



Measuring Efficiency in the Community College Sector

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Abstract

Community colleges are increasingly being pressed to demonstrate efficiency and improve productivity even as these concepts are not clearly defined and require a significant set of assumptions to determine. This paper sets out a preferred economic definition of efficiency: fiscal and social cost per degree. It then assesses the validity of using IPEDS data to calculate efficiency for the community college system. Using IPEDS, I estimate the fiscal cost per associate degree at \$52,900 for comprehensive community colleges and \$42,740 for vocational colleges (in 2008 dollars); the social costs per degree are \$71,610 and \$56,930, respectively. The community college sector has become more efficient over time: fiscal and social costs per degree are lower in real terms in 2008 than they were in 1987. However, two issues are important to the validity of IPEDS: the ability to adjust for differences in student ability and the way that transfer patterns are incorporated. This paper addresses both of them.

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1. Introduction

Increasingly, colleges are under scrutiny to document that they are using tax dollars appropriately, and policymakers are under pressure to implement reforms that will increase efficiency. The Obama administration has set ambitious goals for increased attainment of college credentials, particularly associate degrees and occupational certificates. Given current funding constraints, community colleges will have to make substantial improvements in institutional productivity and efficiency in order to meet the administration's goals (Jenkins, 2011). The Bill & Melinda Gates Foundation and Lumina Foundation are supporting the colleges by investing in their efforts to implement the systemic reforms needed to improve efficiency levels.

In order to determine whether community colleges can improve their performance, it is necessary to understand what efficiency means for them. Unfortunately, in many economic and policy discussions of college performance and education reforms, terms such as “efficiency,” “productivity,” “cost-effectiveness,” “rate of return,” and even “unit cost” are used loosely and sometimes interchangeably. These terms are not formally equivalent: they have distinct meanings but these meanings are often hard to articulate in either policy discussions or the context of a specific reform. For example, President Obama's January 2012 Blueprint for Keeping College Affordable refers to “federal support to tackle college costs” when in fact the support is intended to reduce fees (The White House, 2012). As another example, discussed in detail in Powell, Suitt Gilleland, and Pearson (2012), college personnel equate any reduction in cost (by which they actually mean expenditure) with a deterioration in quality (which would imply no change in cost, strictly defined). Given such ambiguity, this paper finds that—certainly at the community college level—there has been relatively little systematic inquiry into productivity and efficiency (properly defined).¹

¹ Reflecting the increased pressure to evaluate colleges, there has been considerable growth in online materials. Although these sources provide relevant datasets and data mapping, they contain limited analysis that combines both costs and outputs together to provide a better understanding of college productivity and efficiency. A notable exception is the Delta Project on Postsecondary Costs, Productivity, and Accountability, a resource that spans all postsecondary education institutions [<http://www.deltacostproject.org/index.asp>]. The analysis presented in this paper draws on this resource.

This paper offers a basic economic interpretation of efficiency, as applied to the community college sector. First, it reviews the main obstacles to performing an efficiency analysis of community colleges and briefly summarizes existing relevant literature. Next, it defines key terms in economic theory, leading to a discussion of how best to measure community college efficiency empirically. The paper then discusses efficiency measures across the sector over a 20-year period. The broad intent is to shape the debate, hopefully toward a consensus on how efficiency might be best understood both by policymakers and community college leaders. Although this work is an exposition using basic economic principles, there does not appear to be previous research that performs this fundamental task for the community college sector.

2. Efficiency Concepts and Evidence

Fundamentally, efficiency is the production of a given output at the lowest possible cost. This section elaborates on this definition, but first indicates the conceptual challenges involved in considering “efficiency” in higher education.

There is considerable disagreement on what colleges produce, with most writers arguing that measuring “output” in education is hard, both conceptually and empirically.² Colleges produce more than one output, and they receive funding from multiple sources, each of which may have a different valuation of output.³ Also, if outputs are specified too precisely, colleges may engage in “gaming” such that the only activities they in are those that are counted as outputs.

Furthermore, colleges are analyzed using multiple disciplines and frameworks, and many do not relate to each other. For example, there is literature from business studies, educational policy, sociology, general economics, and the economics of industrial organization. These disciplines use different terms and their analyses are often

² Typically, a distinction is made between output, which is fully quantifiable, and outcomes, which include an array of consequences, some of which cannot easily be quantified. This paper analyzes outputs, leaving aside some of the broader social consequences of community college provision. Doing so may be justifiable if all colleges generate these social consequences in proportion to their outputs (or in fixed amounts).

³ Community colleges get revenue from four main sources—38 percent from state subsidies, 20 percent from local funds, 15 percent from federal funds, and 17 percent from tuition revenue—but these proportions vary from college to college.

not comparable.⁴ The result is a plethora of terms, including process indicators, many of which are not clearly defined (for a catalog, see Reyna, 2010). The terminology of reform is also unclear: reforms are often not expressed in terms of specific inputs, practices, or protocols such that efficiency might be easily measured. Instead, reforms are expressed in generalities such as “mentoring” or “academic support.” Mentoring, for example, may involve faculty or administrators, may be intensive or perfunctory, temporary or sustained; it can be implemented in very different ways and cost very different amounts. Moreover, descriptors such as “high performing” and “high quality” are, from an economic perspective, insufficient or even misleading.⁵

Finally, it is clear that the policy debate over economic analysis of colleges is fraught with complexity. The main issue is the extent to which a college is responsible for or has much control over its outcomes. Faculty, for example, may be governed by collective bargaining agreements or have guaranteed employment contracts. State-imposed funding formulas restrict how resources can be used. Perhaps most critically, colleges may claim that their outcomes simply reflect student characteristics, aptitudes, and preferences; community colleges may contend that they have only limited control or influence over all these factors. If students are poorly prepared in school, the college will have a low graduation rate. If students choose lab-based science courses, the college will have high costs. Differences in college efficiency levels are, it is implied, swamped by variations in student characteristics, capabilities, and preferences. But the economic analysis also has uncertain and potentially threatening implications. The implications of

⁴ Evidence from other countries may have limited use as their higher education systems are very different. Typically, fees are very low (obviating the need to analyze different revenue streams) and colleges are selective with rationed enrollments. In some countries, college dropout rates are very low (such that enrollment numbers are positively correlated with graduation numbers). For England, Italy, Japan, and Germany, see respectively Johnes (2008); Agasisti and Johnes (2009); Hashimoto and Cohn (1997); and Kempkes and Pohl (2008).

⁵ Strictly, performance refers to how much output a college produces without any consideration of resource use. A high-performing college, for example, is therefore one with a high graduation rate. The critical assumption, which often goes unexamined, is that this performance is not fully explained by the greater resources available to the college. A college with four times the resources but only twice as high a graduation rate will perform better but is less efficient, for example. The term “college quality” is even more misleading: often it refers to student characteristics, such as freshmen SAT scores; these characteristics are only indirectly linked to how the college operates or is managed. Sometimes, quality refers to process measures, such as the ratio of students to faculty. This is equally problematic: if two colleges produce the same amount of output, the college with the higher student/faculty ratio (*ceteris paribus*) is actually *more* efficient in that it is using fewer faculty to achieve the same result. Again, the term quality connotes positively but omits half the analysis.

being the least efficient college could be extreme, such as closure. Of course, this is only an implication: if the least efficient college is still generating a positive return on investment, then it should not be closed.⁶

Given all these confounding factors, some may question whether efficiency and productivity can be determined from such complex enterprises as higher education institutions generally and community colleges specifically. Institutions, it is claimed, either spend whatever money they have (an assertion noted over three decades ago by Bowen, 1980) or allocate resources based on internal rules and formulas rather than on efficiency considerations. Notwithstanding, there is still considerable scope for colleges to spend efficiently or wastefully and for rules to be efficient or wasteful; and all public enterprises should be held accountable for their use of public funds. On the former point, Syverson (2011, p. 326) has concluded that studies of the private sector “have documented, virtually without exception, enormous and persistent measured productivity differences.” By necessity, therefore, it is important to articulate a valid measure of efficiency at the community college level.⁷

Thus it is perhaps unsurprising that research on the efficiency of community colleges is very limited. Most research on efficiency in higher education has looked at the four-year institutions. The rest have pooled all public institutions together.⁸ Most of these studies have focused either on estimating cost functions (the association between costs and input prices) or on identifying economies of scale.⁹ Even findings pooled across two- and four-year institutions are unlikely to be valid for community colleges: specifications for these studies typically include variables measuring research expenditures and

⁶ Also, there is substantial within-college variation in student performance which may be larger than the cross-college variation. An optimal policy might therefore be to close down specific departments within each college.

⁷ One important issue that is not addressed here is intra-college variation in efficiency. There may be greater variation within colleges than between them.

⁸ Studies of four-year colleges include the following: De Groot, McMahon, and Volkwein (1991); Dolan and Schmidt (1994); Gainsmeyer-Topf and Schul (2006); Harter, Wade, and Watkins (2005); Koshal and Koshal (1999); Toutkoushian (1999); Webber and Ehrenberg (2010); Zhang (2009). Broadly, these studies find a positive association between outcomes such as graduation rates or retention rates and resources. Pooled studies are Cohn, Rhine and Santos (1989); Laband and Lentz (2003, 2004).

⁹ In an early study, Getz and Siegfried (1991) estimated average total cost as a quadratic function of enrollment (implying zero fixed costs), but did not include the community colleges. More recently, Laband and Lentz (2004) estimated cost functions for all higher education institutions using data from 1996. Results have varied, although many studies have found significant economies of scale (Nelson & Hevert, 1992).

graduate student enrollments. Critically, most studies do not count certificates as outputs, even as these were over 40 percent of all awards by public two-year institutions in 2008 (Bailey & Belfield, 2012, Table 6.2).

Two recent studies on community colleges are salient. Neither is strictly an efficiency study; rather, both investigate whether colleges with more resources generate better outcomes. Based on individual-level data, Bound, Lovenheim, and Turner (2010) found no link between completion rates and resources, although the resource measure—the student-faculty ratio—may be questioned as a proxy for resource levels. Also, using individual survey data merged with IPEDS, Stange (2010) found no relation between student outcomes and instructional expenditures per student, faculty salaries, and the proportion of faculty who were full time. In Stange’s study, the outcome of analysis was community college students’ attainment of a bachelor’s degree, which applies to only a subset of community college students. The implications of these studies are presumably that colleges with higher spending are less efficient than colleges with lower spending, i.e., they spend more but have the same outcomes. However, the extent of the inefficiency is unclear. Alternatively, the implication may be that spending on these particular inputs is inefficient; it is important to control for all expenditures. Beyond these two studies, there does not seem to be any published studies that have investigated the efficiency of community colleges specifically.

