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Online Appendix A:

The Case of Two-to-Four-year Transfer Students

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1 Introduction

In addition to the population of four-year beginning students, the MetroU system data also incorporates information for students who have started in a two-year program at a MetroU college and who have subsequently transferred to a four-year MetroU program or college. As with many public colleges, the transfer population is large at MetroU: at any given point, two-thirds of MetroU's total student population attending four-year colleges is comprised of transfer students and transfer students additionally obtain roughly 60 percent of all MetroU bachelor's degrees. However, empirical accounts of transfer students' experiences and outcomes are limited for a variety of reasons, including data constraints, analytical difficulties resulting from transfer students' multiple college selection processes, and theoretical challenges given substantial differences in transfer students' family background and educational preparation, as compared with four-year beginning students (see Ciocca Eller and DiPrete 2018, Online Appendix B for an elaboration of these issues). Though the latter two challenges remain in the present study, I analyze college effects separately for the distinct pool of 44,470 students who transfer from two-year to four-year programs or colleges within the MetroU system, while also comparing college effects estimates for transfer students with those of four-year beginning students. I do so because of the large proportion of two-to-four-year transfer students that comprise the four-year MetroU system[1] as well as the importance of the transfer pathway to traditionally underrepresented

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[1] Transfer between different four-year campuses also is a common path within the MetroU system. On the whole, 30 percent of MetroU students start at one MetroU college and transfer to another. So, while the population of four-to-four-year transfers on MetroU colleges' campuses is not inconsequential, it is nowhere near as large as the population of two-to-four-year transfer students. For this reason, I focus on the two-to-four-year transfer population in this paper rather than the four-to-four-year transfer population.

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Table 1: Proportional Distribution of Student Characteristics among Two-to-Four-Year Transfer Students within MetroU Colleges (*n=44,470*)

	Total Number	Identifies as Male	Identifies as White	Identifies as Black	Identifies as His-panic	Identifies as Asian	Pell Grant Recipi-ent	Transfer to another Four-year College within MetroU	Transfer to another Four-year College Outside of MetroU	Proportion of Trans-fers in the Com-bined Sample
College 1	4,266	0.421	0.260	0.199	0.215	0.325	0.505	0.096	0.031	0.259
College 2	3,822	0.398	0.331	0.126	0.261	0.282	0.493	0.124	0.057	0.257
College 3	6,287	0.405	0.638	0.108	0.129	0.125	0.428	0.100	0.084	0.721
College 4	4,960	0.382	0.373	0.340	0.152	0.136	0.583	0.173	0.073	0.335
College 5	3,716	0.301	0.291	0.214	0.302	0.193	0.535	0.201	0.092	0.213
College 6	6,443	0.383	0.210	0.292	0.411	0.087	0.657	0.147	0.071	0.452
College 7	2,610	0.499	0.118	0.323	0.410	0.149	0.595	0.215	0.094	0.211
College 8	2,872	0.272	0.048	0.392	0.521	0.040	0.719	0.101	0.090	0.305
College 9	2,338	0.349	0.091	0.599	0.190	0.121	0.575	0.232	0.131	0.274
College 10	4,155	0.532	0.135	0.386	0.305	0.173	0.652	0.102	0.061	0.711
College 11	3,001	0.220	0.010	0.923	0.055	0.012	0.600	0.143	0.135	0.778

Source: MetroU administrative data.

students who seek to earn a BA (Bailey 2015; Bowen, Chingos and McPherson 2009; Fink and Jenkins 2017; Jenkins, Davis and Fink, John 2016).

2   Data

Table 1 presents the population of four-year beginning students in each MetroU college, separated by gender, racial background, family financial status, and transfer status (both inside and outside MetroU). I measure family financial status using an indicator in the data capturing whether or not students have received a federal Pell Grant. I use this indicator because the variable for student income is incomplete. However, Pell Grant status, reported via federal financial aid forms, clearly demonstrates whether a student's family income is above or below $50,000, providing useful information pertaining to students' financial status.

