Higher Education "Output Costing"

Chunjuan Zhu
Erez Lenchner
Nathan Dickmeyer
Institutional Research & Assessment
LaGuardia Community College
May 7, 2013

Abstract

The growing costs of higher education have increased the demand for financial accountability. Yet, tying cost to the key community college performance indicator, the ability to bring students to graduation, is seldom done. This paper models the costs associated with the output production of community colleges: graduates, transfers and drop outs. We employ a cost production model using public two-year community college financial and enrollment information collected through the Integrated Post Secondary Education Data System (IPEDS). We tested the reasonableness of the national simulated model using detailed financial information from a large urban community college. We then examined the differences between the general sector model (with limited information) and the case-scenario (with detailed information). Implications to output costing are further evaluated and discussed.

Introduction

As higher education costs increase, community colleges are not immune to being held accountable for their outcomes, especially during economic downturns. In response to these pressures, we attempted to apply pure business output cost analysis to our own college. Thus, please picture a college as a production facility where artists and craftspeople fashion what you believe are valuable works of art: graduates. Some of the students that your craftspeople work with are left unfinished and leave your college without a degree. Others also leave unfinished, but go to other facilities to attempt to become valuable graduates. Thus, in any year your "production" consists of finished grads, partially finished early transfers, and partially finished non-returners. Most students, however, remain "in production" as continuing students and return the following year or a later year.

A brief overview of the previous literature on output costing in community colleges

Massy (2011: 2) differentiates between efficiency as viewed by colleges and efficiency as viewed by an economist. From a college administrator's perspective, efficiency is measure by whether or not students are studying what the faculty indeed planned for those students to study. On the other hand, from the economics perspective, efficiency should be measured as the cost per 'produced' unit, hence per graduate. Massy (ibid: 5) then focuses on two largely comparable outputs across colleges: credit hour production and degrees/certificates awarded. Further, Massy (ibid.) and Johnson (2011: 6) suggest controlling for the field in which the degree is granted, as well as the institutional type used to generate the specific degree. Johnson demonstrated using SHEEHO (State Higher Education Executive Officers

Association) data that a limited number of high cost majors has a very large effect on the total cost of production (e.g., engineering, biology, computer science, ibid:4-5).

The unit cost for higher education production has been explored in several studies. Most recently, Hurlburt and Kirshstein (2010: 4) evaluated expenditures per student in higher education institutions, adjusting for inflation. They asserted that spending per FTE (full-time equivalent) in two-year public community colleges remained consistent (between 10 and 15 thousand dollars—in constant 2010 dollars—per FTE) over a period of ten years. Desrochers and Kirshstein (2010: 1) also report that community colleges suffered the greatest financial cut per FTE from all post secondary institutions following the 2008 downturn. In addition, diligent economists note three components of unit costs that are usually underestimated, or not estimated at all (Johnson, 2011: 14): Capital and infrastructure, student lost wages and added expense burdens above tuition and fees, and tax-exemption benefits as indirect costs to supporting tax jurisdictions.

In terms of output costing, a handful of recent studies have evaluated the cost of producing a degree. Johnson (ibid.) produced an estimate of between $26,000 and $40,645 (catalog cost and actual cost, respectively) for a baccalaureate degree. His calculations did not control for degree category, although he did estimate potential variation. More recently, Belfield (2012: 39) analyzed information from a 20-year Delta Project dataset. The Delta cost project uses IPEDS datasets and adjusts for changes in financial reporting rules over time (but not necessary over sectors). He estimated the median average cost per associate degree to be $45,900, if granted through four-year schools and $36,950 at vocational, two-year community colleges (ibid.). These estimates will also vary by major and region.

Research Questions

This paper addresses the following questions:

(a) What is the total cost on average of producing each of these three outputs: graduates, drop outs, and continuing students?
(b) What is the resource/effort allocation for each type of output? How many students fall into each output category in a year? What is the total value of the production function? What is the value of the "inventory" of students who will return to the college?

Previously, many college cost analyses focused on cost per credit generated, assuming that credits generated was a unit of output. Nevertheless, a more disaggregated and outcome-oriented set of annual outputs for higher education would be (1) graduates, (2) students who transfer to other institutions and (3) students who fail to return to higher education. Since each of these types of leavers accumulates, on average, very different numbers of credits over a number of years, the true cost to the institution of producing each of these "products" is also very different.