3. Economic Analysis of College Operations

In light of the above conceptual issues and paucity of evidence, this paper begins by clarifying key terms and measures for identifying college efficiency (see also Levin, 1991). My approach is to use basic economic terms in their formal sense, i.e., to return to “first principles” (see Massy, 2011a, b). Formally, economics divides the analysis of enterprises into production and costs. With respect to community college, production refers to the outputs produced, such as associate degrees, with a given quantity of inputs, which includes faculty and classroom facilities as well as the students themselves. A college is depicted as an enterprise that uses a quantity of inputs in a process to produce a quantity of outputs. Cost refers to the full resources required to produce a given amount

of outputs. Expenditures are the amounts spent on all inputs (input quantities times input prices) in a given period. It is important to distinguish between these two concepts. Expenditures are equivalent to costs only if they fully reflect resource use and can be explicitly related to outputs. Conceptually, expenditures do not fully capture all resource use because the students are uncompensated; and for reasons given below, empirically, expenditures may not accurately capture full resource use. More importantly, expenditure elides any discussion of outputs: equating “cost” to “expenditure per full-time equivalent student,” for example, presumes that a full-time equivalent (FTE) student is one type of “output.”

For policymakers, presumably the intent is to identify the most efficient colleges—i.e., those that generate outputs at the lowest cost—and to calculate the extent to which efficiency gains are possible. Hence, the appropriate focus is on technical efficiency, as opposed to allocative efficiency. Technical efficiency refers to the use of inputs to produce a given amount of output; allocative efficiency refers to whether the optimal amount of output has been produced. Hence, a college could attain technical efficiency—it produces 100 graduates with the minimum possible amount of resource—but be allocatively inefficient because the economy only “needs” 50 graduates.¹⁰ With respect to the latter, the evidence suggests that the economic benefits of community college are strong (Belfield & Bailey, 2011): indeed, the weight of evidence suggests that there are too few community college graduates and so the community college sector exhibits allocative inefficiency. However, questions of allocative efficiency can only be answered thoroughly by looking at the macroeconomic value of producing graduates and this is beyond the scope of this investigation.¹¹

Related to technical efficiency is the concept of scale efficiency. Clearly, College X, which produces 100 graduates with \$1 million in costs, exhibits greater technical

¹⁰ Or, expressed more formally, the rate of return on public investments to produce college graduates is lower than the opportunity cost of capital.

¹¹ Strictly, a college that exhibits technical efficiency would apply the equi-marginal principle: all inputs are used such that the ratios of their marginal products to input prices are equal. In practice, it is probably impossible to determine whether this is occurring. Instead, therefore, we assume that the college with the lowest unit cost must have come closest to applying the equi-marginal principle and so is the most efficient, not that it is perfectly efficient. The distinction is not semantic: it may be that all public colleges are inefficient because of some general regulatory or bureaucratic constraint (e.g., a state-wide collective bargaining agreement) that prevents application of the equi-marginal principle.

efficiency than College Y, which produces 100 graduates with \$2 million in costs. However, scale efficiency relates to how efficiency changes with output. Thus, College Z, which produces 200 graduates for \$1.5 million, exhibits scale efficiency over College X. The unit cost per graduate is lower at College Z than at College X. But it is not easy to calculate the unit cost at College Z if it had to produce 100 graduates as College X does. To identify colleges that exhibit technical efficiency it is therefore necessary that they spend approximately the same on inputs (or produce approximately the same level of output).¹²

Other measures—the most common of which is “productivity”—are developed to help explain differences in efficiency rather than to serve as alternative ways to measure efficiency. Productivity is an allocative relationship between amounts of output and amounts of either a single input (Q_{output}/Q_{input}) or all inputs (see Massy, 2011b). Cost per unit of output is the relationship between amounts of output and spending on inputs (Q_{output}/EXP_{input} or $Q_{output}/P_{input}Q_{input}$). The distinction is important because productivity can only change if the quantity of inputs change in relation to outputs; unit cost can change in this way too, but it can also change if input prices change. If output from a given input quantity changes, then both productivity and unit cost have changed. But, if the wages paid to professors of a given quality fall, then the unit cost has fallen but productivity has not risen. Review of the literature suggests that almost no study has calculated productivity in this formal sense. Where studies refer to productivity changes, they are almost always actually referring to changes in unit costs.¹³

Given changes in input mix and potential input substitutability, and the general ignorance about how learning is produced, it may not be appropriate to calculate college productivity. There are many measures of labor productivity that might be considered (e.g., number of tenured faculty, number of part-time or adjunct faculty) and many ways

¹² Parallel to allocative and technical efficiency is a distinction between cost-benefit analysis (CBA) and cost-effectiveness analysis (CEA). CBA is akin to allocative efficiency: did the economic value of the outputs (benefits) from community colleges exceed the costs of provision? CEA is similar to technical efficiency: per unit of output, which college had the lowest costs? However, CEA elides the distinction between technical and scale efficiency. In the above example, College X is more cost effective than College Y and College Z is more cost effective than College X. But the reasoning is different (and the latter relation may not be correct).

¹³ Examples of studies that refer to productivity but calculate unit costs include: Hoxby (2004) on K-12 schools; Kelly (2009); Archibald and Feldman (2008); and Webber and Ehrenberg (2010). One exception is a study on the University of Texas-Austin; see Vedder, Matgouranis, and Robe (2011).

to substitute across inputs. If colleges can easily replace full-time faculty with adjunct faculty or computing applications, calculating changes in the productivity of each input is not a helpful indicator of overall efficiency. Instead, cost per unit of output captures both changes in input prices and changes in productivity.

The preferred measure of efficiency for this paper is therefore a unit cost measure: the cost per unit of output.¹⁴ Critically, for this measure to be valid, it is necessary to establish that unit cost can be accurately calculated for community colleges. This is no small task and involves considerable questions on both the output and costs sides.

4. Outputs of the Community College System

4.1 Outputs Measured in Terms of Awards Conferred

Bailey (2011) sets out the two main missions of community colleges as the following: vocational and academic college programs, often leading to transfer to a four-year program, for recent high school graduates; and focused vocational training programs for adults, mostly for workers or job-seekers.¹⁵ From these missions, this paper derives the outputs of community college as: (1) associate degrees (academic and vocational); (2) certificates (one- and two-year); (3) transfer to bachelor of arts candidacy status; and (4) other credits, including remedial courses.¹⁶

Aggregating these four types of students outcomes is a challenge because each is a non-trivial proportion of college output. Across public two-year colleges, 56 percent of

¹⁴ The purpose here is to derive a valid measure of efficiency for policymakers to utilize. We do not model technical efficiency using methods such as Stochastic Frontier Analysis or Data Envelopment Analysis (see Johns, 2008). The advantage of DEA/SFA is that colleges are compared in relation to other colleges with a similar input and output mix (i.e., colleges with mostly certificate courses and adjunct faculty are compared). The disadvantage of these frontier analyses (and regression analyses generally) is that the method is opaque and the results are not easily intelligible to policymakers. A similar caveat applies to the calculation of total factor productivity.

¹⁵ A third mission is continuing education programs—often customized for firms. This mission is not analyzed here on the (somewhat inaccurate) assumption that such programs are self-financing and a relatively small component of the college's provision.

¹⁶ This variety is in contrast with the four-year sector, where the different outputs are more broadly separable into undergraduate education leading to a bachelor's degree, graduate education leading to a master's degree or a doctorate, and research. Obviously, for four-year institutions the biggest concern is to accurately model research outputs and the institutions' broader social value. Another challenge is how to value medical school provision, which is typically very expensive.

awards are associate degrees, 23 percent are short-term certificates, and 21 percent are moderate–long-term certificates (Horn, Li, & Weko, 2009). Large numbers of students transfer, both across community colleges and into four-year institutions, although many of them do not graduate (Stange, 2010).¹⁷ As well as non-credit students, many students accumulate some credits but never complete a credential. Finally, there are substantial numbers of remedial students who cannot progress toward a college award (Bailey, Jeong, & Cho, 2010).

The approach used here to measuring output counts the number of associate degrees and certificates awarded within a given year.¹⁸ These credentials are weighted by the number of credits required to attain them. Before presenting the advantages and disadvantages of this approach, I first consider the alternative approach based on credits.

An alternative way of concatenating output, set out by Massy (2011a), is to count credits completed (Johnson, 2009).¹⁹ All credits are counted, with students who complete their credential given a greater weight to reflect the value of completion (the “sheepskin” effect).

There are some advantages to this method. It allows for a more transparent summation of the output of a college and can incorporate provision across all the possible student pathways. For colleges with large numbers of part-time students and transfer students, using credits is a more refined estimate of student input.²⁰ The measure can be calculated using a single year of cost data to correspond to a single year of credits provided (see the apportioning problem below).

However, there are some important drawbacks to using a credit-based measure. One is that very high proportions of students who start college intend to (or expect to) complete their program. Their failure to do so is only indirectly (and very weakly)

¹⁷ According to Long and Kurlaender (2009), 21 percent of community college students obtained a BA degree within six years. However, their sample consisted of students who were young and who had taken the ACT, and both these characteristics are likely to predispose students toward seeking a BA degree.

¹⁸ A version of this measure is depicted for the two-year college sector from the 1970s on by Harris and Goldrick-Rab (2010). Their depiction includes all expenditures (regardless of purpose) and uses degrees granted as the measure of output (certificates are not counted).

¹⁹ This report rejects measures of output in terms of “time to degree” as overly complex, without any obvious gains in accuracy. It also rejects measures of student satisfaction as these are derivative of completion rates.

²⁰ Conventionally, part timers have been counted as one third of an FTE and a certificate as equal to half that of an associate degree. Currently, the U.S. Department of Education calculates the FTE of a part timer with factors that vary by institutional characteristics (control and level) and by level of student.

counted, in the sense that the sheepskin multiplier is not applied. (The sheepskin multiplier would have to be very high for this criticism not to hold). Given the very high dropout rates at community colleges, this failure is particularly important: the majority of credits are delivered to future dropouts not graduates. A second drawback is that many students accumulate surplus credits beyond the formal course requirements.²¹ Credit aggregation would therefore favor colleges that overload students with surplus credits.²² This measure also provides colleges with very little incentive to increase completion rates.

Fundamentally, however, this annual credit-based measure of output yields an efficiency measure which is very highly correlated with, and almost equivalent to, expenditure per FTE. Given community college graduation rates, which are around 25 percent, the difference between enrollment and program completion is vast. Thus, any enrollment-driven output measure should be regarded as a very approximate measure of efficiency.

4.2 Key Assumptions About Award-Based Outputs

There are four concerns with using an award-based efficiency measure: distinguishing between awards; and accounting for remediation, late graduation, and transfers (see Stange, 2010).

Valuing all awards in proportion to their credits. The preferred method in this paper assumes that all award-based credits are equivalent and so values the outputs of higher education primarily in relation to its mission of producing graduates. It is possible to adjust these outputs to more closely reflect their economic value and the most straightforward way to do this is to weight student outcomes according to their economic value in the labor market or to apply a sheepskin multiplier. For example, Kelly (2009, Figure 2) used a set of state-specific weights based on median earnings for each STEM/non-STEM credential.²³ An associate degree should be weighted more than a

²¹ For BA degrees in Florida, Johnson (2009) calculated that the transcript cost of a degree was 25 percent higher than the catalog cost (i.e., what it should cost students if they only took the required courses).

²² Based on a case study of one community college, Romano et al. (2010) found significant differences in costs based on transcripts of actual courses taken rather than the required courses for a given award.

