College Transfer Performance: A Methodology for Equitable Measurement and Comparison

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Accountability in performance is a subject of increasing attention and concern for community colleges. In California, much attention has been focused on student transfers from the community colleges to four-year institutions as a primary facet of institutional performance. This focus often leads to comparisons of transfer rates between colleges with the goal of identifying low performing and high performing colleges. However, comparison of raw rates of transfer ignores important differences in the structural conditions and exogenous variables affecting the performance of each college, leading to inequitable stratification of colleges and inaccurate classification of colleges in terms of transfer performance. To treat this fundamental incomparability of raw transfer rates, a method for equitable comparison of transfer outcomes was developed and implemented in California's community college system. This method involves major enhancements to prior efforts in California to implement transfer comparisons, including a less biased definition of the transfer rate, the use of statistical models to adjust for exogenous variables observed to affect the transfer outcome, the use of multiple student cohorts, and the inclusion of data on student transfers to a wider range of four-year institutions (both private and public, and both in-state and out-of-state).

Introduction

The initiation of California's Partnership for Excellence (PFE) program has increased substantially the attention on accountability in performance for California's community colleges. Among the performance measures of concern is student transfer to four-year institutions. This aspect of community college performance has been deemed so important that identification of colleges with persistently low rates of student transfer to four-year institutions, for the purposes of administrative assistance, was mandated by the California Legislature and executed by the Chancellor's Office of California Community Colleges in 2002.

On the surface, the identification of colleges with low transfer performance appears to be a straightforward task. One simply calculates the rate of transfer from a given college based upon the number of students enrolled at the college and the number of those students who transfer to four-year institutions. Then, one compares that calculated transfer rate with either a predetermined expectation or with the rates of other colleges. Upon closer examination, however, a number of methodological questions and complications arise (Bradburn, Hurst & Peng, 2001). First, should all students enrolled at a particular community college be considered potential transfer students? In other words, should all students be included in the denominator of a calculated transfer rate for any given community college? If not, what criteria should be used to identify potential transfer students? Second, given the inherent lag between initial enrollment of any given student at a community college and the student's transfer to a four-year institution, how long of a period of time should be allowed before determination is made concerning the successful transfer of any particular student from any given college? Third, given the disparities in economic and social conditions in which the community colleges operate, and given the wide variation in the characteristics and academic objectives of students enrolled at each college, how can community colleges be compared with one another in a manner that is equitable? Fourth, how low must the transfer rate of a particular community college be before the college is considered a "low transfer" college? Fifth, since a transfer rate reasonably could be calculated for every annual cohort of students, is one year of low transfer performance sufficient to classify a college as a "low transfer" college, and, if not, how long must low transfer performance persist before a college is classified as such? Finally, what is to be done about the lag between enrollment of a group of students and their transfer, or failure to transfer, to four-year institutions, and the subsequent identification of the low transfer rate? For example, if a college is identified as a "low transfer" college solely based upon the aggregate transfer behavior of students who initially enrolled in the year 1997, would intervention in the year 2003 still be warranted?

This article describes the analytical process we undertook to answer these questions through the development and implementation of an equitable system for the identification of colleges with persistently low annual rates of student transfer to four-year institutions. However, we caution the readers that the results of this present analysis do not match perfectly the results published previously in a report to the California Legislature on the matter (Chancellor's Office of California Community Colleges, 2002). Subsequent to the initial report to the California Legislature, new data were made available, and these data are incorporated into the analysis presented here. Also, readers should note that this article expands substantially upon an earlier study conducted by Hom (2000), employing a rudimentary model applied to one student cohort.

Methods

Three decisions were made at the outset of the statistical process to identify "low transfer" colleges that guided the remainder of the process. First, it was determined *a priori* that a minimum of three consecutive years of low transfer performance must be evident before a college can be classified as a "low transfer" college. This rule reduced the possibility of identifying a college as "low transfer" based on random variation in student cohort behavior, such as might occur in a single aberrant cohort of students, which satisfied objections raised by community college administrators, institutional researchers, and other stakeholders to the single-cohort approach discussed by Hom (2000). Second, only first-time college freshmen would be considered in calculating transfer rates. This decision was based upon the rationale that first-time freshmen most closely resemble the hypothetical model of community college transfer students. Finally, a six-year lag was selected for the period of time between initial enrollment of a student and final determination concerning a student's transfer outcome. This decision was made on the basis of available data and conditioned by the first decision concerning the length of time (number of cohorts) over which low transfer performance must be observed in order to classify a college as a "low transfer" college. At the time that the work began in 2002, the data available for the study encompassed the period between 1993 and 2001. While the data allowed for an eight-year transfer lag for the 1993 cohort (the earliest possible cohort), the data allowed for only a seven-year transfer lag for the 1994 cohort, only a six-year transfer lag for the 1995 cohort, and progressively shorter lags for more recent cohorts. Therefore, to standardize the observation period across the three cohorts, a six-year lag was selected because six years was the minimum observation period available in the data for the three cohorts that had the longest possible observation periods. The consequence of these three decisions was the selection of data addressing three cohorts of first-time college freshmen, specifically the Summer/Fall cohorts of 1993, 1994, and 1995.