The rest of the paper is built as follows: We begin by presenting the output costing methodology and applying it to the case of a large, urban, two year community college. After calculating output costs for the private case, we compare the results with national data. This proved challenging because counts of the numbers of students not returning to college are not maintained in national data. In the end, we built a rough flow model of national two-year public college enrollment and used what variables we found from BPS and IPEDS sources to calibrate it.

Sampling and Methodology

Sampling

Following Massy's (2011) recommendations, we limited our analysis to two-year public colleges, hence controlling for the type of institution used to generate the outputs. In addition, limiting the study to two-year public community colleges allowed us largely to deal with expenses reported by different colleges within a comparable framework of similar accounting rules.

Institutional Level (the college-level study)

We derived performance data for all students enrolled during the fiscal year 2010-11 (four sessions). For this period, there were nearly 24,000 different individuals enrolled in for-credit courses at the College, including non-degree students. Of these, 20,374 began degree enrollment after spring 2000. We eliminated 371 students from the calculations who began earlier than fall 2000 because we do not have course enrollment data for those students' entire careers.

To find cost per credit, we used the total educational and general expenses of the College less expenses for research, public service, scholarships, and mandatory transfers for each of the fiscal years beginning in 2000-01. We used the CPI to change all historical dollars to current dollars to allow summing of costs. We then summed all equated credits taken in all courses during the fiscal year, including developmental courses. The fiscal year at the College begins with spring session II and ends with spring session I. The cost per credit was then found by dividing total expenses in the fiscal year by the total number of credits attempted during the four sessions of that fiscal year.

Inflation-adjusted costs per credit ranged from $340 in 2000-01 to $461 in 2009-10.

The cost of each student was then found by multiplying the number of credits the student took in each fiscal year by the cost per credit for that year and summing over all years in his or her career. We then averaged these costs over all students in each output or continuing category.

National Level

Replicating this methodology at the national level does not appear to be possible because we cannot directly determine the years when credits are earned. Also, while we know the enrollment each year and the number of graduates, we do not know the number of students who leave college without returning each year. Fortunately, a third challenge at the national level, making annual costs per credit comparable, does not appear significant. Although inflation may have had a small effect, calculated cost per credit does not appear to vary much from year to year.

To find indirectly the number of students who return to each institution, we constructed a flow model of enrollments, using the Beginning Postsecondary Studies (BPS) data. This study, conducted by the National Center for Education Statistics (NCES) followed student higher education enrollment patterns for nearly six years, beginning in Fall 2003. BPS was also the first data collection in which students reported patterns were verified using both administrative/transcript and national records (e.g. national student clearinghouse), thus increasing data reliability. BPS data guided the setting of model parameters so that the model predicted known national data from IPEDS for the academic year 2010-2011.

The flow model was constructed using a full year as the basic time unit and attempted to simulate enrollment into and out of all public two-year colleges in the U.S during each year. All inputs, enrollments, and outputs therefore had to be for a full academic year (and not fall semester snapshot data). The simulation was constructed as an input-output flow model using a rolling six-year horizon to conform to the BPS horizon. Inputs included the number of new first-time students and the number of students transferring into community colleges. The outputs were students with certificates, students with associate's degrees, students transferring to another college, and students leaving college and not returning. We used IPEDS data to determine the unduplicated number of new, first-time students annually and to determine target numbers for annual unduplicated headcount and numbers of certificate and associate's degree recipients.

The model assumed that the "destiny" of each entering student was known at the time of entry. Thus, entering students were put into pools that would eventually receive a certificate, associate's degree, transfer out, drop out, or continue past the six-year rolling horizon. We used BPS data to estimate the distribution of new students into these pools. The number of students withdrawn from the pools each year equaled the number in pools divided by the average academic life of the pools. We used BPS data once again to estimate average lives. That is, if, on average, students took six years to graduate with an associate's degree, one-sixth of the "destined for an associate's degree" pool was removed as output each year.

BPS data indicated that students spent an average of one year between colleges after leaving to transfer. We also noted from that data that only a fraction of those who transferred out each year returned to the community college sector, but that many of those lost were replaced by students from other sectors. Thus, we built the model such that some fixed fraction of the transfer out output became the transfer-in input for the year after the next year.