²³ Nationally, Kelly (2009) estimated these weights at: 0.71 for a non-STEM certificate; 1.19 for a STEM certificate; 0.81 for a non-STEM associate degree; 1.19 for a STEM associate degree; and 1.0 for a non-

certificate, because it has a higher labor market value; and a STEM credential more than a non-STEM credential, for the same reason. However, the net effect of Kelly's weights is to change total United States higher education output by 1.8 percent. At the state level, the biggest impact of the weights is to raise output by 11 percent at the upper tail and to reduce it by 4 percent at the lower tail. These do not appear to be substantial changes.

However, there are some practical issues with applying these labor market weights: it is not easy to get weights for certificates (the Current Population Survey does not ask about them); labor market weights implicitly include a regional price index, the appropriateness of which it is hard to judge; and labor market outcomes may reflect migration patterns of graduates. Finally, calculating the sheepskin multiplier is not straightforward. The sheepskin value of college is based on the labor market value of college, which is not the full value of a credential (Trostel, 2010) and which will vary across labor markets, across fields of study, and across time. Generally, although there are differences in labor market earnings across awards, e.g., vocational versus academic associate degrees (Belfield & Bailey, 2011), the evidence is unlikely to be precise enough or complete enough to calculate these weights.

Accounting for remediation. Another issue to consider is how to value remediation.²⁴ Colleges provide significant amounts of remediation and approximately two thirds of students who take remedial courses fail to complete the sequence. One approach is to discount (give zero value to) all remedial courses. This may be inappropriate insofar as variations in student aptitude are important. By discounting remedial outcomes, but including the cost of providing them, the effect of student aptitude has been exacerbated. For some students, remediation may be an end in itself, i.e., raising their basic skills. Yet for most students there is no reason to take remedial courses other than to progress into college-level programs; adult basic skills programs (e.g., Adult Basic English, English as a Second Language, and GED preparation) are non-credit and are not funded under Title IV. Moreover, many students taking remedial

STEM BA degree. Actually, the certificate weights were for persons with "some college." These weights imply that a STEM associate degree is more economically valuable than a non-STEM BA degree.

²⁴ Nationally, 43 percent of community college students take one remedial course (Horn & Nevill, 2006, Table 6.2). Rates cited in Bailey et al. (2010, p. 257) are even higher. For example, Florida data show that 78 percent of students in community colleges need remediation (Florida Office of Program Policy Analysis and Government Accountability, 2007). Data for Ohio indicate that 11 percent of all undergraduate credits are in remedial courses at community colleges (Ohio Board of Regents, 2006).

courses are also taking college credit at the same time: without the remedial provision, the college-level provision might not exist. Remediation is therefore a cost associated with keeping students in college-level programs. Given the very high attrition rates from remediation, questions about its efficacy, and issues concerning inaccurate placement into remediation, the preferred measure here does not count any remediation course provision as an output *per se*.

Accounting for late graduation. The two remaining concerns—transfers and late graduation—are best illustrated by looking at how students progress through community college. Student pathways can be analyzed using the Beginning Postsecondary Students (BPS). According to analysis by the National Research Council (NRC) of BPS data, the 2003 entry cohort into community colleges graduated at a rate of 23 percent (within 150 percent of normal time).²⁵ The remainder—77 percent of the cohort—followed many paths (NRC Panel on Improving Measurement of Productivity in Higher Education, 2011):

1. At same community college, graduated after >3 years	6 percent
2. At same community college, still enrolled after 6 years	11 percent
3. At different institution, graduated within 3 years	2 percent
4. At different institution, graduated after >3 years	14 percent
5. At different institution, still enrolled after six years	7 percent
6. No degree, never completed	37 percent

A count measure includes all awards, regardless of how long the student took to obtain the award. In contrast, rate measures are expressed as a proportion of a cohort of students who received an award within a specified time from initial enrollment (e.g., the graduation rate within 150 percent of normal time). It may be legitimate to declare that a college should produce an output within 150 percent of the time expected for a full-time student to complete the credential (GR150) and that awards outside that time frame should not be counted as output. The BPS data show that the difference is not trivial. The awards measure would count (item 1 above), which is 6 percent of all students and one

²⁵ This is primarily a concern for associate degrees. The graduation rate for certificates at two-year institutions is 56 percent (within 100 percent of normal time), 74 percent (150 percent), and 79 percent (200 percent). Hence, the residual group is much smaller.

quarter of the size of the graduation rate (23 percent). Even this is an understatement because some of the 11 percent (item 2) will eventually graduate.²⁶

Moreover, a count measure is preferable, not least because of its simplicity. First, many community college students are attending college and working simultaneously; imposing a time restriction on their graduation may therefore be inappropriate. Second, many students transfer across colleges—both out of and into community college; attributing a graduation rate for these transfer students is even more problematic than attributing a count of awards. As discussed below, student transfer is a key issue for measuring community colleges' output.

Accounting for student transfer. Many students transfer. Using the BPS data, transfers represent 23 percent of the entire cohort (items 3 through 5 above). As this is equal in size to the 150 percent graduation rate, it raises the question about whether the graduation rate underestimates output by 50 percent.

IPEDS does have information on transfer rates from 2003 to the present. However, the validity of these transfer rate statistics has been questioned (Medwick, 2009). Only three quarters of public two-year institutions report a transfer rate (with smaller colleges much less likely to report and in two states no college reports its transfer rate). IPEDS data show a transfer rate of 18 percent for community colleges as against the comparable rate of 42 percent from BPS (Medwick, 2009, Tables 9 and 10, respectively). However, IPEDS cannot distinguish between the following: transfers with an award and transfers with no award; those who transfer to a four-year college and those who leave for a different two-year college; and those who complete a BA at their destination college and those who drop out. Nevertheless, transfers are important even using IPEDS. If each transfer is counted as output, more than half (54 percent) of a community college's "awards" are from transfers. The standard deviation is also greater for a transfer output than for an award-based output, increasing college-level variance. IPEDS data are therefore likely to underestimate output and introduce bias in favor of colleges with low transfer rates.

²⁶ The analysis used here, which considered the BPS on all students, suggests even more caution. For the 2003–04 cohort in public two-year institutions only 16 percent had completed a credential (10 percent associate degrees and 6 percent certificates) after two years. Of the remaining 84 percent, 30 percent were still enrolled at a two-year college, 9 percent were enrolled at a four-year college, and 45 percent were no longer enrolled. After six years, 33 percent had completed a credential.

This paper draws similar conclusions using transcript data for college students starting in 2005–06 at five colleges. (These colleges are ones that have made their data available for direct analysis.) These transcript data are precise as to the following: how many students transferred; when they did so; their transfer destination; and whether they got an award at their origin and/or destination college. Of the full cohort, 17 percent transferred to a four-year institution within five years and did so after accumulating on average 24 credits at the origin college (this does not count students who received an award at the origin college before transferring and omits lateral transfers to other two-year colleges). These transfer rates varied across the five colleges from 10 percent to 22 percent. Instead of subtracting expenditures on transfer students, the paper assumes that transfer to a four-year college is a successful outcome. Using the transcript data, it is possible to count all the credits of the transfer students; one option then is to weight their credits against the number of credits required for an associate degree. Thus, if an associate degree requires 72 credits and transfer students complete 24 credits before transferring to a four-year college, then each transfer is valued at one third of an award. Applying this formula, the average output across the five community colleges for which there are data would be 62 percent higher. This too is an enormous effect. It is primarily driven by the assumption that every transfer student—to a four-year institution—is an output in a system where only one quarter of students typically complete an award. The range is also substantial: across the five colleges, this formula would increase output by between 24 percent and 101 percent.

This formula does not address the likelihood that the student fails to complete a four-year degree. Practically, it is very difficult to follow up on transfer students to see if they do receive an award at the destination four-year college and, conceptually, it is also unclear how much of that award (or lack of it) should be attributed to the community college.²⁷ However, it is possible using transcript data from the five colleges to get a rough estimate. Counting only those (transfer) students who obtain a BA degree within five years of first enrolling at the origin community college, output is underestimated by on average 17 percent. The under-estimates range from 0 percent to 26 percent.

²⁷ Plus, BA-transfer credits may be more valuable than typical credits because they can be applied toward a four-year degree, with all the concomitant social and economic benefits.

Therefore, even when completely adjusting for the students' probability of completing a four-year degree, the inaccuracy from omitting transfer students, although reduced, remains very large.

Finally, a recent study by National Student Clearinghouse Research Center (NSCRC, 2012) calculated the transfer rate by cross-referencing student enrollments at different colleges. This report estimates the transfer rate from public two-year colleges at 33 percent, with 60 percent of transfer students going to a four-year institution.²⁸ But the report raises important questions about what transfer means. Specifically, the transfer rate for four-year public institutions is as high as for community colleges and approximately 20 percent of students are transferring to colleges out of state. Thus, it is not clear what proportion of transfers reflects the goal of the college rather than the high mobility rates of young people. Finally, the NSCRC student notes that community colleges actually receive the most transfer students (see also Romano, Losinger, & Millard, 2010).

Looking across these datasets, the transfer rate from community college to a four-year institution is approximately one fifth, with substantial variation by college. But, this figure understates the importance of transfers because they are counted as “output” in a system where only one quarter of students graduate. Awards-based measures (and other measures) of output are therefore significantly biased downward. The next section addresses the potential bias from failing to accurately account for transfers when calculating overall efficiency and when comparing across colleges.

5. College Costs

On the cost side, expenditure figures must be adjusted to reflect all the resources being used to produce a given amount of outputs in order for them to be labeled as costs. Review of the literature indicates that there are many factors related to the accurate apportionment of expenditures to get a more accurate measure of costs.²⁹

²⁸ In addition, 5-10 percent of each cohort transfers to obtain an associate degree elsewhere.

²⁹ A basic issue is that budget statements do not readily relate to input use. The Appendix shows total expenditures across the community sector in 2009, using IPEDS data. The line items do not describe inputs (e.g., faculty) but processes (e.g., instruction). Also, budgets do not reflect full expenditures because they include transfers and do not include any items which the government does not have to spend for directly.

5.1 Student Input

The most obvious adjustment is for student inputs. Students vary in aptitude, and differences may have a critical effect on the college's outputs. The conventional solution is to weight the student body according to indicators of aptitude. However, determining which weights to use is not straightforward because the effort component of student input is essentially confounded with college practices: an effective college makes students work harder. In calculating school unit costs, Hoxby (2004), for example, used family income levels. In theory, the adjustment should relate to the students' ability to succeed in college but it is hard to separate this from student effort or from other confounders such as income.

Many community college students enroll in the college closest to their home; in fact, Stange (2010) posits that there is no relationship between student ability and the quality of the community college. This supposition implies, at least in cross-section, that adjusting for student ability is not critical. But it does not necessarily mean that colleges have the same quality of student inputs, because colleges are located in areas with different income levels. Moreover, it is still necessary to adjust for student quality over time if the pool of nearby applicants improves or deteriorates. This adjustment is unlikely to be trivial: over the prior two decades, Bound et al. (2010) calculate that more than two thirds of the decline in community college completion rates for males is attributable to their weaker math skills.

