in its production, whether it is work in the dining hall, linebacker talents, or the supply of peer quality. Under these circumstances, all students actually *do* pay the sticker price, partly in cash and partly in kind.

When in doubt, I would suggest calling financial aid a price discount and not a legitimate production cost. My reasons are timidity and a desire for uniformity—most schools use aid as a price discount, and until the recognition of peer inputs catches on, taking the latter approach will be hard to defend. Also, it is probably wise to save persuasive energy for the much more important issues of adequately accounting capital service costs. (And

Table 3.2. William College's Costs, Prices, and Subsidies: 1995–96

	Total ($)	*Per Student ($) (N = 2,019)*
Operating expenses		
Instructional and research (see note below)	25,524,118	12,642
Academic support	3,970,299	1,966
Student services	6,979,599	3,457
Institutional support	12,870,573	6,375
Operation and maintenance	6,891,072	3,413
Auxiliary enterprises	13,059,803	6,468
Total operating expenses	69,295,464	34,322
Scholarships and fellowships	9,099,760	4,507
Total operating expenses with aid	78,395,224	38,829
Capital service costs		
Replacement value	400,000,000	198,118
Deferred maintenance	12,000,000	5,944
Net replacement value	388,000,000	192,174
Depreciation (2.5 percent) on replacement	10,000,000	4,953
Opportunity cost on net replacement value:		
At 8.5%	32,980,000	16,335
At 12%	46,560,000	23,061
Capital service costs		
At 8.5%	42,980,000	21,288
At 12%	56,560,000	28,014
Cost: Aid as a price discount		
At 8.5%	112,275,464	55,609
At 12%	125,855,464	62,336
Cost: Aid as an educational cost		
At 8.5%	121,375,224	60,117
At 12%	134,955,224	66,843
Price		
Tuition, fees, and auxiliary	56,238,922	27,855
Scholarships and fellowships	9,099,760	4,507
Net price		23,348
Subsidy: Aid as a price discount		
At 8.5% opportunity cost		32,262
At 12% opportunity cost		38,988

Notes: Operation and maintenance have no renovation and repair component. Both reported depreciation and interest are replaced by capital cost estimates. An adjustment should have been made for $1,050,000 of funded research—trivial for Williams but serious for most universities. With that correction and with replacement value of capital reduced proportionately, cost and student subsidy would have been reduced by $963 or 1.5% and 2.4%, respectively.

because it does not matter to the calculation of subsidies whether financial aid is or is not added to both sides of the difference that defines them, I am particularly tempted to avoid the squabble.) It is important, though, to be clear and explicit and to report the size of financial aid, if it is included as a cost, so that others can subtract it for comparability.

Operation and Maintenance

Operation and maintenance of plant is reported as a current expenditure, and much of it is. But in many schools—beside things such as heating oil, janitorial service, and building management—it includes significant renovation-and-repair spending that offsets real depreciation and serves, therefore, the same long-term role as new capital investment. That amount reflecting renovation and repair should be subtracted from the year's operating costs and added, instead, to the year's new capital investment.

By consulting with facilities managers who can estimate how much of reported operations-and-maintenance spending is a genuine yearly operating cost and how much of it is a durable investment, the latter can be eliminated from current costs and added to capital investment. But without that information, no serious error is likely to be introduced by counting all operation and maintenance as a current educational cost because it is usually small relative to other costs. (The larger error, which can accumulate over time, will be found in the accounting of physical capital wealth alluded to later.)

The Cost of Using Physical Capital

This is the worst issue—conceptually and practically—in the calculation of educational costs because it is huge, and neither for-profit nor nonprofit accounting prepares us (or the critics) for its careful incorporation. Indeed, under the rules of fund accounting, financial accounts often described colleges and universities as if they taught their classes and held their labs outdoors in borrowed vacant lots and with no equipment—no recognition of the role or the cost of buildings and land and equipment was required. The new standards of FASB 117 that apply to private colleges and universities move in the right direction but not far enough to make the problem a trivial one. The neglect of capital distorts calculated educational costs by 25 to 40 percent.