Initially, we considered using all first-time freshmen, regardless of individual student academic goals, as the base cohort (the denominator) for calculating transfer rates in each year. However, community colleges have multiple missions, and students enroll in community colleges for a multiplicity of reasons; so, it was not expected that every first-time freshmen would enroll in college with the objective of transferring to a four-year institution. This concept of academic objective (i.e., student motivation) has been shown to be a relevant, albeit dynamic, variable (Bahr, 2005; Cejda & Kaylor, 2001; Laanan, 2001; Voorhees & Zhou, 2000), and one which must be considered when college-level performance indicators are developed and implemented (Hoyt, 2001). We concluded that using all first-time freshmen as a base cohort for each college would lead to significant negative bias in measuring transfer rates for community colleges that tend to attract students who have academic objectives other than transfer. Thus, a method of differentiating students who have the objective of transfer from students who have other academic objectives was required.

The simplest available method of measuring student intent was a nominal measure of self-reported academic goal collected at initial enrollment. However, the malleability of student academic intent within the postsecondary environment, combined with an anticipated response bias associated with the measurement process itself, made this measure too unreliable for this purpose. Consequently, we determined that the most reliable method of identifying students who have the goal of transfer would be found in actual student behavior, as indicated by course enrollment decisions. To accomplish this, each student in the three cohorts was tracked for six years to identify course-taking behavior consistent with intent to transfer to a four-year institution. The specific behaviors we selected as screening criteria for intent to transfer included successful completion of a minimum of twelve transferable units and successful completion of at least one transferable mathematics course or at least one transferable English course. We defined "transferable" coursework as coursework accepted for credit within the California State University and/or the University of California systems. Students not meeting both of these criteria were dropped from the base cohorts, resulting in reduced cohorts of first-time freshmen who had academic trajectories consistent with, but not limited to, transfer to a four-year institution.

While definitions of transfer rate vary from state to state (Cohen, 1999; Grubb, 1991; Wellman, 2002), some degree of consensus has been reached concerning the use of behavioral indicators of intent to transfer, the window of time for the transfer outcome to manifest, and a focus upon cohorts of first-time freshmen (Armstrong, 1993; Banks, 1992; Bradburn, et al., 2001; Cohen, 1993, 1995, 1999; Karpp, 1995; Prather, 2000) Thus, the definition we employed for delineating the population constituting the transfer cohort (the denominator of the transfer rate) agrees in large part with the conclusions presented in prior research.

Students remaining after the initial screening for intent to transfer were matched (using social security number) against a transfer database assembled by the Chancellor's Office of California Community Colleges to determine which of the students in these reduced cohorts actually transferred to four-year institutions. The database included data collected from the California State University (CSU) system, the University of California (UC) system, and the National Student Clearinghouse (Boughan, 2001). The database constitutes a term-by-term list of enrolled students at each four-year institution represented in the database, which includes all of the CSU and UC campuses, as well as many public and private four-year institutions both within and outside California. Students identified as appearing on the enrollment records of one or more four-year institutions within six years of first enrollment in the community college system were deemed successful transfers from the community college of origin.

We then calculated raw transfer rates for each college for each of the three cohorts. The denominator in this calculated rate was the number of students in the respective cohort identified as exhibiting behavior consistent with intent to transfer. The numerator was the number of these students who were identified as having transferred to four-year institutions within six years of first enrollment in California's community college system. The number of students in each of the three cohorts, the number of students in each cohort who transferred, and the number of colleges for which raw transfer rates were calculated are provided in Table 1. Although raw transfer rates were calculated for 112 colleges, as indicated in Table 1, three colleges were excluded from the adjustment modeling process described later in this paper due to narrowness of academic mission (e.g., community colleges focused exclusively on adult basic education).

While these raw transfer rates might have been used to identify colleges that have low transfer rates, these rates ignore important information about the structural context in which each college operates. In essence, the use of raw transfer rates as a performance measure assumes either that this institutional outcome (aggregate student behavior) is entirely a product of variables within the purview of individual colleges/districts or that exogenous variables (those that are not within the purview of the individual colleges/districts) are of equal effect (both in size and direction) across colleges. Since these are certainly unreasonable assumptions, it was necessary for us to correct the raw transfer rates for the effects of exogenous variables on each community college's transfer performance.