5.2 Student Tuition Payments and Scholarships

On one side, students pay tuition for college; on the other side, some students receive scholarships. As shown in the Appendix, community colleges get 17 percent of their revenues from tuition and scholarships constitute 8 percent of expenditures. Both have to be addressed when considering efficiency. Student tuition should be subtracted from the expenditure total when resource use is interpreted from the government perspective.³⁰ Similarly, there is debate over whether student scholarships are a cost. For community colleges, the assumption here is that scholarships are discounts on fees, not

³⁰ If Colleges A and B each spend \$1 million to graduate 100 students, but College A levies fees to cover 50 percent of expenditures and College B levies fees to cover only 25 percent, then from the state perspective, College A is more efficient than College B.

wages paid to students. Scholarship spending is treated as a price discount because student peer effects are not especially strong in community colleges, i.e., the college is not paying the scholarship students to “help” the non-scholarship students.

5.3 Capital Assets

One key issue to deal with is capital expenditures. Winston (1998) makes a strong case that they are probably inaccurately valued by higher education institutions. In theory, the value of the capital is expressed in terms of its rental rate, i.e., the amount it would cost a college to buy the equivalent facilities and land for the specified time period. This rental rate should reflect the costs of replacing the capital stock and the depreciation it suffers during the time period (and the cost associated with having capital tied up during that period). Community colleges do vary in age and in the quality of their capital stock (although they do not have large endowments or own valuable financial assets) and it is unlikely that the value of the capital is adequately calculated using totals of operating expenditure. Colleges face restrictions on their use (and sale) of land and, according to Winston (1998), do not accurately report depreciation because of mis-estimation of replacement values.³¹

More generally, annual operating expenditures are unlikely to accurately capture college fixed costs. Mis-estimation of depreciation of long-lived assets or fixed costs by colleges will have consequences for estimates of scale efficiency. Specifically, because average capital costs usually decline with size, the minimum cost output level will be understated.

5.4 Regional Price Variations

As community colleges are partially constrained in their locations, it is important to adjust for regional price variations.³² Most studies use housing prices to account for the geographical variation in the costs of inputs or changes in wages for professionally

³¹ A back-of-an-envelope calculation illustrates the potential mis-estimation. According to Winston (1998), depreciation should be 2–3 percent of capital replacement value. As capital replacement value is five times operating expenses, colleges should report depreciation at approximately 10 percent of operating expenses. As shown in the Appendix, depreciation is only approximately 3 percent of operating expenses. Importantly, this mis-estimation is likely to grow over time.

³² If colleges could make independent choices about where to locate, a regional price index would penalize colleges that deliberately chose areas where input prices were lower. However, most community college location decisions are determined publicly.

educated persons (Hashimoto & Cohn, 1997). However, there does not appear to be a price index that is specific to community college's inputs.

5.5 Inflation

Clearly, comparisons of resource use over time require adjustments for inflation. Given the particular technology and provision of higher education, the choice of a price index may matter (Gillen & Robe, 2011). Three indices are commonly used: the HEPI, HECA, and the CPI-U (for details on each of the inflation measures, see State Higher Education Executive Officers [SHEEO, 2009, Appendix A]). The HECA may be preferred over the privately developed HEPI, which is heavily weighted toward faculty salaries, and the CPI-U, which has oil prices as a large component.

Inflation trends using the CPI-U, HECA, and HEPI are somewhat different. Inflation over the period 1993 to 2008 was 49 percent according to the CPI-U, but 60 percent using the HECA, and 71 percent using the HEPI (SHEEO, 2009, Appendix Table 11). Thus, real spending would appear to have grown 20 percent less using HEPI than CPI-U. However, annual differences are much smaller, such that the path of inflation is consistent across the indices.

5.6 Expenditures Unrelated to Measured Outputs

Some college activities are not directly related to (measured) outputs. As shown in the Appendix, 6 percent of community college allocations are for other expenditures, including research, and 2 percent are defined as public service. Where these expenditures are not directed at increasing output, they should be subtracted from the measure of costs. Of course, the subtraction of some expenditure items implies that there is no complementarity between them and the output measure (i.e., if the research program improves the quality of instruction but expenditures on research are excluded). More straightforwardly, it is also appropriate to subtract expenditures that are directly tied to other self-supporting revenues, such as dormitories.³³

³³ The community college sector, unlike the four-year sector, has no upper tail of very expensive, research-intensive colleges. Its absolute spending on other activities is also low: average expenditures on research per college was \$0.2 million (IPEDS data).

5.7 Expenditures Matched with Outputs

Fundamentally, outputs should be mapped against college expenditures over the entire period when the students were enrolled. However, this period is variable (because completion of a certificate and an associate degree take different amounts of time) and few students use college resources uniformly each year. For example, half of those who graduate within 150 percent of time do so within two years and the other half take a third year (IPEDS data). Apportioning three years of expenditures to the graduation rate is therefore inaccurate: more than half of the graduates had already graduated a year earlier.³⁴ Therefore, matching expenditures to outputs is more challenging when colleges have diverse programs of different lengths and when college enrollments fluctuate significantly. A growing college will appear to be less efficient than a declining one: the former has disproportionately large expenditures on first-year students who will not graduate in that year.

5.8 Cross-Subsidies

Many colleges cross-subsidize such that each student in each class may not receive the same amount of resources. Studies have identified cross-subsidies across subjects (e.g., from arts to sciences), across years (e.g., freshmen to sophomores), and across campuses.³⁵ The extent of such cross-subsidy, and the need to account for it, is debatable. One approach is to use an index to account for students' choices. SHEEO (2009) used an enrollment mix index to account for the different resource requirements across degree types (associate versus bachelor's) across all higher education institutions. However, this index does not allow for comparisons between colleges according to subject mix (e.g., colleges offering more sciences versus humanities) or certificates.

It may be legitimate to assume that the changing mix of subjects studied reflects the changing mix of students' preferences and that colleges decide on efficiency grounds whether to accommodate such preferences. Based on this logic, colleges that offer higher cost courses (e.g., sciences) will appear inefficient unless these courses also yield higher

³⁴ A further complication is that these figures are for full-time, first-time students; there is not much equivalent information for the part timers or returners.

³⁵ One solution is to use weights, e.g., weighting sophomore classes at 50 percent more than freshman classes. However, it is not clear what should be included in the weights.

graduation rates or are offset by higher tuition fees. Nevertheless, adjusting for subject mix absolves colleges from making efficient decisions regarding what subjects to provide. Therefore, it is more reasonable to account for the mission of the college, without adjusting for the specific subject and course provision within the college.

In summary, the preferred measure of social costs is based on public educational expenditure net of self-supporting activities and the fiscal cost is this expenditure net of fees.³⁶

6. Measurement of the Efficiency of Community Colleges

This section discusses actual measures of efficiency across the community college system. The analysis is based on the Delta Project dataset from 1987 to 2008, which uses IPEDS data adjusted to reflect changes in financial reporting over this 20-year period. In total, there are more than 980 colleges each year, of which approximately one fifth are vocational colleges and the remainder are academic (or comprehensive colleges).

Reflecting the discussion in Section 3 above, the best available measure of output is described in Box 1. It is worth reviewing the assumptions behind this output measure. The measure counts all awards, no matter how long they take. It weights all credits leading to an award as equivalent. It counts students who earn two awards twice. Critically, this measure gives zero value to credits *per se*, zero value to remedial courses, and zero value for students who transfer to another college without receiving an award. This last assumption—driven by the lack of data in IPEDS—introduces significant measurement error.

³⁶ This paper does not count the social costs of raising taxpayer funds to subsidize community colleges.

Box 1
Derivation of Output Measure

Resource	Mean in 2008	[SD]
Output Components		
Associate degrees awarded in given year (AA)	514	[834]
Short certificates (C _S)	205	[609]
Medium certificates (C _M)	129	[199]
Long certificates (C _{L0})	10	[27]
“Output” (Associate Degree Equivalent) = AA+0.25C _S +0.5C _M +0.75C _L	637	[933]
Other Possible Measures		
Number of graduates within 150% of normal time	149	[185]
Undergraduate credits provided (000s)	142	[179]
Associate degrees	514	[834]
Full-Time Equivalent students	3,672	[4,975]
Colleges	981	
Factors		
Remediation		
Credits Completed		
Transfer to BA Degrees		
Non-Credit Programs		
Other Credentials		

Note. Other credentials would include higher degrees and post-baccalaureate credentials: MAs, doctorates, BA degrees (<1 per college), post-baccalaureate credentials (<0.05 per college). **Associate degrees** defined as: Total number of associate degrees conferred that normally require at least two but less than four years of full-time equivalent college work. **Short certificates** defined as: Total number of awards granted that require completion of an organized program of study at the postsecondary level (below the baccalaureate degree) in less than one academic year (two semesters or three quarters), or designed for completion in less than 30 semester or trimester credit hours, or in less than 45 quarter credit hours, or in less than 900 contact or clock hours, by a student enrolled full time. **Medium certificates** defined as: Total number of awards granted that require completion of an organized program of study at the postsecondary level (below the baccalaureate degree) in at least one but less than two full-time equivalent academic years, or designed for completion in at least 30 but less than 60 semester or trimester credit hours, or in at least 45 but less than 90 quarter credit hours, or in at least 900 but less than 1,800 contact or clock hours, by a student enrolled full time. **Long certificates** defined as: Total number of awards granted that require completion of an organized program of study at the postsecondary level (below the baccalaureate degree) in at least 2 but less than 4 full-time equivalent academic years, or designed for completion in at least 60 but less than 120 semester or trimester credit hours, or in at least 90 but less than 180 quarter credit hours, or in at least 1,800 but less than 3,600 contact or clock hours, by a student enrolled full time. Adapted from Delta Project, IPEDS data.

Across the 981 colleges, average annual output is 637 associate degree equivalent awards, of which 514 are associate degrees.³⁷

For social and fiscal costs, the best available measure from IPEDS cost is presented in Box 2. Total expenditures are measured using the value for Total Operating

³⁷ Two related measures are reported in Desrochers and Wellman (2011). The first, “spending per degree,” excludes all awards that are not associate degrees. The second, “spending per completion,” counts certificates and associate degrees equivalently.

Expenditures.³⁸ This measure of costs excludes investment income, public service expenditures, and self-sustaining activities independent from education; for the fiscal measure, I net out private fees and tuition. Thus, the relevant social expenditure averages \$39.9 million per college; the fiscal cost is \$29.6 million. The cost measure adjusts for regional price differences (and inflation) and is apportioned as a moving-average over three years. A regional price index from K-12 education (Taylor, 2005) and the HECA is used to transform all expenditures into 2008 dollars. To capture some of the mission-related differences in output, which may also in part adjust for student ability, I calculate efficiency measures separately for academic (comprehensive) colleges and those colleges with a strong emphasis on vocational/technical provision. Ideally, other considerations, such as inaccuracies in measuring depreciation and student ability, should be incorporated.³⁹

³⁸ This value correlates almost precisely with “education and general” expenditures and total expenditures ($p > 0.99$).

³⁹ The depreciation inaccuracy cannot be resolved in this paper because of inconsistent IPEDS data: depreciation measures are calculated very differently over the period 1987-2008, and the year 2006 has a depreciation estimate 300 percent more than in 2005 and 2007. There is no consistent balance sheet mapping before 2002 for public institutions. Also, some expenditures in operation and maintenance of plant may be more accurately classed as offsetting depreciation.