BPS data indicated that after six years, some students were still enrolled. The model put those students in a continuing pool and each year took one-sixth of them and put them back into the transfer-in number to be redistributed to the destiny pools.

The following two tables give the basic parameter data for the model from the BPS survey. Table 1 shows the disaggregated "destiny" of students entering two-year public colleges. We used the probabilities given in the aggregate, "total" line. Table 2 gives the number of credits earned before the outcome was reached, once again from the BPS. This table allowed us to estimate the two-year college "lives" for each outcome type of student, using NCES data indicating annual numbers of credits earned.

Cumulative retention and attainment at first inst 6-yr total 2009 by Degree program during 2003-04 for First institution sector (level and control) 2003-04 (Public 2-year, Private not-for-profit 2-year, Private for-profit 2-year).

Cumulative retention and attainment at first inst 6-yr total 2009	Associate's degree	Certificate	No degree, still enrolled	No degree, transferred	No degree, left without return	Total
	(%)	(%)	(%)	(%)	(%)	
Estimates						
Total	15.5	5.9	8.9	32.3	37.4	100%
Degree program during 2003-04						
Certificate	4	47.6	4.8	16	27.7	100%
Associate's degree	17.7	3.5	9.1	32.4	37.3	100%
Not in a degree program	7.8	6.2	9.1	36.5	40.5	100%

Source: U.S. Department of Education, National Center for Education Statistics, BPS:2009 Beginning Postsecondary Students

Table 1

First Institution Outcomes: Number of Credits Taken

	Earned Associate Degree	Earned Certificated	No Degree-Transferred	No Degree-Left without Return	No Degree-Still Enrolled at the Institution
First Degree Program					
Total	80.7	50.7	53.8	36.1	59.2
Certificate	‡	54	34	23.2	‡
Associate	79.4	55.4	54.3	37.6	59.4
Non-Degree	94.3	31.6	54	32.1	62.9

Source: BPS

‡ Too Small for Valid Estimates

Table 2

Based on the data from the BPS, we set up the "destiny" enrollment flow model using these parameters in Table 3.

	Freshmen		New Transfers-In		
	Destiny %	Ave. Life in Yrs.	Destiny %	Ave. Life in Yrs.	Transfer Factor
Graduate--cert.	6%	3.00	12%	2.50	0.95
Graduate--assoc.	18%	5.90	24%	5.40	
Transfer	32%	3.58	24%	3.08	
Non-returning	37%	3.00	32%	2.50	
Continue	7%	6.00	8%	5.50	

Table 3

We ran the flow model beginning with approximate data in academic year 1999-2000, and actual NCES unduplicated annual new, first-time student data from 2005-06 to 2010-11. The parameters above are the result of "tweaking" to allow the model to exactly hit the NCES total annual enrollment for 2010-11 and approximate the number of graduates that year as shown by NCES for certificates and associate's degrees for public two-year colleges.

We had very little data for new transfers, however. We did know from BPS data that transfers earn about one semester of credits before transferring, and we used that information to reduce their average expected "life" in the system. We also assumed that their destiny profile was equivalent to a new student who had "survived" one semester. Thus, the drop-out rate is lower and transfer and graduation rates are higher.

We did not know, however, how many of the transfers out, made it back into the community college system. BPS data told us that on average transfer students waited one year before re-entering. Thus, the model assumes that new transfer students equal the number of transfer-out students from the year once removed from the previous year, times some factor. The factor that worked best was 95%. That is, the number of transfers into community colleges from outside the community college sector nearly equaled the number of early (pre-degree) transfers out to colleges outside the community college sector. This seems high, but lower numbers did not reproduce the graduation outcomes of actual NCES data.

Table 4 shows the result of the flow simulation.

Year 2010-2011

Input	
New	2,399,447
Transfer in	766,068
Inventory	
Continuing	7,739,733
Total	10,905,248

Size of Destiny Pools	
Freshmen	
Graduate--cert	388,755
Graduate--assoc	1,968,154
Transfer	2,470,813
Non-returning	2,464,313
Continuing	753,294
Transfer	
Graduate--cert	259,388
Graduate--assoc	962,916
Transfer	620,830
Non-returning	691,701
Continuing	325,085
Total	10,905,248

Output	
End of year:	
Graduate--cert	233,340
Graduate--assoc	511,903
Transfer	891,739
Non-returning	1,098,118
Still in school, return to destiny pools	184,655
Total	2,919,756

Table 4

The goal of the model was to attempt to establish an appropriate set of annual output numbers for the public two-year college sector. While the model was off by less than 20,000 for associate's graduates for that year, the number of certificates was about 127,000 too low. We believe that the model is correct in terms of certificates as "output" and that many of the certificates reported in NCES data are not "output" in the sense of the model. They are certificates received "en passant," and the students continue in college. Many of them go on to receive an associate's degree later. The model is thus internally consistent as an input/output flow model.