The process of accounting for the effects of exogenous variables took the form of adjustment models, which are statistically derived equations that "adjust" for observed relationships between exogenous variables and a college-level outcome of interest. The strategy for developing a multiple regression model that adjusts for exogenous variables is well documented in the literature (e.g., Angrist & Krueger, 1999; Boniface, 1995; Judd & Kenny, 1981; Langbein, 1980; McNeil, Newman & Kelly, 1996; Nachmias, 1979; Stiefel, Schwartz & Rubenstein, 1999). The adjustment models account for one segment of a generic model of institutional performance. Specifically, they embody an attempt to correct for the effects of systematic exogenous variables on college performance, as represented in Figure 1. However, the adjustment modeling process ignores the effects of nonsystematic exogenous variables (e.g., natural disasters). Because data addressing nonsystematic exogenous variables could help explain institutional performance on transfer, yet are excluded from the adjustment modeling process, individuals using the results of an adjustment model must recognize that the model accounts only for one major type of uncontrollable variable in transfer performance. In short, the models detailed here provide a substantial, albeit incomplete, remedy to the use of raw transfer rates for measuring relative college performance.

We developed the adjustment models (one for each cohort year) using an exploratory process and using the calculated college-level annual transfer rates as the outcome (dependent) variable. General theoretical models of student achievement guided our enumeration of an initial set of potential adjustment (independent) variables to be tested for statistical significance in each year's adjustment model. Historically, these models have included past student achievement, student demographics, local economic conditions, and institutional characteristics (Astin, 1975; Banks, 1992; Blau & Presler-Marshall, 1994; Bryk & Hermanson, 1993; Cejda & Kaylor, 2001; Cofer & Somers, 2000; Kahn & Nauta, 2001; Koppel, 1992; Lee & Frank, 1990; Pike & Saupe, 2002; Vars & Bowen, 1998; Wassmer, Moore & Shulock, 2003; Zimmer, Buddin, Chau, Daley, Gill, Guarino, et al., 2003). Additionally, the California Community College Contingent Funding Task Force provided guidance concerning certain variables (e.g., aggregate racial/ethnic and gender characteristics of each college) that should be excluded from testing in order to maintain consistency with the mission of California's

Table 1. *N*s for the three annual cohorts of students

	1993	1994	1995
First-time freshmen exhibiting intent to transfer	118,838	112,819	112,891
First-time freshmen determined to have transferred	43,079	42,056	43,141
Number of colleges	112	112	112

community colleges. Specifically, the Task Force noted that the finding of negative effects on transfer rate associated with the concentration of racial groups or males/females in the colleges could result in lower academic aspirations among the identified groups. For example, if a model were to indicate that the concentration of Black students is associated with lower rates of transfer, this information could produce a "chilling effect," discouraging Black students from seeking transfer and further reducing the rate of transfer among these students. Such a scenario would conflict directly with the transfer mission of California's community college system. Ultimately, we assembled a list of 74 potential adjustment variables. These variables included aggregate student characteristics at each college (e.g., percent of the student population receiving financial aid of various sorts, percent indicating various academic objectives), characteristics of the colleges (e.g., driving distance from the college to the nearest public four-year institution), county-level variables (e.g., per capita income, unemployment rate), and derived measures, such as the *Student Average Academic Preparedness Index* developed by Bahr, Hom, and Perry (2004).

Following the assemblage of all potential adjustment variables into a single data set, we executed a systematic nine-step protocol to identify significant relationships for each annual cohort. The protocol was as follows:

1. The distribution of each of the potential adjustment variables was examined, and each variable was transformed as necessary to approximate normality in order to improve the fit of the ordinary least-squares adjustment equation (Fox, 1997).
2. The bivariate relationships between raw transfer rate and each of the potential adjustment variables was examined for each cohort year using two-way scatter plots to identify nonlinear relationships and potential outliers.
3. The Pearson correlation coefficients of raw transfer rate and each of the potential adjustment variables was calculated and inspected, both with and without the potential outliers identified in step #2, to identify the variables most pertinent to each adjustment model.
4. Ordinary least squares regression models were