Box 2
Derivation of Cost Measure

Resource	Definition	Mean [SD] in 2008 (\$ millions)	Percent of Total Operating Expenses	N
<i>Foundation Measure of Costs</i>				
Total operating expenses [TOE]	Total operating expenses comprises the sum of all operating expenses that results from providing goods and services. Operating transactions are incurred in the course of the operating activities of the institution.	\$45.1 [56.5]	-	953
<i>Items Subtracted</i>				
1. Investment income [INV]	Investment income is revenues derived from the institution's investments, including investments of endowment funds. Such income may take the form of interest income, dividend income, rental income or royalty income and includes both realized and unrealized gains and losses at FASB institutions.	\$0.9 [3.6]	1.2% [2.4]	882
2. Self-sustaining activities [SSA]	The total amount of revenue from auxiliary enterprises, hospitals, independent operations, and other sources.	\$3.7 [4.9]	9.3% [9.4]	925
3. Depreciation [DEP]	Total expenses and deductions: Depreciation is the sum of operating and non-operating depreciation expenses.	\$2.0 [3.1]	4.3% [1.9]	904
4. Student fees [FEES]	Net tuition revenue is the amount of money the institution takes in from students after institutional grant aid is provided.	\$10.3 [13.3]	23.5% [14.8]	960
<i>Public Annual Operating Costs of Community College</i>				
TC = TOE – INV – SSA – FEES		\$29.6 [39.4]	62.0% [16.2]	884
<i>Other Adjustments</i>				
A. Inflation	Use HECA index			
B. Regional prices	Taylor-Fowler Cost of Education index by state for 2001			
C. Subject mix of provision	Colleges split by vocational/technical and academic			
D. Apportionment of costs over time	Three-year moving average of Total Costs			
E. Student ability/effort/scholarships	No adjustment made			

Note. Depreciation adjustment not applied because of inconsistent measures of depreciation over time. Regional price index from Taylor (2005); ECEC not available by state. Adapted from Delta Project, IPEDS data.

This paper calculates output, total costs, and unit social and fiscal costs. For cross-sectional comparisons between colleges, it uses data from the academic year 2008. For analysis of trends, it uses an unbalanced panel of data on colleges from 1987 to 2008.⁴⁰ In a separate section, I consider the sensitivity of the components of this measure.

Notwithstanding the possible imprecisions noted above, this measure appears to be the best available yardstick for looking at college efficiency. Importantly, it reflects

⁴⁰ The panel is unbalanced because some colleges open and some close and because some colleges have missing information in some years.

the goals of the colleges and students, the vast majority of whom enroll with the intent of earning some type of award. This measure—unlike a credit-based measure (or indeed no measure) —embeds the appropriate incentives for efficiency and yields a comprehensible logic for increasing efficiency. Unit cost will fall if the following occurs: more students complete, more students receive an award, fewer students are misplaced in remediation, fewer students accumulate surplus credits, and fewer students move across peer colleges (e.g., from one community college to another). One perverse incentive would be for colleges to seek to reduce their credit requirements such that students can graduate more quickly. Ultimately, these changes would impact on accreditation status.⁴¹

Finally, it is important to emphasize that this cost measure is most valid for analysis of an individual college over time; much of the measurement error may “wash out” (e.g., the student body is comparable in 2004 and 2010). It is less valid as a way to compare across community colleges. Across colleges, some of the measurement error may be orthogonal (e.g., capital costs are understated for all colleges). This measure is not appropriate for comparing across sectors (e.g., two-year versus four-year institutions), as the challenges noted above severely compromise any comparisons of the efficiency of two-year versus four-year institutions. In particular, the high rate of transfer at the two-year level introduces a severe downward bias in calculating their efficiency relative to four-year colleges.

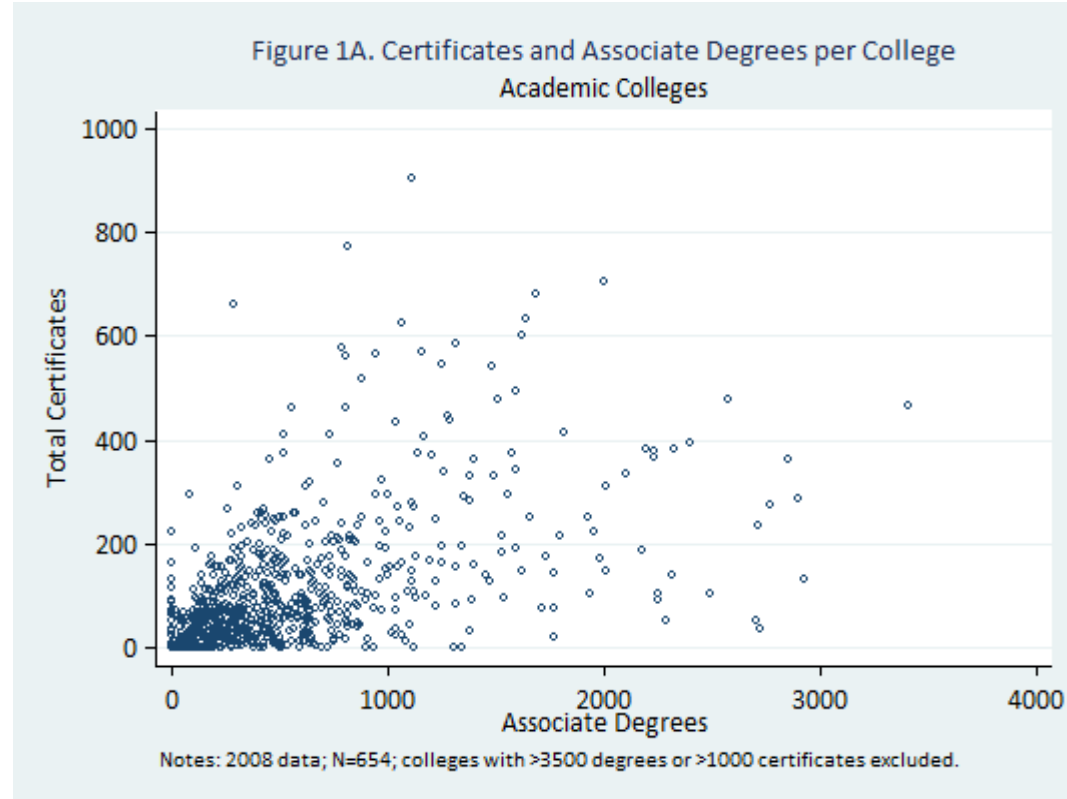
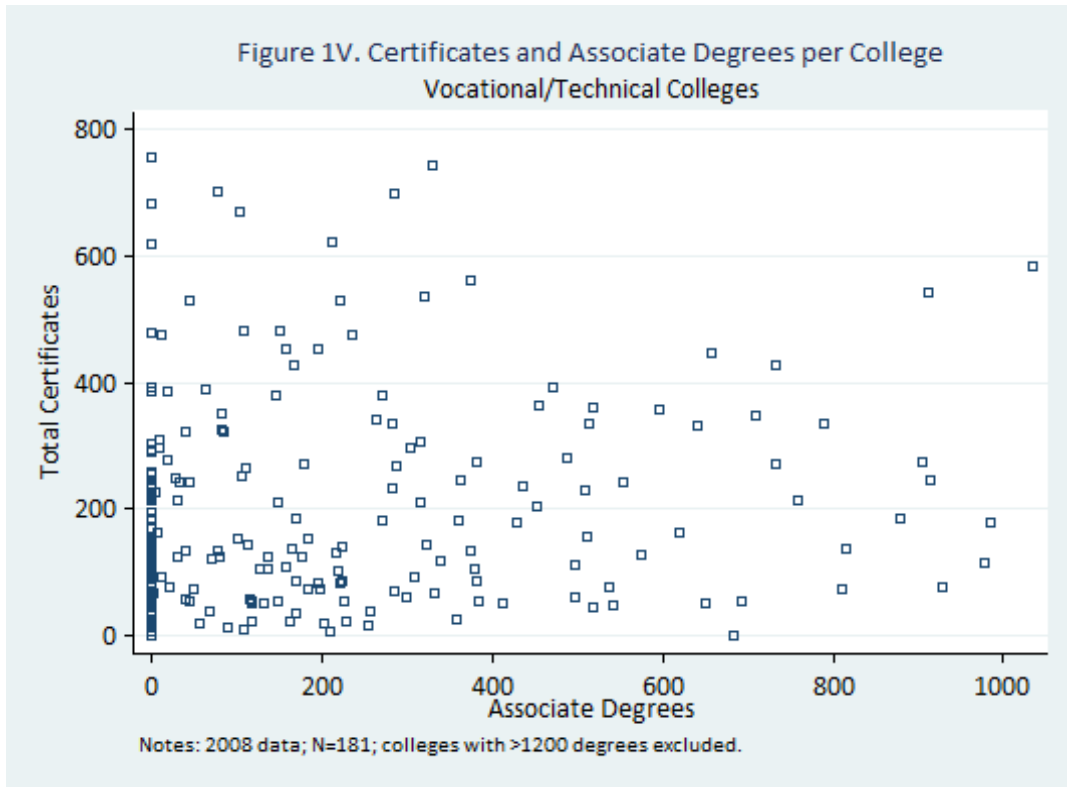
6.1 Output

The first depiction of output is of the production possibilities frontier (PPF): how colleges produce both certificates and associate degrees and the trade-off between these credentials. In theory, efficient colleges may differ in their proportion of certificates to associate degrees. But there should be a frontier: colleges producing at the same scale should also produce in the same proportion. If College X produces 200 certificates and 400 associate degrees and College Y produces 200 certificates and 200 associate degrees, one of these colleges is presumably inefficient in trading off production of certificates compared with associate degrees.

⁴¹ Another perverse incentive would be for colleges to poach students who are close to graduation. However, upper level courses are typically more expensive than lower level courses and poachers would incur advising and credit-transfer costs. So this perverse incentive may not be strong.

Figure 1 shows these PPFs for the two types of colleges in 2008. Academic colleges appear to reach a plateau at approximately 200 certificates annually—few colleges go beyond this scale—but the scale of associate degrees is much wider. Vocational colleges produce awards in a very different way: a significant proportion produce only certificates; the colleges producing both outputs do so in varying proportions and intensities.