Though the MetroU administrative data enable me to construct robust measures of college

effects on BA completion for transfer students, two caveats are present. First, I cannot observe students who transfer into an MetroU college from outside of the system. According to MetroU's Office of Institutional Research, about half of all transfer students come from outside of the MetroU system. However, these non-MetroU students possess comparable entry characteristics to MetroU transfer students and, based on extensive interview research I have conducted, non-MetroU and MetroU transfer students tend to encounter similar experiences and challenges (Ciocca Eller 2017, 2019). Thus while I cannot provide an exact estimate of college effects for non-MetroU transfer students, the findings reported for MetroU's two-to-four-year transfer students likely are a strong indication of the BA completion rates non-MetroU two-to-four-year transfers also possess. Second, transfer students are more right-censored than four-year beginners. Based on MetroU's data collection procedures, transfer students remain in the data for only twenty semesters from when they begin at a two-year college, even if they have transferred to a four-year college very late in the observation period. So, for example, it would be difficult to observe whether a transfer student who moved to a four-year college in semester 18 went on to earn a BA. For this reason, I include a control in all transfer models indicating the semester during which they have transferred to take right-censoring into account. I also incorporate a variety of variables from students' two-year college experience for the transfer population such as total credits accumulated and two-year GPA, among others. I do so because these characteristics are important indicators of transfer students' future success in the four-year context.

3 Methodological Shifts to Accommodate Two-to-Four-year Transfer Students

I employ both entropy balanced (ENT) and within-matched-applicant (WMA) models for the analysis of two-to-four-year transfer students as described in the main body of the text. However, I cannot evenly apply WMA models to four-year beginners and to two-to-four-year transfer students, in that I only observe students' *initial* college application and admissions decisions rather than this information at the point of transfer. I address this issue by inserting different statistical controls into the WMA models for transfer students than I do for four-year beginners. These controls include whether or not transfer students have listed a four-year college as their first choice in their initial college application, viewing this variable as a proxy for self-perceptions

about skill and ability. I also control for student experiences accrued during two-year college attendance, such as credit accrual and AA completion, which I list in full in Table 2.

While the comparison of college effects by racial background and family income is relatively straightforward, comparing four-year beginners with transfer students is more complex. This complexity emerges from the fact that transfer students have accumulated college experiences, and course credits, prior to four-year college entry, whereas the four-year beginning students have not. Most analysts have addressed this complexity by comparing transfer students only with those four-year beginners who have progressed to their third year of college or who have accumulated a similar number of credits (Monaghan and Attewell 2015). However, this approach is difficult when estimating school effects since the four-year beginners already have received the "treatment" of the college for a prolonged period of time if they are observed during their third, rather than their first, year of college. I therefore primarily compare transfer students with four-year beginners who are just starting college, but take care to address possible inconsistencies between the two groups in two ways.

First, I balance the four-year beginning and transfer student samples using ENT by relying only on pre-college characteristics, since all students share these common measures. I make one exception to this rule, constructing the GPA measure as a composite of four-year beginners' high school GPA rescaled to a four-point measure and transfer students' two-year college GPAs. I make this adjustment because two-year college grades are arguably a more precise metric of transfer students' academic preparation than are their high school grades, incorporating greater precision into the ENT approach. Second, I incorporate this combined GPA measures, as well as a variety of additional composite controls, in the outcome equation. I do so by coding four-year beginners into the following variables established for two-year students: credits accumulated, AA completion, transfer-in semester, application to a four-year college, acceptance to a four-year college, and need for remediation. For the first three of these variables, I simply set the value for four-year beginners to "0." On the remaining three, I code them according to students' actual behavior, so that four-year beginners receive a "1" for applying to and being accepted by a four-year colleges and a "0" or a "1" on remediation according to the MetroU system's categorization strategy. I also compare four-year beginners and freshmen by including only four-year beginners who have progressed to their third year of college in the sample to mimic the typical behavior of transfer

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students, though this strategy is less optimal because it confounds the college effect. Regardless, this sensitivity check yields similar results, confirming the robustness of my results.