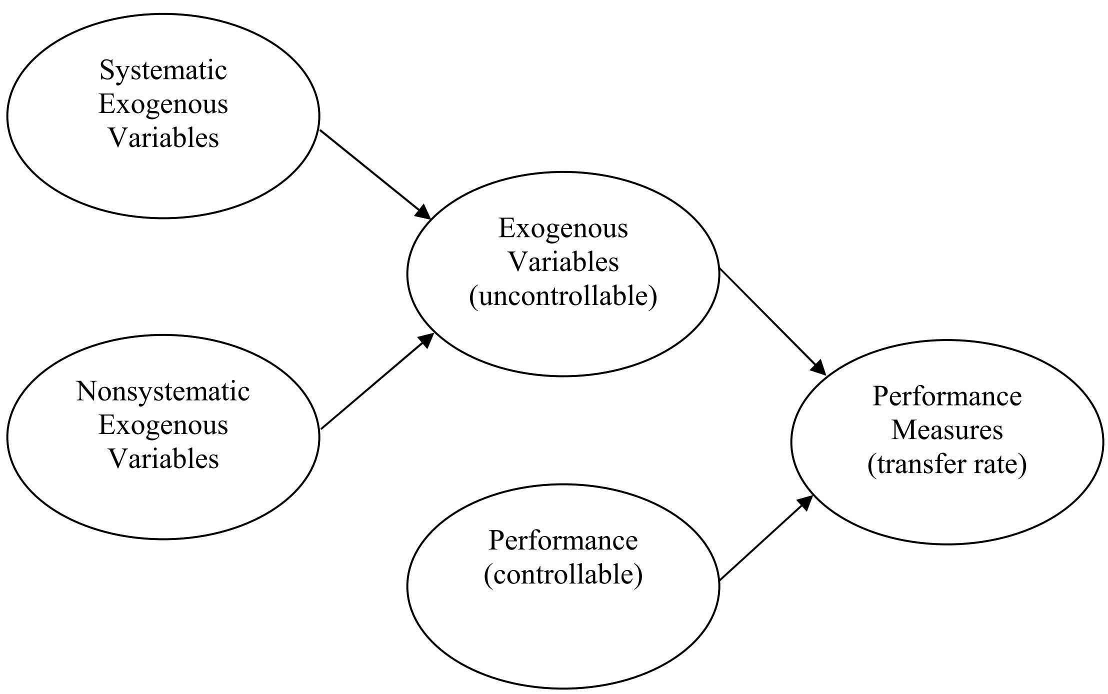

Figure 1. A basic model of college performance

estimated for each cohort beginning with the single strongest bivariate relationship identified in step #3, excluding potential outliers identified in step #2. Additional variables were added and tested iteratively based upon the strength of the relationships identified in step #3. Consideration also was given to the likelihood of strong correlations between the potential adjustment variables (the potential for multicollinearity), so independent variables were removed and replaced, and the regression equations were re-estimated, to identify a parsimonious set of adjustment variables. Adjustment variables identified through this process as having statistically significant associations ($p < 0.10$) with the transfer rate outcome variable for each year were retained in the equation.

5. The equations were re-estimated using the adjustment variables identified in step #4 and including all previously excluded outliers. Partial regression plots (also known as added-variable plots) and leverage-versus-residual-squared plots were used to verify previously identified outlying cases that have excessive influence on the regression equation.
6. Standard regression diagnostic statistics (*dfBeta* and Cook's *D*) were used to confirm outliers identified in step #5.
7. The final models were estimated, excluding any outliers identified in step #5 and confirmed in step #6.
8. For each model (each cohort year), adjusted transfer rates (i.e., predicted values or "y-hat" values) were calculated. These values represent the expected transfer rate for each college, conditional on the values of the adjustment variables identified in step #4.
9. The adjusted transfer rate for each college in each cohort was compared with the raw transfer rate for that college in order to calculate a transfer residual. This residual represents the extent of "underachievement" or "overachievement" in transfer performance of each college, conditional on the adjustment variables identified in step #4.

This modeling protocol resulted in parsimonious sets of adjustment variables for each model (each cohort year). The sets of variables proved remarkably consistent across the three models, as is evident in Table 2. Seven adjustment variables were identified for the transfer outcome for each model, including the *Student Average Academic Preparation Index* (positive relationship), county unemployment rate (positive relationship), county per capita income (positive relationship), percentage of students identified as English-as-a-Second-Language learners (positive relationship), percentage of students receiving need-based financial aid (negative relationship), percentage of students stating an academic goal of transfer (positive relationship), and percentage of students age thirty or older (negative relationship) The number of observations included in each model varied by year because differing outliers were identified across years, but no model included less than 105 of the 109 cases (colleges) considered in the adjustment modeling process.

The adjustment models enabled an ordering of colleges for each cohort according to the magnitude of each college's transfer residual, which represents the magnitude of underperformance or overperformance of each college. However, the rank orderings, in and of themselves, could not fulfill the objective of identifying "low transfer" colleges for a given cohort year. The categorization of a college as "low transfer" required the application of a classification rule that would identify colleges at the extreme low end of the ranking without splitting hairs between colleges that are, for all practical purposes, equal in performance.

With that in mind, we selected a simple and robust measure of an extreme value in a distribution, namely the interquartile range (IQR). The IQR is the numeric distance between the 25^{th} percentile and the 75^{th} percentile of a distribution and is used as a measure of the dispersion of a distribution (Fox, 1997). Small IQRs indicate that the middle 50 percent of a set of observations are clustered relatively closely together. Conversely, large IQRs indicate a large spread among the middle 50 percent of a set of observations.