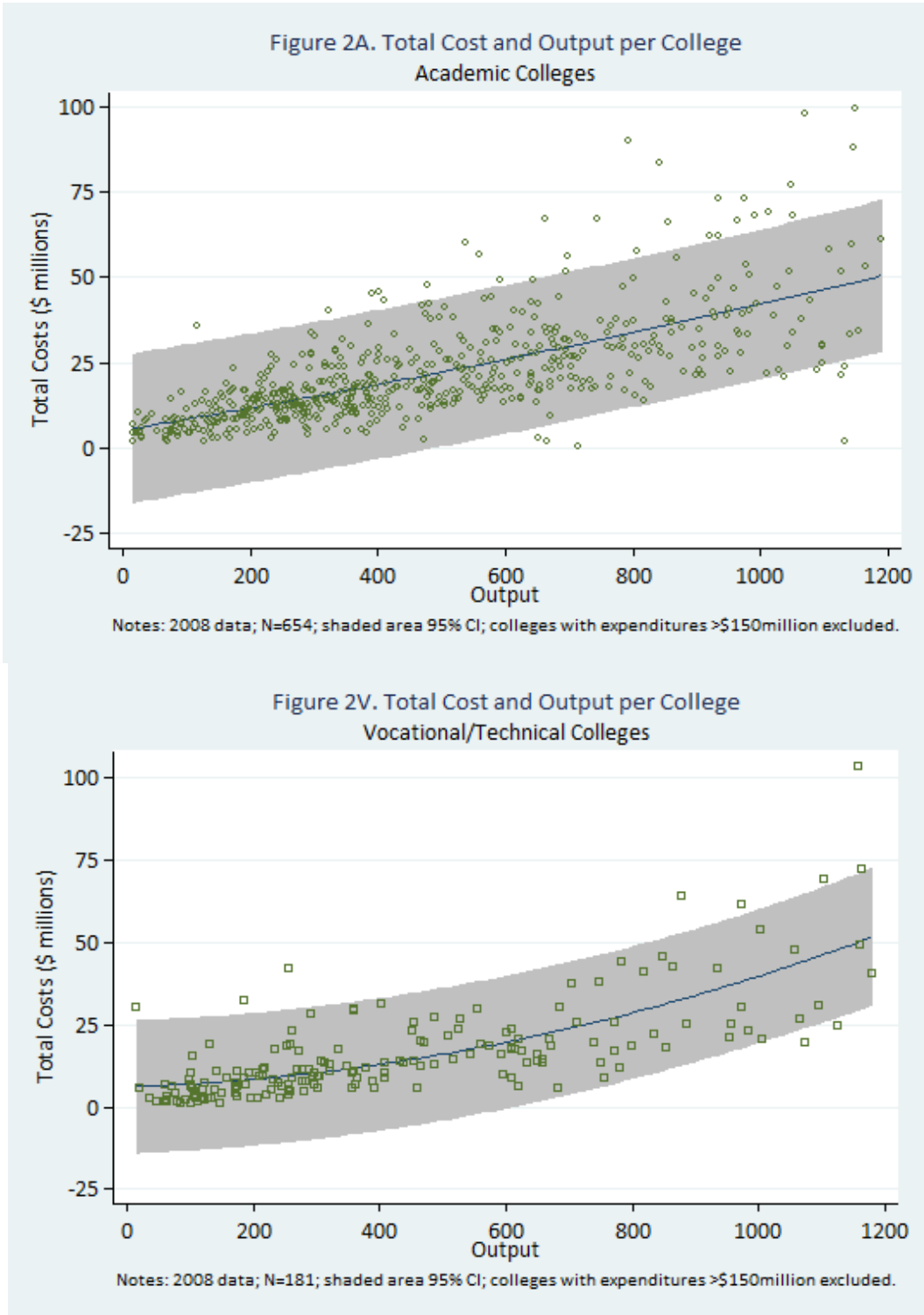
Figure 1
Certificates and Associate Degrees per College



6.2 Costs

As a preliminary exercise, I consider the Total Fiscal Cost function, i.e., how costs rise with output. This function will have an upward slope (it costs more to produce more) and it should also have an increasing slope: as output increases, total costs increase at a faster rate. If all colleges were equally efficient, they would all have the same Total Cost if they produce the same output. Figure 2 shows the Total Cost functions for academic and vocational colleges respectively; for each type a line of best fit and confidence interval are also shown. There is a clear upward slope to the Total Cost function. The functions also show an increasing slope; it is clearer for vocational colleges, with an inflexion at output equal to approximately 600. For academic colleges the greater variation at higher output levels makes it harder to see an inflexion: indeed, at output of 500, Total Cost is approximately \$25 million and at output of 1,000, Total Cost is approximately double at \$50 million. This indicates constant returns to scale over this range of output. Figure 2 shows that there are many colleges above and below the best fit line; they are inefficient and efficient colleges, respectively. Again, however, the variation increases markedly with scale. In fact, for vocational colleges producing up to 400 units of output, there is very tight clustering along the line of best fit.

Figure 2
Total Cost and Output per College



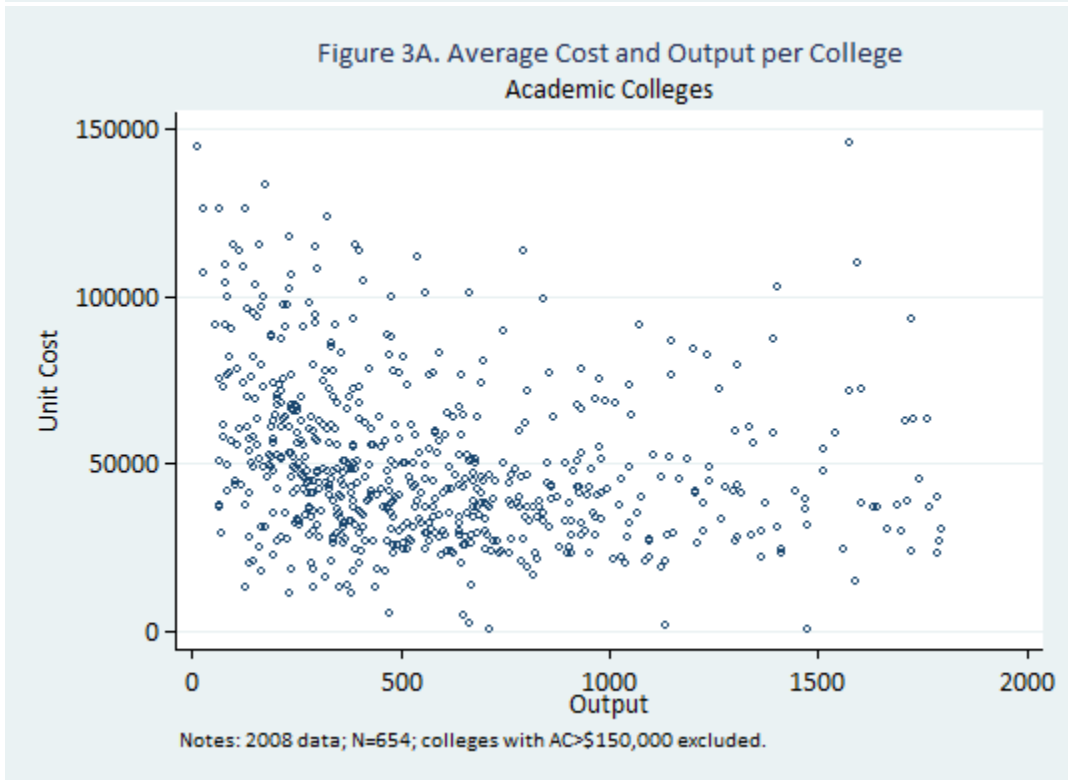
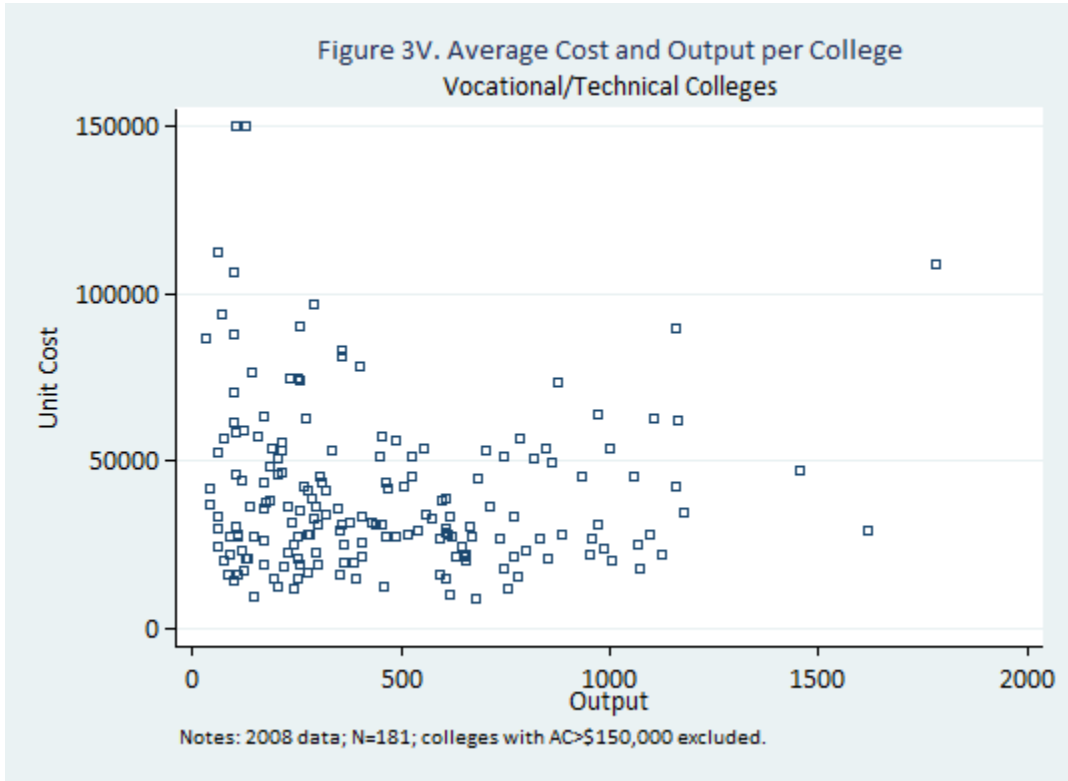
This paper’s preferred measure of efficiency—unit cost—is summarized in Table 1. Across academic colleges, the mean social unit cost is \$71,610 and fiscal unit cost is \$52,900 per associate degree. Across vocational colleges, the mean social and fiscal unit costs are lower, at \$56,930 and \$42,740. For both groups, there is a very large variance across colleges; as the mean exceeds the median, there is a small upper tail of colleges with very high unit costs. The spread of unit fiscal costs is given in Figures 3. Conventionally, the average cost function should decrease with output (increasing returns to scale) and then at some level of output increase (decreasing returns to scale). For academic colleges, increasing returns to scale are evident as output increases to 500 but beyond this level of output average cost appears to be stable. For vocational colleges, constant returns to scale are reached at even lower levels of output—approximately 250—and then there appears to be a slow upward slope to the average cost curve (decreasing returns to scale). Overall, however, there appears to be considerable variation in efficiency across colleges.

Table 1
Unit Cost in the Community College Sector

Type of Unit	Unit Cost per Associate Degree Equivalent (2008)			N
	Average	[SD]	Median	
<i>Academic Colleges</i>				
Social Unit Cost	\$71,610	[40,810]	\$62,230	
Fiscal Unit Cost	\$52,900	[37,480]	\$44,420	695
Pairwise correlation = 0.93				
<i>Vocational Colleges</i>				
Social Unit Cost	\$56,930	[31,340]	\$53,970	
Fiscal Unit Cost	\$42,740	[34,070]	\$33,320	191
Pairwise correlation = 0.94				

Note. 2008 dollars rounded to nearest \$10.