All sorts of things mess up our understanding of the costs of capital services in production: unlike labor or office supplies that are bought from outsiders at a price, the services of buildings, equipment, and land often come from capital stocks owned by the college itself; capital is durable, purchased at a considerable cost in one year for use over future years; inflation changes the value of a building without regard to its condition or use or the services it yields; capital wears out through use and the elements and obsolescence, so its value depreciates over time without regular maintenance spending to offset it; and resources—funds—that have been devoted to buying physical

capital are locked up and unavailable for a long time either for alternative uses or to earn a financial return. Finally, a careful accounting of capital costs and capital wealth is not necessary in the for-profit firms that dominate the economy because both returns to capital and returns to entrepreneurial risk taking are lumped together under what Economics 101 instructors take pains to call *accounting profits* and because a market in the firms themselves reflects the value of their physical assets.

Luckily, a lot of thoughtful attention was given to all this by earlier economists, even though little has made its way into college accounting conventions. However, that attention does give us a coherent basis for generating reasonable and consistent estimates of the costs of capital services in education. That they do not ring immediate and familiar bells makes it harder to gain acceptance for those estimates. (Or maybe it recommends some sensible vagueness as regards to what degree the costs of capital are estimates—see Carleton College, 1997.) They are, nonetheless, essential.

The value of the capital services used in production is unambiguously described by a *rental rate*—what a college would have to pay in a competitive market to use its buildings, land, and equipment for a year if they were owned by someone else. The components of the rental rate are (1) the current replacement value of the capital stock, (2) the real economic depreciation it suffers during the year, and (3) the opportunity cost of tying up resources in that form for the year. The rental rate, symbolically, is $P_kK(* + r)$, where P_kK is the current replacement value of K of capital stock, * is the yearly rate of depreciation, and r is the cost of funds, or opportunity cost, of tying up resources in the form of physical capital for the year.[1]

These three components of yearly capital costs can be estimated fairly reasonably and used to replace the partial accounting of capital costs reported in conventional financial statements (and IPEDS). So the procedure is (1) to eliminate from operating expenditures all reported values of depreciation and interest on indebtedness for buildings and (2) to replace them with a full yearly cost of capital services as a computed rental rate.

The Current Replacement Value of the Capital Stock

The major problem here, of course, is that accounting conventions report the value of a school's physical capital stock by adding together *historic* or *book values*—what each building or piece of land or equipment cost when it was originally purchased—with no attempt to account for changes in the prices of those things since then. The result is a jumble of costs of buildings and land and equipment, some reflecting prices prevailing in the 1890s, some from 1996, some from 1950, and so on. Every campus has its bizarre examples—at Williams a nice little faculty house with two bedrooms is carried on the books at $850 because that is what it cost to build early in the century. In book values, apples are added to oranges and flounder and new

tires. Interestingly, of the two dozen or so financial statements I have looked at recently, Harvard remains the only school to report the *replacement* value of its capital stock.

Estimating replacement values for capital stocks to use as a substitute for the reported book values is fairly straightforward for an individual school. (And as with so much else in college's treatment of the costs of using capital, the present use of historical book values is so bad that estimates of replacement values can be pretty crude and still represent a major improvement.) Facilities managers can tap insurance records for current replacement values of buildings and equipment, and estimates can be made for replacement value of land and improvements. Some campuses have obtained engineering appraisals of replacement values. Consensus estimates of current replacement costs will generate usable numbers if all else fails. Updating these figures after one year's careful estimates can be done by tracking the value of new investment and changes in the construction price index. In the IPEDS Finance Survey, replacement values are requested and most schools do report, but for some it was necessary to estimate them from book values or educational and general (E&G) spending (again, details are reported in the Appendix to Winston, 1995).

Depreciation. The idea that a capital stock is worn out by use, deteriorates through time, and loses value through obsolescence is not at all unusual, though the use of that fact as a vehicle for important tax advantages in business has pushed the measurement of depreciation pretty far away from its basic economic rationale. (Indeed, when I started out on all this ten years ago, I was told by a college comptroller that colleges did not have depreciation because they did not pay taxes.) But the FASB 117 accounting procedures take the important step of requiring colleges to estimate yearly depreciation and to include it as a cost of operation. The only problem remaining is that the *base* for that estimate is the highly understated book value of capital. Note that depreciation is intended to capture the actual decline in value during the year, absent maintenance spending, not the present value of anticipated possible future loss from events such as fires.