The interquartile range can be used to measure the relative distance of an outlying observation from the middle 50 percent of observations, while accounting for the spread of that middle 50 percent of observations (Fox, 1997). This is important because an outlying observation in a set of observations that are already widely dispersed is a very different phenomenon from an outlying observation in a set of obser-

Table 2. Ordinary least squares adjustment models of college-level rates of transfer to four-year institutions for three annual cohorts of students

Adjustment Variable	transf [a]	1993 Cohort coefficient (standard error)	1994 Cohort coefficient (standard error)	1995 Cohort coefficient (standard error)
SAAP [b]	*X*	0.008*** (0.001)	0.008*** (0.001)	0.008*** (0.001)
% Age 30+ [c]	$1/X^{-2}$	0.058*** (0.009)	0.054*** (0.008)	0.038*** (0.008)
% ESL [d]	X^{-2}	0.099** (0.032)	0.113** (0.034)	0.070* (0.029)
% Goal of Transfer [d]	X^{2}	0.105* (0.040)	0.093* (0.040)	0.113** (0.034)
% Need-Based Financial Aid [f]	X^{-2}	-0.108* (0.046)	-0.138** (0.048)	-0.096* (0.042)
1996 County Avg Unemployment [g]	*ln(X)*	0.064** (0.021)		
1996 County Per Capita Income [h]	*ln(X)*	0.157*** (0.038)		
1997 County Avg Unemployment [g]	*ln(X)*		0.067** (0.020)	
1997 County Per Capita Income [h]	$1/X^{-2}$		-1.711*** (0.394)	
1998 County Avg Unemployment [g]	*ln(X)*			0.064*** (0.016)
1998 County Per Capita Income [h]	$1/X^{-2}$			-1.856*** (0.333)
Constant	----------	-0.822*** (0.176)	0.013 (0.078)	0.106 (0.066)
N (colleges)		107	106	105
F		35.03***	33.38***	42.75***
R^2		0.712	0.708	0.755

NOTES:
$*p < 0.05$ $**p < 0.01$ $***p < 0.001$
[a] This column indicates the transformation applied to each independent variable prior to introduction into the regression model. Note that, while the direction of the coefficients presented in this table may appear at odds with the description of the relationships as positive or negative detailed in the text, this is a consequence of the transformation of the independent variables to approximate normality. For example, the coefficients associated with the percentage of students age 30 and over are positive, yet the relationship itself is negative because this variable was normalized using an inverse square root transformation.
[b] The Student Average Academic Preparation Index score for each college.
[c] The percentage of students enrolled at the college in the base year who were 30 years of age or older.
[d] The percentage of students enrolled at the college in the base year who were identified as English-as-a-Second-Language learners.
[e] The percentage of students enrolled at the college in the base year who reported transfer to a four-year institution as among their academic goals.
[f] The percentage of students enrolled at the college in the base year who received need-based financial aid.
[g] The average unemployment rate in the indicated year for the county in which the college is located.
[h] The per capita income in the indicated year for the county in which the college is located.

vations that otherwise are closely bunched together. This measurement of distance applied to an outlier is accomplished by calculating the number of IQRs a particular outlying observation is from the closest outer edge of the middle 50 percent of observations (either from the 25th percentile if the outlying observation is less than the 25th percentile, or from the 75th percentile if that outlying observation is greater than the 75th percentile).

Applying this logic to the adjustment models, we calculated the IQRs for the residuals for each cohort year and used them to determine the distance of each observation from the nearest outer edge of the middle 50 percent of observations. Colleges with residuals that fell within the middle 50 percent of observations had IQR distance values of zero. Colleges with residuals that fell below the middle 50 percent of observations had IQR distances measured from the 25th percentile value. Colleges with residuals that fell above the middle 50 percent of observations had IQR distances measured from the 75th percentile value.

To classify particular colleges as deficient in transfer, we selected a statistically substantiated rule for outliers of three IQRs as the cutoff for low performing colleges (Fox, 1997). In other words, in order to be identified as "low transfer," a college must have a transfer residual falling below the 25th percentile by at least three times the numeric distance between the 25th and 75th percentiles. Colleges classified as "low transfer" for all three years would be classified as "*persistently* low transfer" colleges. Conversely, a college with a transfer residual falling above the 75th percentile by at least three times the numeric distance between the 25th and 75th percentiles for three consecutive years would be classified as a "*persistently* high transfer" college.

Results

In order to illustrate the method we have described here and the results that followed from it, we provide in Table 3 the unadjusted transfer rates, adjusted transfer rates, transfer residuals, and IQR distances for each of the 109 colleges for the 1993 cohort. The unadjusted transfer rates represent the raw transfer rates of colleges prior to the application of adjustment for systematic exogenous variables. The adjusted transfer rates constitute the expected transfer performance of each college given each college's particular exogenous conditions. The transfer residual is the difference between the unadjusted transfer rate and the adjusted transfer rate. It represents the extent to which each college has exceeded, or fallen short of, expected performance given the particular exogenous conditions. The IQR distance is the numeric distance of each college's transfer residual from the closest outer edge of the middle 50 percent of transfer residuals, measured in terms of the numeric distance between the 25th and 75th percentiles of the distribution of transfer residuals.