Figure 3
Average Cost and Output per College



Unit costs and graduation rates do not yield similar rankings of colleges. Colleges with the highest graduation rates are not necessarily the most scale efficient. Across the 690 academic colleges, only 14 were in the bottom decile when ranked using the 150 percent graduation rate and when ranked using the unit cost measure (i.e., 20 percent of the bottom decile). Across the 190 vocational colleges, only two were in the bottom decile for both ranking systems (10 percent). In fact, the correlation between unit cost and the 150 percent graduation rate is very weak: -0.08 for academic colleges and -0.13 for vocational colleges.

6.3 Output and Efficiency Trends

Figure 4 shows how unit cost has changed over the last two decades.⁴² The figures are in constant 2008 dollars from 1987 (the first year for which consistent data are available) to 2008 with academic and vocational colleges separated.⁴³

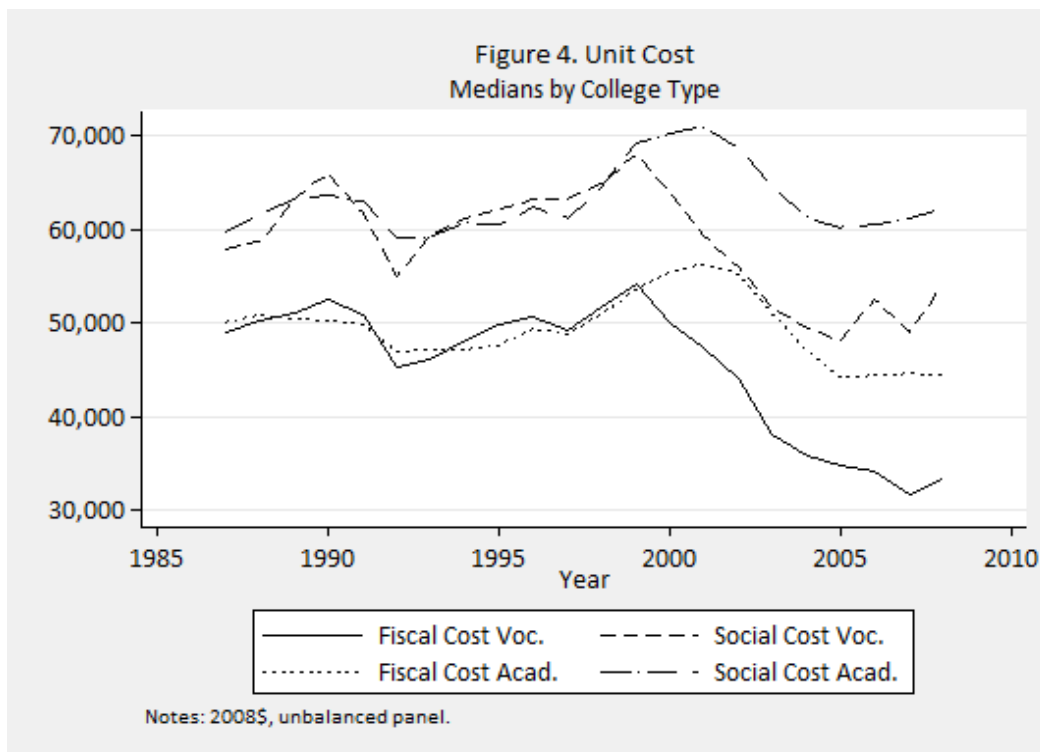
Unit costs have fluctuated over the two decades but the long run trend is for unit costs to fall. For academic colleges, the mean social cost was \$69,070 in 1987; by 2008 it had increased by only 4 percent (to \$71,610). Fiscal cost per degree for academic colleges has fallen; by 2008 the fiscal cost was 11 percent lower than it had been in 1987. For vocational colleges, the decline is even greater: unit social costs were 7 percent lower by 2008 and unit fiscal costs were 19 percent lower. Using the median values, the decline in unit cost is even sharper. Thus, colleges appear to have become more efficient in producing associate degrees. This conclusion is much stronger using the HEPI deflator but slightly weaker using the CPI deflator.⁴⁴

⁴² Trends are shown for the median but the trends are very similar for the mean.

⁴³ I leave aside the question of whether the quality of these degrees has fallen. Certainly, the labor market returns to college have not fallen over this period.

⁴⁴ Using the HEPI deflator, costs have fallen by an even larger percentage. Using the CPI, for academic colleges the unit social cost has risen by 12 percent and the unit fiscal cost has fallen by 3 percent; for vocational colleges, the unit social cost is exactly the same and the unit fiscal cost has fallen by 12 percent.

Figure 4
College Unit Costs



I now turn to rates of growth in output and average costs for individual colleges. Figure 4 shows the unit costs across the sector but this does not reveal what is possible for individual colleges. To get a better sense of how much change is possible, I calculate growth rates across the sector. Table 2 shows four-year growth rates for colleges, i.e., how much output and average cost changed, looking across two decades.

In terms of output, academic colleges grow slowly: the average increase in output between 2005 and 2008 was 1 percent. However, there is significantly volatility over the period 1989-2008; four-year growth rates ranged between -9 percent and +12 percent; and the distribution of growth rates changed (as shown by the relationships between the average and the median). The bottom panel of Table 2 shows how much growth in output is possible by looking at the performance of the best quartile of colleges. The fastest growing quartile of colleges expanded significantly: output at these colleges grew by at least 10 percent, with the potential for much higher growth rates.

Table 2
Trends in Output and Unit Fiscal Cost over Four-Year Periods

Period	Output % Growth over 4 Years		Average Cost % Growth over 4 Years (Real dollars)	
	Academic Colleges	Vocational/ Technical Colleges	Academic Colleges	Vocational/ Technical Colleges
<i>Average for All Colleges</i>				
1989–1992	0.1	0.7	-15.6	-14.1
1993–1996	1.7	-1.6	-2.0	-2.2
1997–2000	-8.8	-15.1	-2.2	6.4
2001–2004	11.5	8.6	-30.4	-58.3
2005–2008	1.2	-4.8	-15.8	-9.5
<i>Median</i>				
1989–1992	18.1	18.3	-11.6	-10.8
1993–1996	3.4	8.2	2.3	5.2
1997–2000	-2.5	4.6	11.0	5.1
2001–2004	14.3	17.5	-22.5	-26.9
2005–2008	3.3	2.7	0.2	1.8
<i>Best Quartile</i>				
1989–1992	30.4	30.7	-32.6	-32.1
1993–1996	17.1	28.6	-11.9	-7.7
1997–2000	10.1	16.7	-1.1	-5.4
2001–2004	26.5	30.3	-45.5	-55.6
2005–2008	14.8	14.3	-15.2	-12.8

Note. Four-year growth rate is calculated as $(X_{t+4} - X_t)/X_t$. Sample sizes vary across time periods. Best quartile refers to fastest growth in output and lowest growth in costs.

Vocational colleges exhibit even greater volatility in four-year output growth; four-year output actually fell by 5 percent between 2005 and 2008 (after rising by 9 percent in the previous four-year period). The median growth is also unstable. However, the fastest growing quartile of colleges is able to increase output by at least 14 percent over a four-year period.

There is similar volatility in average costs, as Table 2 shows. Generally, average cost fell over the two decades, but the rate of change varied dramatically. The distribution of the growth rates also changed, such that the median and average growth rates varied in sign in some periods. There is some possibility of a significant change in average cost over time: looking at the quartile of colleges that reduced costs the fastest, these colleges managed to reduce unit cost by between 5 percent and 56 percent over a four-year period.

6.4 Validity Issues

This section examines the validity of this measure (within the constraints of IPEDS data).

Table 3 shows the correlations between measures of unit cost based on alternative measures of output. The preferred measure is given in the “Output” column; other output measures are associate degrees only, total credits, and the graduation rate within 150 percent of time. The associate degree cost measure correlates very highly with the measure for academic colleges, but for vocational colleges the correlation is extremely weak. The credit-based measure is strongly correlated with each measure, but it is very highly correlated with a unit cost measure that uses full-time equivalents (0.84 and 0.90 respectively). At least from IPEDS, therefore, the credit-based cost measure is nearly equivalent to spending per student. Finally, the unit cost based on the graduation rate within 150 percent of time is correlated with the output measure, although significantly more strongly for vocational colleges.

Table 3
Correlations Using Alternative Measures for Calculating Unit Fiscal Cost

Type of Credential	Output	AA Degrees	Credits	GR150%
<i>Academic Colleges</i>				
AA degrees	0.90			
Credits	0.66	0.67		
Number GR150%	0.34	0.36	0.18	
FTEs	0.65	0.70	0.84	0.27
<i>Vocational Colleges</i>				
AA degrees	0.04			
Credits	0.75	0.02		
Number GR150%	0.56	-0.04	0.24	
FTEs	0.74	0.12	0.90	0.24

Note. Unit fiscal cost calculated based on alternative measures of college production in 2008. Output measure from Box 1. AA degree measure counts associate degrees awarded in 2009. Credits measure counts credit hour activity for undergraduate academic programs. Number GR150% counts the number of students graduating within 150 percent of normal time. FTEs is the number of full-time equivalents.

Moreover, the robustness across efficiency measures varies with the size of the college. Thus, there is a strong correlation between total cost and total operating

expenditure per college for 2008. But, as the scale of the college grows, the variance in costs to expenditures grows (both for academic and vocational/technical colleges). Similar patterns are evident when alternative measures of output (credit-based and graduation within 150 percent of time) and their corresponding average costs are applied. Also, the relationship between FTEs and output is strongly positive, but the variance increases with output.

Finally, I compare average cost and expenditure per FTE. Expenditure per FTE is total expenditure (adjusted as per Box 2) divided by the number of full-time equivalent students. In 2008 this was on average \$9,020 at academic colleges and \$12,310 at vocational/technical colleges. These are of course significantly below the average cost figures in Table 1 and indicate that academic colleges have lower unit costs. Again, there is a positive correlation between the two measures but the variance increases substantially for higher cost college costs.

As noted above, the two key challenges are transfer and student ability. For colleges in the sample, 21 percent of academic college students transferred in 2008. For vocational colleges, the rate is 14.6 percent. The implications for efficiency are significant but to estimate the precise effect requires a series of interwoven judgments about the value of each transfer. If every transfer student is counted as an output, then efficiency is grossly understated. Almost as many students transfer as graduate and, for more than half of community colleges, the output from transfer students would exceed that from awards. For academic colleges, the unit social cost would be \$32,360 (45 percent of the estimate in Table 1). For vocational colleges, the unit social cost would be \$39,950 (70 percent of the respective estimate in Table 1). Thus, the gap in efficiency that favors vocational colleges has been overturned when all transfer students are counted as output. (Unfortunately, even these changes cannot be regarded as the extreme because IPEDS appears to undercount transfers.) However, there is a strong correlation between the two cost estimates—those in Table 1 and adjusted for transfers: for academic colleges, the two cost estimates are correlated at 0.69; for vocational colleges, the correlation is 0.80. Thus, the omission of transfers may not significantly distort rankings of colleges.

As argued by Stange (2010), it may not be necessary to model student ability for open access colleges. Unfortunately, direct measures of student ability are not available. Instead, Figures 5 and 6 show the association between unit fiscal costs and indicators of student disadvantage. Figure 5 shows the association between unit cost and the proportion of students with FISAP Total Income (FTI) less than \$15,000. For the academic colleges there is a strong association between unit cost and proportion of low-income students: costs are much higher when the student body consists of more low-income students. However, this association is not evident for vocational colleges. Figure 6 shows the association between unit cost and the proportion of students at the college receiving financial aid. Neither of these figures shows any obvious association between costs and levels of student disadvantage.