Depreciation is reflected in the rental rate as a yearly percentage of the replacement value of the capital stock. That rate can be developed from considerable detail, using different rates (useful life estimates) for different types of capital (see, for instance, Probasco, 1991), or it can be done more simply as an average over the aggregate of all of the school's capital. In both the individual school estimates shown in Tables 3.1 and 3.2 and those for IPEDS, I have used 2.5 percent of replacement value (from Dunn, 1989) and that, reassuringly, is just about what Harvard's very thoughtful procedure works out to be. Of course, a larger percentage rate can arbitrarily be applied to understated book values to back into much the same numbers—as Williams College seems to have done in 1996—but that procedure has little underlying rationale, and if it is right, it is lucky.

The Opportunity Cost of Capital

This is far and away the stickiest component of the idea that a rental rate measures the current cost of capital services. It will often prove as elusive or even counterintuitive to noneconomists in administrations and faculties as it does to Economics 101 students when they first meet the idea in fall semester. (An encouraging sign appears in "Lease a Computer?" (1998), where an opportunity cost is used explicitly—and identified as such—in an analysis of alternative ways to own or rent or buy a computer.) At base, it is pretty simple: the real resources—funds—that were used to build a building could be in use elsewhere if they weren't tied up there. Specifically, they could have been used to buy financial assets that would pay a yearly return: if you don't build a $1 million building, you've got $1 million to put into the stock market to earn (these days) $250,000 in the year. So if you *do* use it in the building, you have to recognize what you're giving up—the yearly earnings that that use precludes: $250,000. If you don't recognize that cost—if you recognize only depreciation costs—you're kidding yourself about the actual cost of using capital in education.

One thing we do not want to involve in the idea of opportunity cost is that it depends on who owns the capital stock—our measure of the cost of education should not be affected by ownership—yet conventional reporting leads to that mistake. Take two absolutely identical schools doing exactly the same thing, each with, say, $500 million in wealth. In one school, all that wealth is in the form of financial assets on which it earns an income that it uses to, among other things, rent its $250 million campus from somebody else. The other school has made a different portfolio decision—it has $250 million in financial assets and owns an identical $250 million campus. The costs of education in these two identical schools should be the same—and will be with an appropriate recognition of the opportunity cost of owning physical capital.

But, it might be objected, schools typically own part of their capital stock outright but have taken out loans against another part. That is why interest on indebtedness shows up as an operating cost in financial accounts. This fact has two consequences. One is that because the proportion of the capital stock against which debt has been issued will vary from one campus to another (and one set of state laws and agencies to another), comparability between schools—and for a single school over time—will best be served by replacing *all* such interest payments with consistently estimated opportunity costs. The other consequence is that for schools with endowments, borrowing is rarely necessary to finance building or equipment or land—the school could instead pay for it by reducing its endowment or quasi endowment. To do so, of course, would sacrifice returns on that financial wealth. If the school can borrow at a lower rate than the sacrificed earnings, it will be tempted to do so—simultaneously issuing debt and retaining

financial assets in equal amount because what it pays in interest is less than what it earns. (Indeed, if the rate differential did not exist, it is not clear why a school would ever borrow, paying more on debt than it earns on the assets it protects by that borrowing.) So it seems wise to treat the interest on indebtedness, though nominally paying for the funds that built physical capital, as a strictly financial operation in which interest arbitrage earns revenues for the college—a transaction that has little to do with the actual costs of the use of capital. Interest, then, is fully recognized in the uniform opportunity cost of capital embedded in the calculated rental rate.

The procedural implication of all this is (1) to eliminate all interest on indebtedness from reported operating costs and (2) to choose an opportunity cost of capital that will form a reasonable basis of a calculated rental rate.

Conceptually, the right opportunity cost rate to use is the return the school would earn if its financial assets were greater. However, that rate—as the past few years have made very clear—is highly volatile over time as well as highly variable among alternative financial investments that differ in risk and return. So unless the purpose of the cost calculations is to track short-term changes, including those driven by the financial markets, a rate averaged over a long period makes the most sense. I have used, for the IPEDS data, a five-year average of the federal long-term bond rate—which came to 8.55 percent for the 1991 subsidy study—and for an individual school, a conservative smoothing of its endowment performance returns—12 percent for the Williams cost estimates in Table 3.2. To generate comparable figures for, say, the thirty-one selective private institutions in the Consortium on Financing Higher Education, agreement on something like a five- (or ten-) year average of the National Association of College and University Business Officer's reported endowment returns would produce uniformity and probably no more volatility than makes sense. What is important is that the chosen opportunity cost be (1) realistic in reflecting lost earning opportunities, (2) fairly stable if educational changes are to be tracked over time, and (3) consistent among schools if comparisons are to be made among them.