The reader will note that colleges 28 through 82 constitute the middle 50 percent of observations in terms of transfer residuals. The 25th percentile (college 28) is -0.034, and the 75th percentile (college 82) is 0.019. Each of the colleges within the middle 50 percent of observations has an IQR distance of zero, as does college 27 because it has the same transfer residual as college 28. Colleges 1 through 26 have transfer residuals that fall below the middle 50 percent of observations and, commensurate with their transfer residual rank, have IQR distances that are negative. Colleges 83 through 109 have transfer residuals that fall above the middle 50 percent of observations and associated IQR distances that are positive. The college with the greatest transfer residual (0.121), indicating transfer performance above that which would be expected given the systematic exogenous conditions of that particular college, is college 109. College 109 has an IQR distance of 1.931, indicating that the transfer residual for that college is 1.931 IQRs above the 75th percentile. The college with the lowest transfer residual (-0.262), indicating transfer performance below that which would be expected given the systematic exogenous conditions of that particular college, is college 1. The IQR distance for this college is -4.322, indicating that the transfer residual of this college is 4.322 IQRs below the 25th percentile. College 1 is the only college with a transfer residual large enough in absolute magnitude to exceed the predetermined three-IQR classification rule required to designate a college as exceptionally low or high performing (in this case, exceptionally low performing because the transfer residual is negative). Univariate descriptive statistics for the unadjusted transfer rates, adjusted transfer rates, and transfer residuals for all three annual cohorts are presented in Table 4. Zero-order correlations between the three ranked lists of colleges are 0.650 for 1993–1994, 0.664 for 1993–1995, and 0.723 for 1994–1995, indicating highly comparable relative rankings of the colleges from one year to the next (i.e., a correlation of 1.000 would indicate that the relative rankings of the colleges in terms of transfer residual are identical from one year to the next)

The application of the three-IQR classification rule resulted in one particular college being identified as "low transfer" for both 1993 and 1994. For 1995, again only one college was identified as "low transfer." However, the college identified as "low transfer" in 1995 was not the same college as that identified as "low transfer" in 1993 and 1994. Therefore, the three-IQR classification rule resulted in no colleges being identified as "*persistently* low transfer," because none of the colleges fell below the three-IQR rule for the three consecutive years under study. In addition, in none of the three cohort years did any college have a transfer residual sufficiently large for the college to be identified as exceptionally high performing in terms of transfer. A less conservative classification rule of one and one-half IQRs (Agresti & Finlay, 1997) would have identified three colleges as "low transfer" and two colleges as "high transfer" in 1993. In 1994, three colleges would have been identified as "low transfer," and one college would have been identified as "high transfer." In 1995, four colleges would have been identified as "low transfer," and one college would have been identified as "high transfer." Across all three years, two colleges would have been identified as "*persistently* low transfer" (low in three consecutive years), while none of the

Table 3. Unadjusted transfer rates, adjusted transfer rates, transfer residuals, and IQR distances for each of the 109 colleges for the 1993 cohort (colleges are ordered by transfer residual and assigned an identifying number accordingly)

College	Unadjusted Transfer Rate	Adjusted Transfer Rate	Transfer Residual	IQR Distance
1	0.126	0.388	-0.262	-4.322
2	0.306	0.453	-0.147	-2.150
3	0.083	0.201	-0.118	-1.595
4	0.281	0.370	-0.089	-1.044
5	0.245	0.322	-0.077	-0.825
6	0.324	0.401	-0.077	-0.823
7	0.273	0.339	-0.067	-0.617
8	0.297	0.364	-0.066	-0.613
9	0.275	0.337	-0.062	-0.532
10	0.243	0.305	-0.062	-0.529
11	0.153	0.210	-0.057	-0.433
12	0.268	0.323	-0.055	-0.396
13	0.289	0.341	-0.052	-0.349
14	0.280	0.331	-0.051	-0.329
15	0.276	0.324	-0.049	-0.277
16	0.110	0.156	-0.046	-0.235
17	0.328	0.373	-0.046	-0.220
18	0.343	0.385	-0.042	-0.146
19	0.286	0.326	-0.040	-0.122
20	0.376	0.417	-0.040	-0.121

Table 3 (continued).

College	Unadjusted Transfer Rate	Adjusted Transfer Rate	Transfer Residual	IQR Distance
21	0.412	0.451	-0.039	-0.100
22	0.239	0.278	-0.039	-0.096
23	0.257	0.296	-0.039	-0.095
24	0.285	0.323	-0.038	-0.077
25	0.303	0.339	-0.036	-0.044
26	0.272	0.308	-0.035	-0.028
27	0.300	0.334	-0.034	0.000
28	0.304	0.338	-0.034	0.000
29	0.246	0.275	-0.029	0.000
30	0.323	0.351	-0.028	0.000
31	0.311	0.338	-0.027	0.000
32	0.227	0.253	-0.027	0.000
33	0.387	0.413	-0.026	0.000
34	0.326	0.350	-0.025	0.000
35	0.279	0.304	-0.024	0.000
36	0.441	0.465	-0.024	0.000
37	0.307	0.329	-0.023	0.000
38	0.356	0.378	-0.022	0.000
39	0.227	0.249	-0.021	0.000
40	0.357	0.378	-0.021	0.000
41	0.320	0.338	-0.018	0.000
42	0.271	0.288	-0.017	0.000
43	0.270	0.287	-0.017	0.000
44	0.265	0.281	-0.016	0.000
45	0.329	0.345	-0.016	0.000
46	0.392	0.404	-0.012	0.000
47	0.327	0.338	-0.011	0.000
48	0.427	0.437	-0.010	0.000
49	0.402	0.412	-0.009	0.000
50	0.338	0.344	-0.007	0.000
51	0.425	0.431	-0.006	0.000
52	0.320	0.324	-0.004	0.000
53	0.365	0.369	-0.004	0.000
54	0.255	0.258	-0.004	0.000
55	0.369	0.372	-0.003	0.000
56	0.326	0.327	-0.001	0.000
57	0.271	0.272	-0.001	0.000
58	0.484	0.485	-0.001	0.000
59	0.366	0.367	-0.001	0.000
60	0.363	0.361	0.002	0.000
61	0.478	0.475	0.002	0.000
62	0.402	0.399	0.003	0.000
63	0.362	0.358	0.003	0.000
64	0.228	0.221	0.007	0.000
65	0.442	0.434	0.008	0.000