In 2010-2011 total unrestricted current expenses less research and community service dollars comes to over $44 billion dollars for public two-year colleges. In that year these colleges generated nearly 120 million credits of instruction. The resulting cost per credit of instruction is $371. While there are some anomalies in the intervening years as accounting standards shifted, the same calculation yields $369 per credit of instruction generated in 2004-05. We used the 2010-2011 amount as our estimate because we did not know in what year the credits for each of our outputs were generated.

Findings

As can be seen on the left side of Figures 1 and 2, during the four sessions in fiscal 2010-11, LaGuardia Community College produced 1,954 associate's degree graduates at an average cost over the academic career of these students of $35,519. The national figure is 511,903 associate's degrees, costing $29,936 each on average.

The College produced 878 early transfer students (students whose last semester occurred during 2010-11, who did not graduate from LaGuardia in 2010-11, but who were subsequently recorded in the National Clearinghouse as attending another college) and who cost $20,783. Nationally, over 890,000 students are estimated to have transferred out at an average invested cost of $19,957.

Of the students who attended at least one of the sessions in fiscal 2010-11, 6,210 never returned after spring 2011 and cost $19,107. Nationally, we estimated over one million drop outs had cost colleges $13,391 each.

The major differences between LaGuardia and national figures occur with the proportion and invested cost in continuing students. Both the individual invested costs and numbers of students continuing are much lower for LaGuardia. LaGuardia students appear to reach their "destiny" more quickly than that indicated in the BPS data for all students.