Note that even using something conservative such as the long-term U.S. bond rate, the opportunity cost contributes more than three times as much to the yearly cost of capital services as does depreciation. So the current practice in FASB 117 of including depreciation while excluding opportunity costs *seems* to recognize physical capital service costs but still seriously understates their contribution to college costs.

Furthermore, I understand that with next year's financial reports, FASB 117 will require that depreciation not be shown separately but rather embedded in the activities reported in current operating expenses. That will make it impossible to follow the procedure I have followed in the past—and recommended earlier—of subtracting those dubious depreciation estimates to replace them with the better ones just described. Nevertheless, there are some gains from this new procedure—at least part of capital costs will be

allocated among activities, and it will still be possible to add in the larger and more important part of capital service cost as opportunity cost. So although $P_kK(* + r) = P_kK* + P_kKr$ is the complete rental rate and the depreciation part, P_kK*, will be hidden in operating expenses, it will still be possible (and necessary) to recognize the larger part, P_kKr, which is the opportunity cost.

In Table 3.2 I have done high and low estimates of the cost of a year of education, the low one treating financial aid as price discounting and taking the conservative opportunity cost of capital (to get a cost of $55,609 per student in 1995–96) and the high one treating financial aid as a cost of production and taking a 12 percent endowment return as the opportunity cost (to get $62,336). The difference is large, but both are a far cry from the $34,322 got by simply using E&G spending per student.

Two Further Complications: Collections and Accumulated Deferred Maintenance

Collections (and historic buildings) are quite difficult to value meaningfully and equally difficult to include in a blanket depreciation calculation. They do, typically, have a price and hence a replacement value (however appealing words such as *invaluable* and *irreplaceable* may be), but that value may appreciate with the passage of time rather than depreciate. The implication is that where they are a significant part of a school's wealth, collections and historic buildings may need to be recognized separately in replacement value estimates and in the depreciation component of rental rate. (In 1983, Williams completed its acquisition of supposedly irreplaceable original copies of the three primary documents of U.S. history—the Declaration of Independence, the Constitution, and the Bill of Rights—with the purchase, by an alumnus, of an original copy of the Declaration of Independence for $412,500. So even these documents have a calculable replacement value.)

The accumulation of deferred maintenance can be significant (Yale's announced $1 billion figure a few years ago made that dramatically clear), and it has implications for calculation of the rental rate because it reduces the opportunity cost associated with a given replacement value of capital stock. Letting maintenance go for a year frees up money that can be spent elsewhere, including investment in earning assets. Deferring a good deal of maintenance will free up a good deal of resources, reducing the opportunity cost of a capital stock of a given replacement value. (The Appendix to Winston and Lewis, 1997, spells this out more patiently.)

So the logic of opportunity cost applies not to the total replacement value of a capital stock but to its replacement value *net* of accumulated deferred maintenance. In estimating the rental rate, therefore, the solution is simply to apply the opportunity cost calculation only to the net replacement value while still calculating the depreciation component of the rental rate on gross replacement value. For some schools, this will make little difference in the year's capital costs; for some it will make a lot. (See note 1.)

Multiple Products, Cost Allocation, and Joint Costs

I do not have much that is useful to say about the issue of multiple products, cost allocation, or joint costs, not because it is unimportant but because its resolution is either terribly simple or terribly complicated and quite institution specific. Either way, no great generalizations seem to help.

The single product of liberal arts colleges such as Williams and Swarthmore and Carleton takes the form of undergraduate education, so, as noted earlier, it is safe to assume that virtually all current costs are incurred in production of that service. If resources are used for faculty research, for instance, they must be justified because of their effect—directly or through faculty engagement and recruiting—on the quality of the undergraduate learning experience. Pretty simple.

But even a relatively uncomplicated university has serious problems of cost accounting as it produces undergraduate, graduate, and professional education; health services; research; serious service activities; athletic entertainment and TV programming; and hotel and restaurant services. Costs have to be allocated among these activities, and joint costs have to be divided among them. This seems to be the most difficult problem facing the generation of meaningful estimates of the cost of undergraduate education in a university, and it is the problem most in need of coordination of methodologies and assumptions among schools if their results are to be comparable.