Table 3 (continued).

College	Unadjusted Transfer Rate	Adjusted Transfer Rate	Transfer Residual	IQR Distance
66	0.263	0.255	0.008	0.000
67	0.452	0.444	0.008	0.000
68	0.407	0.399	0.008	0.000
69	0.438	0.428	0.009	0.000
70	0.313	0.304	0.009	0.000
71	0.415	0.403	0.012	0.000
72	0.414	0.401	0.012	0.000
73	0.395	0.383	0.013	0.000
74	0.213	0.199	0.014	0.000
75	0.278	0.264	0.014	0.000
76	0.498	0.483	0.015	0.000
77	0.351	0.336	0.015	0.000
78	0.379	0.362	0.016	0.000
79	0.272	0.255	0.017	0.000
80	0.385	0.367	0.018	0.000
81	0.403	0.385	0.018	0.000
82	0.452	0.434	0.019	0.000
83	0.350	0.328	0.021	0.048
84	0.468	0.446	0.022	0.063
85	0.329	0.304	0.025	0.126
86	0.434	0.406	0.028	0.183
87	0.244	0.210	0.033	0.279
88	0.329	0.287	0.041	0.430
89	0.324	0.278	0.046	0.509
90	0.444	0.398	0.047	0.533
91	0.324	0.276	0.048	0.551
92	0.494	0.445	0.050	0.587
93	0.475	0.423	0.053	0.642
94	0.445	0.392	0.053	0.647
95	0.326	0.271	0.055	0.689
96	0.491	0.434	0.056	0.715
97	0.345	0.288	0.058	0.737
98	0.393	0.328	0.065	0.884
99	0.304	0.237	0.067	0.910
100	0.456	0.388	0.067	0.919
101	0.497	0.426	0.070	0.977
102	0.380	0.308	0.072	1.020
103	0.289	0.215	0.075	1.060
104	0.368	0.292	0.076	1.085
105	0.414	0.336	0.078	1.129
106	0.361	0.280	0.081	1.178
107	0.366	0.277	0.089	1.342
108	0.445	0.344	0.101	1.558
109	0.381	0.260	0.121	1.931

colleges would have been identified as "*persistently* high transfer" (high in three consecutive years).

Conclusion

As stated at the outset of this paper, measuring the transfer performance of community colleges is a more complex task than it may appear at first. The work presented here represents one approach to measuring transfer performance in an equitable and methodologically sound manner. The statistical process we applied to adjust transfer rates accounts for variation in the observed relationships between performance and a set of systematic exogenous variables. In effect, the adjustment models "level the playing field" between colleges with regard to transfer performance, at least insofar as systematic exogenous variables are concerned. Moreover, the application of the interquartile range measure effectively identifies low performing colleges, while avoiding hair-splitting between relatively comparable levels of transfer performance. Finally, the use of three annual cohorts, and the three models associated with these three cohorts, prevents the misidentification of "low transfer colleges" based upon atypical performance in any given year (i.e., false positives).

The method described here holds promise for other community college systems seeking to increase equity in measuring college performance. In addition, it provides future research efforts with a virtual "springboard" for expanded causal models of transfer performance. In particular, projects such as the *Transfer and Retention of Community College Students* (TRUCCS) (Hagedorn & Maxwell, 2002) could use the transfer rates (raw and adjusted) to expand the scope of testable theories, and, as of this writing, one research entity has already completed a study employing data from the analysis we present here (Wassmer, et al., 2003)

However, it should be reiterated that the single equation model (per annual cohort), while adequately controlling for measured variables, oversimplifies the causal system associated with student transfer. This system includes unmeasured variables that are ignored in the adjustment modeling process. Moreover, causal models in the social sciences generally require multiple models to test, and provide evidence for, the numerous causal paths associated with any given outcome (Blalock, 1964), which the adjustment modeling process presented here does not accomplish. This appraisal, in addition to forewarning against overinterpretation of the results of the adjustment models, indicates the amount of future work that is needed to inform educational policy fully as it pertains to the student transfer mission of community colleges.