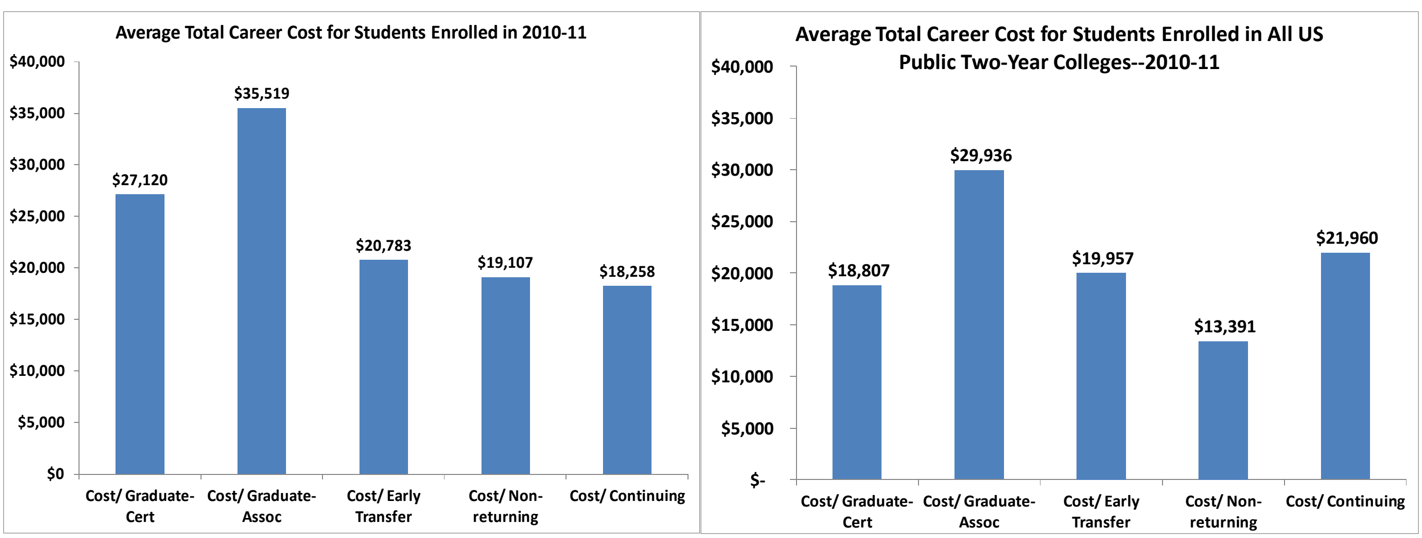


Figure 1

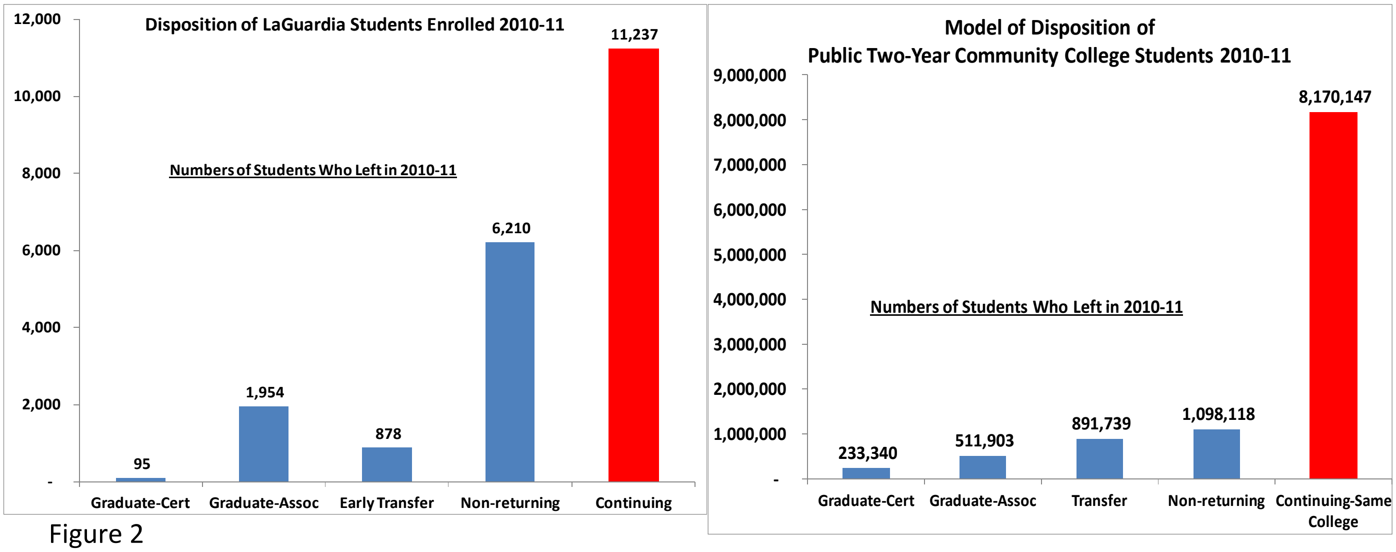


Figure 2

The average career cost differs among certificate recipients, associate's degree graduates, early transfers and non-returning students because the total number of credits attempted on average by each of these groups varies widely. The more credits a student attempts during his or her career, the higher the cost of "production." At LaGuardia, graduates attempt about twice the number of equated credits attempted by non-returning students as shown in Figure 3. "Equated credits" include equivalent hours enrolled for zero "real" credit developmental courses and freshmen seminars. Credits transferred from other institutions are not included. According to BPS data, however, students take slightly more credits to reach a degree nationally than at LaGuardia, and those enrolled are further along than students at LaGuardia, according to our model using BPS and IPEDS data.