My own cost estimates have met this problem in the national IPEDS data used for subsidy estimates, but there I was precluded from a very sophisticated—and certainly an individually tailored—accommodation by the absence of data. Because there were no data on the differences in tuition and financial aid that would have been necessary to generate different subsidy estimates, I even ignored differences in costs by level of instruction. Inserting the Bowen (1980) cost weights (1.0 for freshmen and sophomores, 1.5 for upper-class undergraduates, 2.1 for first-year graduates, 2.5 for professional degree students, and 3.0 for advanced graduate students) without correction for tuition and financial aid altered the subsidy estimates by Carnegie classification but not in an unexpected way, so I dropped efforts to differentiate by level. On the other hand, I followed To (1987) in dividing aggregate E&G spending into (1) costs directly related to instruction; (2) costs irrelevant to instruction (graduate and undergraduate); and (3) joint costs, which I allocated on the basis of the relative dollar values of the other two. Capital costs were estimated for the whole of the institution and then allocated among functions (products) in the same way. Both of these procedures were, I think, defensible, given the minimal detail of national data, but neither would seem well advised for an individual university seeking comparability. If there is a cooperative initiative to measure undergraduate costs, this is surely the area where shared methodology would make the greatest contribution.

FTE Students

All of that estimated total undergraduate cost is divided by the number of students to get cost per student. Again, this is a simple procedure for Williams or Swarthmore, but it is not so simple for a university with more part-time students who make different demands on the educational resources and incur different costs. The conventional way to convert from part-time to FTE students is simply to assume that the average part-time student takes one-third as many courses and resources as the average full-time student, so one divides the number of part-time students by three to get an FTE figure. For IPEDS data, that is fine, but for any individual school with a nontrivial proportion of part-time students, it might make sense to be more careful in the conversion, using credit hours or courses or some other, more sensitive measure.

Subsidy Calculations

As noted a few times earlier, much of my effort on college cost estimates has been to generate meaningful figures for student subsidies—the average student's educational cost less the price that she pays, both net of grant aid. The total subsidy, in turn, is divided between a general subsidy that every student gets because her sticker price (gross tuition) is less than her educational costs, on the one hand, and any individual financial aid that further reduces the price she pays.[2] The subsidy calculations are indifferent (because of reporting and fungibility problems) to the source of the donative resources that support those subsidies.

Williams's Costs (and Prices and Subsidies) for 1995–96

The tables in this chapter show the calculation of cost (and subsidy) for Williams College. Table 3.1 reproduces page 8, Statements of Activities, from Williams's 1996 *Financial Report,* whereas Table 3.2 maps those data into a spreadsheet that adds capital costs and calculates the resulting educational cost per student. The simplicity that a single-product college allows will be the envy of those trying to allocate costs for a university, but the major issues of financial aid and capital costs—and their importance—are usefully illustrated, I think. I have calculated costs, as noted earlier, using high (12 percent opportunity cost and financial aid as a cost) and low estimates (8.5 percent opportunity cost and financial aid as a price discount). The mapping from financial statement to spreadsheet should be clear although, for reasons rehearsed at length previously, the replacement value of capital and deferred maintenance had to be estimated independently of the school's *Financial Report*.[3]

Conclusion

The purpose of this chapter has been to address some of the major issues involved in measuring the yearly cost of an undergraduate education as they have emerged in recent studies of colleges' student subsidies. Two of the three stickiest elements—the treatment of financial aid and of the costs of buildings, equipment, and land—have been addressed more successfully than the third—the less general problem of disentangling undergraduate costs within a university that does a whole lot of things other than teach undergraduates.

Notes

1. When deferred maintenance (DM) is considered, it is clear that with accumulated deferred maintenance, a year's rental rate is $P_kK^* + (P_kK - DM)r$ because past failure to spend to maintain the capital stock's replacement value has released funds for other uses, leaving only a net physical capital wealth, $P_kK - DM$, still tied up. But the whole of the capital stock, P_kK, nonetheless depreciates each year. See the Appendix of Winston and Yen (1995) on this.
2. Obviously (and conveniently), if financial aid is taken as a legitimate educational cost instead of a price discount, the difference that defines subsidy is unchanged as financial aid is added to both side of the equation $S = C - P_n = C + A - P_n + A$, where S is subsidy; C is cost without financial aid; A is financial aid; and P_n is net price or sticker price less aid.
3. And typical of the murkiness surrounding such estimates, the $400 million replacement value used there does not agree with a figure of $335 million in Williams's recent reaccredidation report. But, importantly, both are a good deal closer to the truth than the $134 million of book value reported in the *Financial Report.*

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