Table 4. Univariate descriptive statistics for the unadjusted transfer rates, adjusted transfer rates, and transfer residuals

	Mean	Std Dev	Median	25th Percentile	75th Percentile	Min	Max
1993							
Unadjusted Transfer Rate	0.339	0.084	0.329	0.279	0.402	0.083	0.498
Adjusted Transfer Rate	0.342	0.070	0.338	0.288	0.398	0.156	0.485
Transfer Residual	-0.004	0.052	-0.003	-0.034	0.019	-0.262	0.121
1994							
Unadjusted Transfer Rate	0.347	0.086	0.341	0.296	0.419	0.093	0.503
Adjusted Transfer Rate	0.352	0.071	0.352	0.313	0.408	0.164	0.527
Transfer Residual	-0.005	0.055	-0.003	-0.035	0.029	-0.299	0.145
1995							
Unadjusted Transfer Rate	0.358	0.083	0.352	0.312	0.417	0.053	0.535
Adjusted Transfer Rate	0.364	0.068	0.361	0.314	0.415	0.168	0.508
Transfer Residual	-0.006	0.050	-0.004	-0.031	0.025	-0.237	0.110

As a component of California's PFE accountability program, the implementation of the transfer adjustment models was met by a variety of reactions from policy makers, community college administrators, institutional researchers, and other stakeholders. Although some administrators and institutional researcher balked at the use of the statistical tool for evaluating transfer performance, the general sentiment among administrators and researchers was favorable toward the use of the adjustment models in place of raw transfer rates. Many administrators discussed the results of the modeling process in the context of local efforts at institutional improvement, and a renewed emphasis on the quality of administrative data was observed system-wide. At least one district Board of Trustees acted to change administrative leadership. State oversight agencies reviewed the results and supported the methodological improvements represented by the adjustment models. Some confusion also ensued as various parties attempted to replicate the results. These efforts at replication used different data, omitted some of the steps of the modeling process (e.g., transforming variables to approximate normality), and, as a result, met with only limited success. Easy access to the results of the adjustment modeling process was made available to the public through the Chancellor's Office website. Yet, despite this (or, ironically, perhaps because of it), the statistical work received only minimal attention from the mass media. As a related matter, California's well-publicized budget crisis, and the turnover in the legislative and executive branches that followed it, inhibited further actions on state policy concerning the issue of "persistently low transfer" community colleges. The well-publicized restrictions on capacity in the University of California system and tuition increases in all of the state's higher education institutions attracted the bulk of attention in the higher education policy agenda, somewhat diminishing the salience of the community college transfer issue as a topic of policy debate. Regardless, the adjustment modeling process was effective in dispelling the longstanding myth concerning the existence of a cluster of "low transfer" community colleges, which was an important finding for educational policy. Quite possibly, this study may have contributed to the fading of "persistently low transfer" colleges as a policy agenda item. From the perspective of accountability, the adjustment modeling process we implemented demonstrated how a community college system could advance considerably beyond the simple rates that most state oversight agencies use to monitor institutional performance.

For other state offices of higher education that face the need to develop statistical adjustment models as a component of college performance measurement and accountability, there are lessons to learn from the work presented here, foremost of which is the understanding that such work cannot divorce analytical methodology from political dynamics. The exclusion from the analysis, by the California Community College Contingent Funding Task Force, of variables measuring concentrations of racial/ethnic groups demonstrated this point clearly. Second, a wealth of valid administrative data is a prerequisite of the development of any adjustment model. The research discussed here employed one of the largest educational databases in the country, and a less comprehensive database surely would have resulted in models both with much lower validity and with much lower salability to policy makers and stakeholders in the educational community. Third, any state office undertaking such an effort should collaborate with the affected educational institutions to develop the adjustment model. Although some community colleges opposed the model in concept, the project still enjoyed widespread participation, and technical advice from colleges and districts helped to improve the analysis at numerous junctures in the process. Finally, to bring such a project to fruition, a state office will need very diligent and knowledgeable staff. This project absorbed an inordinate percentage of the work time of three staff in the Research Unit and three staff in the Management Information Systems (MIS) Unit for more than two years. The level of statistical expertise of the staff, and the knowledge and attention to detail concerning the data, must be exceptionally great because any errors or oversights made in the process are magnified in light of what is at stake for the affected educational institutions.

Concerning future work on the topic, a recently published study (Ehrenberg & Smith, 2004) of the transfer process in New York State's public higher education system provides an independently developed model for transfer analysis that future efforts should consider. Ehrenberg and Smith's study addresses a more durable transfer outcome than that addressed in our analysis by tracking transfer students through the completion of four-year degrees. This is an important development in modeling the transfer process, as efforts to gain a more comprehensive understanding of the transfer phenomenon should incorporate the effects of the four-year institutions to which students transfer. Further work in this area could contribute to providing policy makers with a sufficiently broad decision framework to improve the entire system of public higher education rather than only the community college segment.

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