Figure 5
Association Between College Unit Cost and Student Income

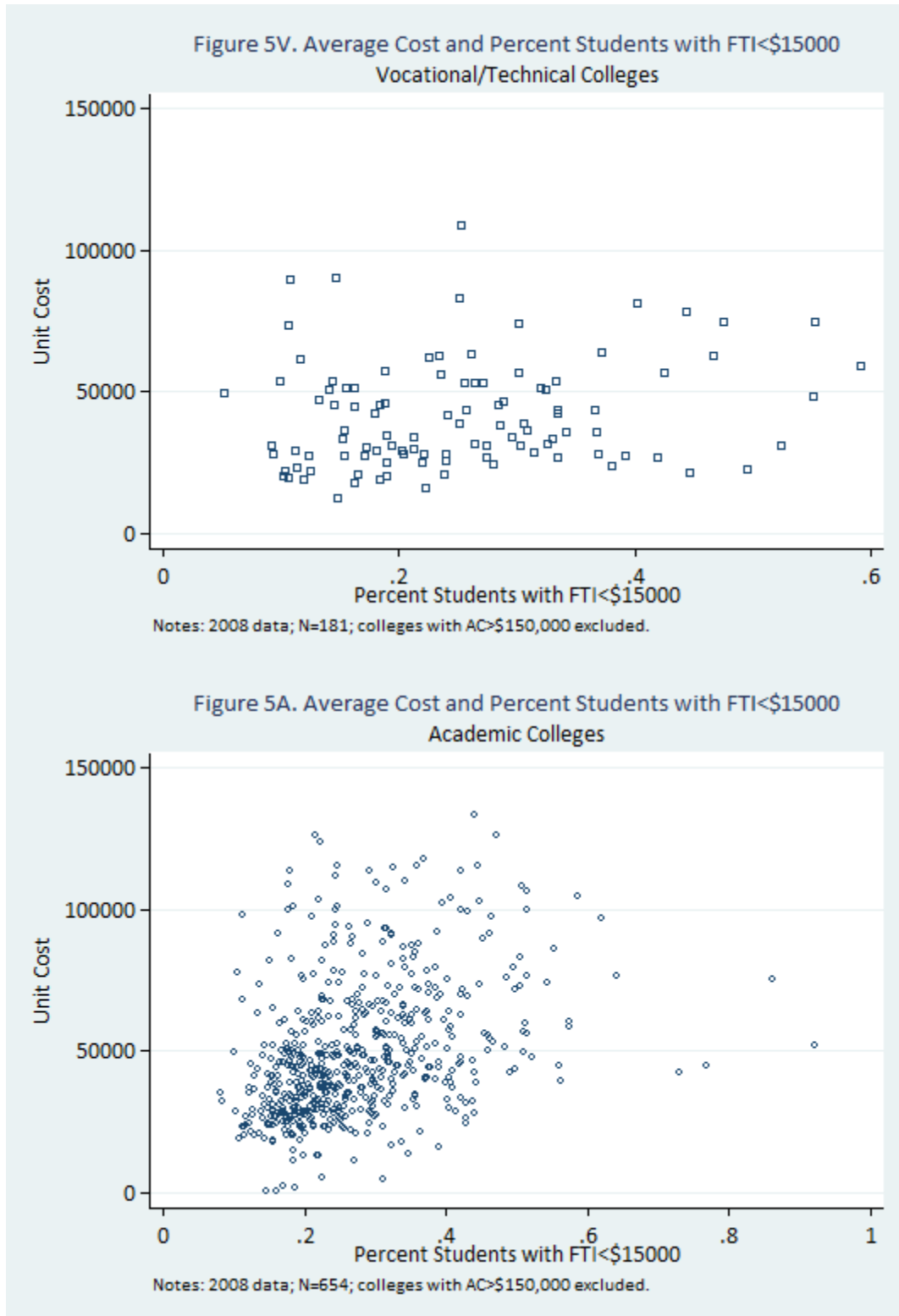
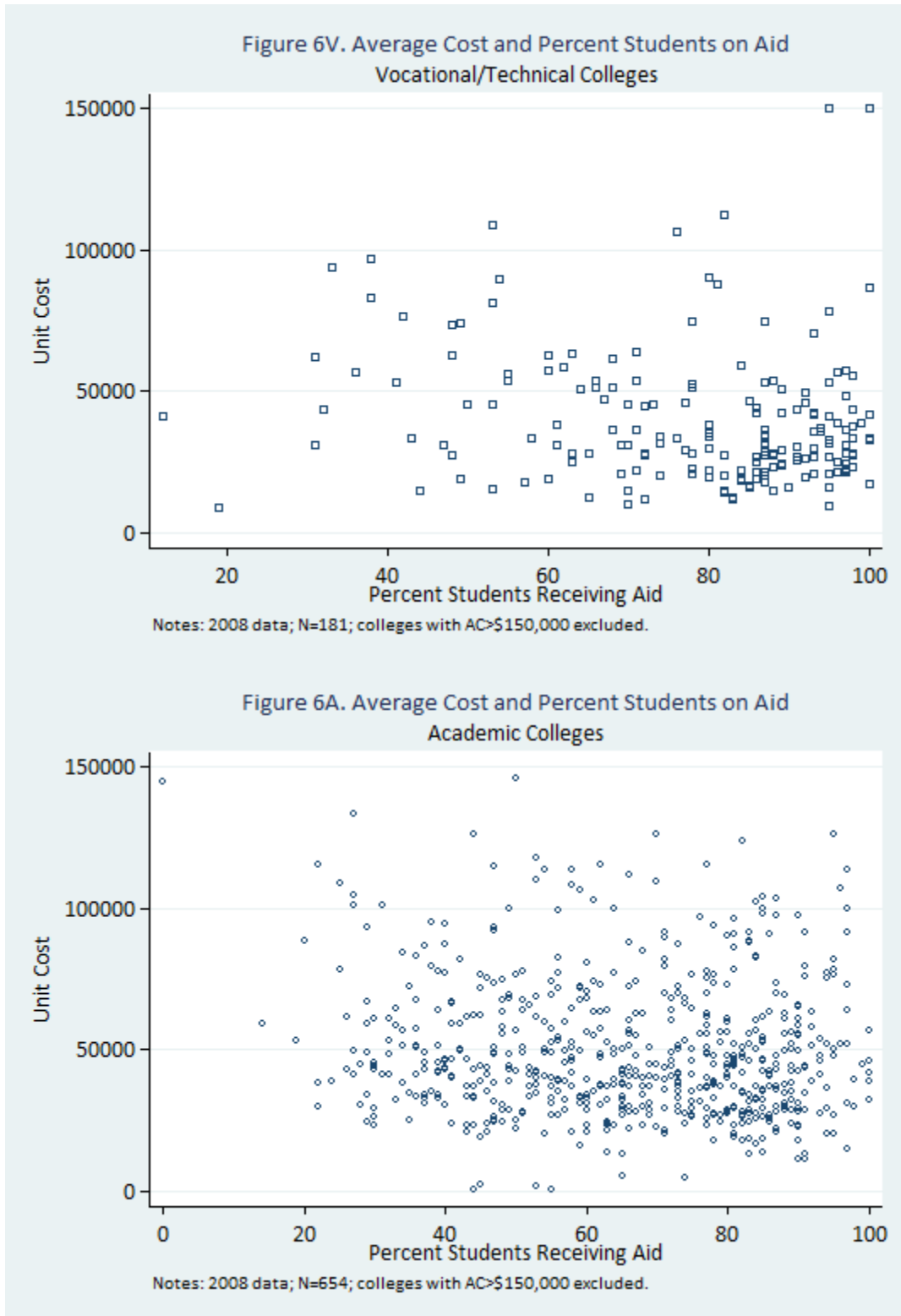


Figure 6
Association Between College Average Cost and Student Income



7. Conclusions

This paper sought to present a method for determining efficiency for the community college sector. A review of the literature indicates considerable ambiguity (even confusion) over terminology—key terms such as “efficiency,” “productivity,” “cost-effectiveness,” “rate of return,” and even “unit cost”—which hinders the development of a body of research that is useful for policy.

The paper therefore argues for a return to basic economic terms and a focus on unit cost (Total Cost divided by Output) as the most useful measure of efficiency from the public perspective. It describes a preferred method for measuring efficiency, one that excludes student fees. This method requires making series of assumptions about what should be counted in Total Cost and in Output. There may be reasonable debate about these assumptions—and the paper’s sensitivity analysis suggests that it does matter which assumptions are made—but it is important to be explicit about what is assumed. Many of the cost and output measures are correlated, but there is still considerable variation and this increases with the size of the college. A critical issue is the extent to which IPEDS can accurately measure efficiency, which depends heavily on the importance of the transfer goal at community college.

The empirical work here on output and costs at individual community colleges yields several conclusions. In terms of output, academic community colleges rarely produce more than 200 certificates per cohort, but their output of associate degrees is more flexible; indeed, a large subset of vocational colleges produces zero associate degrees. Operating expenditures and total costs are positively correlated, but the correlation is considerably weaker at larger colleges. Total cost is increasing in output, with an inflexion point at approximately 600 degree awards; economies of scale appear to be exhausted beyond that level of output.

This paper further estimates the median average cost per associate degree in 2008 to be \$45,900 at academic colleges and \$36,950 at vocational colleges, a much more useful metric than the graduation rate. Even as graduation rates have flat-lined, the real costs of college are significantly lower in 2008 than in 1987. Indeed, this unit cost measure can be directly related to the benefits of attending community college and so partially address allocative efficiency issues. Trostel (2010) has calculated the present

value taxpayer benefits of an associate degree at \$137,400. Comparing this to the estimates here, it is evident that the economic benefits per associate degree exceed the costs by a factor of at least 3:1.

However, the analysis of average cost undertaken in this paper suggests that very few colleges are on a cost minimization frontier: for a given level of output, some colleges have much higher unit costs than other colleges. Moreover, the time trends show considerable volatility. Over any four-year period, a best-case estimate in the growth of output would be approximately 10 percent; even the fastest growing quartile of colleges only grew by 30 percent. Over the same duration of time, average cost might fall sharply, perhaps by as much as 50 percent; but this fall is unlikely to be sustainable and might even revert in subsequent periods. Reflecting this volatility, average cost followed a cyclical trend over the last two decades. This analysis suggests caution in expecting large efficiency gains from reorganization of the community college system.

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Appendix

Total Annual Expenditures: Community College Sector

Community College Activity	Expenditures (\$ millions)	Percent of Budget
Instruction	\$19,103	40%
Institutional support	\$7,136	15%
Student services	\$4,604	10%
Academic support	\$3,733	8%
Scholarships	\$3,979	8%
Other (incl. research)	\$2,703	6%
Operation and maintenance of plant	\$2,661	6%
Auxiliary spending	\$2,398	5%
Depreciation	\$1,213	3%
Public service	\$795	2%
Total	\$47,531	

Notes: Fiscal year 2009; 2009 dollars. Source: IPEDS data.