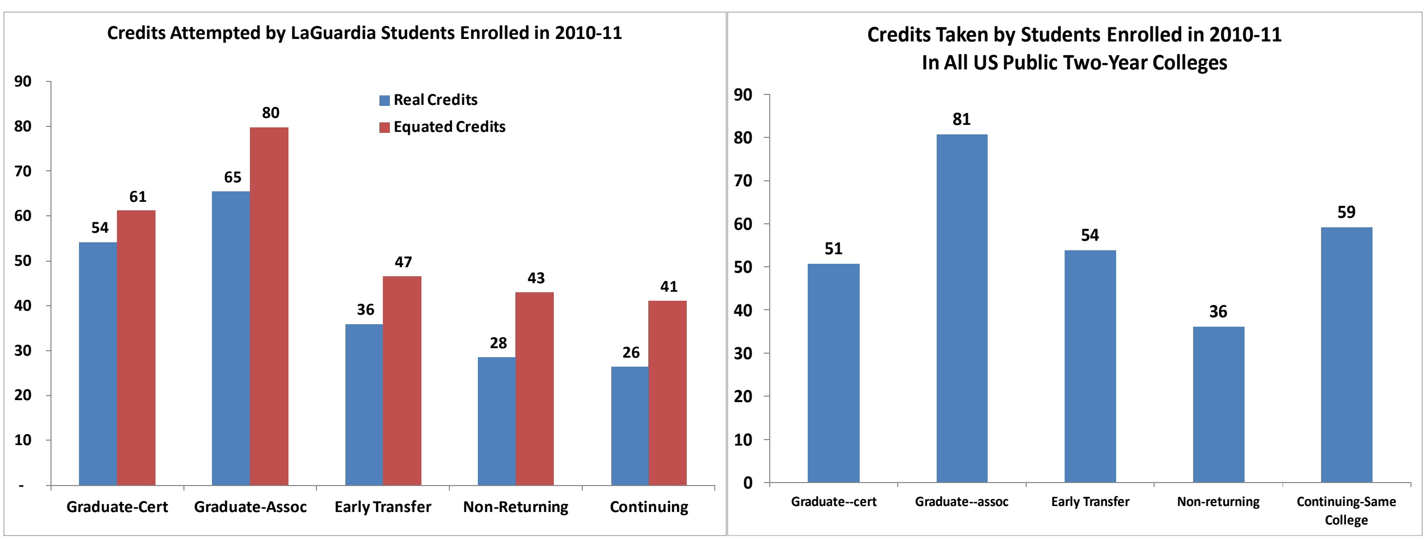
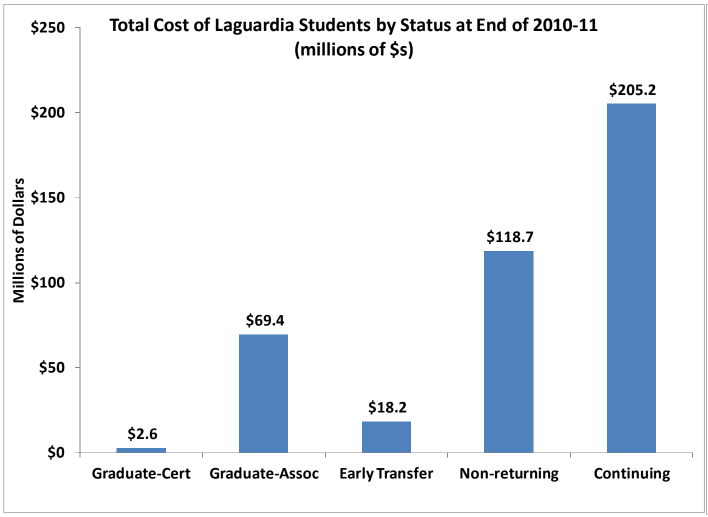


Figure 3

The average cost of a graduate times the number of graduates gives us the total cost required to produce the graduates from 2010-11 over their academic careers at the college. As seen on the left of Figure 4, producing the 1,954 LaGuardia associate's graduates required an investment of over $69 million. We had invested over $18 million in students who left in 2010-11 to attend other colleges, and over $118 million in students who never returned to higher education. We also “carried forward” over $205 million invested in students who returned to the college after 2010-11.

Nationally, graduates left with over $19 billion invested, while transfers moved nearly $18 billion within the sector. Non-returning students left with accumulated costs of nearly $15 billion, while continuing students represented an amazing $179 billion of investment.



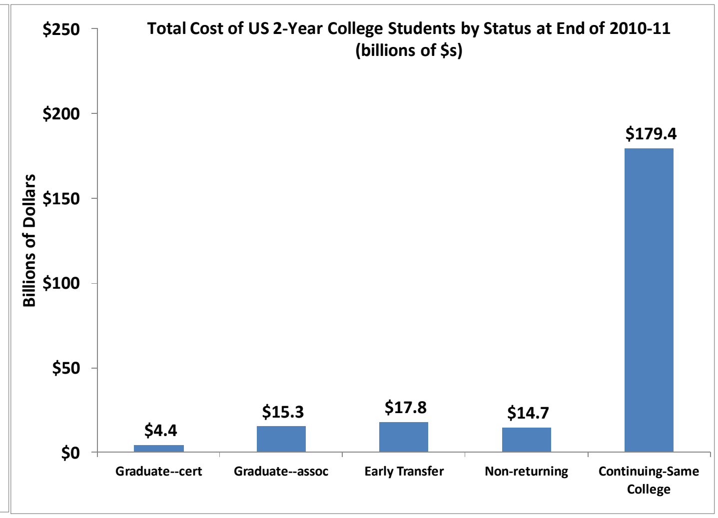


Figure 4

Discussion of Results

The implications of this research for LaGuardia are not clear. The College has always tried to reduce the numbers of students who leave before graduation. We now see, however, that most non-returning students do not draw down large amounts of resources individually. The cost to the college when the College takes a risk and admits a student who fails to complete is only $19,107. Nevertheless, we can see from the calculations in this paper that any program that reduced student attrition and transformed non-returners into graduates would put enrollment and financial pressure on the college. For a discussion of the national implications of such a transformation, see, for example, August, B. A., Cota, A., Jayaram, K., & Laboissiere, M. C. A. (2010).

Nevertheless, the result showing that the College spent over $118 million on students who failed to either gain a degree or transfer to another college is troubling.

We also found it troubling that non-returning students had, on average, attempted so many credits, 43 including the equivalent credits for developmental courses. Further analysis showed that many of our students leave with substantial numbers of credits, causing the College to put greater emphasis on retention programs aimed at the needs of more advanced students.

The high cost of producing a graduate should not raise concerns, although the large number of attempted credits, compared with the normal 60-credit associate’s degree is of concern.

The final question that the analysis raises is how to measure the benefit to non-completers of their experience. We now can measure the cost. Have we measured the benefit sufficiently?

References

August, B. A., Cota, A., Jayaram, K., & Laboissiere, M. C. A. (2010). *Winning by degrees: the strategies of highly productive higher-education institutions* (McKinsey & Company Education Report). New York NY: McKinsey & Company.

Belfield, C.R. (2012). *Measuring Efficiency in the Community College Sector,* Community College Working Paper 43. New York, NY: Columbia University
Desrochers D., Kirshstein R.J. (2010). *College Spending in a Turbulent Decade: Findings From the Delta Cost Project*. Washington DC: American Institute for Research (AIR).
Hurlburt S., Kirshstein R.J.(2010). *Spending: Where Does the Money Go?* Washington DC: American Institute for Research (AIR).
Johnson, N. (2011), *Linking Costs and Postsecondary Degrees: Key Issues for Policymakers, Working Paper 2011-03,* Washington, DC: Future of American Education.
Massy, W. F. (2011). *Metrics for efficiency and effectiveness in higher education.* Washington DC: National Governors Association, The Miller Center on Public Affairs.

Appendix: Additional methodology notes for practitioners

1) **Choice of finance variables:** We intended to include direct and indirect costs of instruction. While much of the research done at the College pertains to improving instruction, we chose to exclude it. Much of the expense of non-credit instruction is carried in the Community Service expense category and was also excluded. We are seeking more feedback on the wisdom of our choices.

2) **Critical variable:** The most important variable for determining output cost in each category is the average number of credits attempted by students in that output category. The year the credits were taken is less important, although a gradual increase in real dollars per credit is visible as a trend.

3) **Variances between national and LaGuardia data.** There are two points where the national data is not defined as tightly as we were able to define the data using data from our own college. First, we were able to include credits that do not count toward a degree. Second, we were able to use credits attempted, not just earned. Since this error appears in both the numerator and denominator for the national calculation of output cost, the errors are somewhat offsetting, except in the distribution among students. To the extent that non-returning students attempt and fail to earn credits or take more zero-credit developmental courses than graduates, the cost per non-returning student in the national data may be somewhat low compared with our data and the cost per graduate somewhat high. Nevertheless, given the number of approximations used to arrive at the numbers of non-returning students, the cost figures are remarkably similar between the national data and LaGuardia data.

4) **Accounting changes:** In the final year there is a large increase in total college expenses reported to NCES, resulting from a change in City University central system expense allocations.

5) **Disaggregating by academic major:** This methodology is not appropriate for estimating costs below the level of the entire college. The costs per credit are not differentiated by department or faculty member. We were able to note differences among majors in the average number of credits required to earn a degree, however. As a result of this supplemental research we found some departments attracted students requiring more developmental course work than others.