Table 2: Descriptive Statistics

	All Students (n=126,455)		Transfer Students (n=44,470)	
	Mean	Std. Dev.	Mean	Std. Dev
Individual-level Variables				
BA completion within initial college	0.513		0.563	
Entry age	19.554	3.971	20.626	5.163
Female	0.591		0.615	
White	0.305		0.268	
Black	0.249		0.317	
Hispanic	0.255		0.263	
Asian	0.191		0.152	
U.S. citizen	0.692		0.629	
Permanent resident	0.205		0.238	
Visa-holder / refugee	0.044		0.059	
Undocumented	0.039		0.039	
Unknown	0.019		0.042	
Pell Grant recipient	0.521		0.569	
State funding recipient	0.591		0.562	
Family income	44,972.27	46,373.99	37,662.11	34,870.11
Economic disadvantage flag	0.783		0.819	
Eligible for low-income, high-talent program	0.109		0.045	
Dependent	0.906		0.829	
Total financial award offered upon application	4,189.409	3,085.406	3,647.80	2,587.42
From same city as college	0.816		0.835	
From same state as college	0.065		0.033	
From outside the college state	0.040		0.037	
From abroad	0.079		0.095	
Live within same geographical boundaries as college	0.352		0.336	
Speak limited English	0.285		0.274	
Disabled	0.020		0.029	
Single parent	0.030		0.054	
Attended public high school in same city as college	0.638		0.610	
Enrolled within 15 months of high school graduation	0.819		0.720	
High school GPA	—		75.661	6.732

Table 2: Descriptive Statistics

Number of college credits earned in high school	3.794	0.889	3.352	0.967
State English test score in 12th grade	74.743	13.259	66.361	14.004
State math test score in 12th grade	76.378	13.931	69.165	14.811
Number of MetroU colleges to which applied	3.347	2.326	2.524	2.432
Enrolled in four-year college in September	0.859		0.780	
Enrolled in four-year college in January	0.141		0.220	
First enrolled in MetroU system in 1999	0.030		0.085	
First enrolled in MetroU system in 2000	0.047		0.134	
First enrolled in MetroU system in 2001	0.121		0.138	
First enrolled in MetroU system in 2002	0.135		0.146	
First enrolled in MetroU system in 2003	0.137		0.137	
First enrolled in MetroU system in 2004	0.141		0.130	
First enrolled in MetroU system in 2005	0.134		0.113	
First enrolled in MetroU system in 2006	0.128		0.081	
First enrolled in MetroU system in 2007	0.119		0.037	
First enrolled in MetroU system in 2008	0.008		N/A	
Transfer student	0.352		1	
College-Level Variables				
Transfer-out rate for four-year beginners	—		—	
Transfer-out rate for transfer students	—		0.204	
Total average transfer-out rate	0.291		—	
Total average students per college	13,085.06	3,698.68	13,085.06	3,698.68
Proportion underrepresented minority	0.504		0.521	
Proportion receiving Pell Grants	0.521		0.524	

Table 2: Descriptive Statistics

Proportion attending college with "mid-selective" Barron's rating	0.712		0.581	
Proportion "Less Selective" in Barron's rating	0.288		0.419	
Two-year College and "Hybrid" Variables				
Applied to a four-year college	0.753		0.297	
Accepted at a four-year college	0.663		0.041	
Needed remediation	0.285		0.626	
Total two-year credits	15.925	25.454	45.286	22.643
Earned an associate's degree	0.177		0.503	
Prior academic achievement	80.087	7.739	—	
Two-year college GPA	—		2.825	0.606
Proportion of total credits completed in year one	—		0.924	0.162
Earned 24 credits in first year at two-year college	—		0.275	
Amount of financial distribution from two-year college	—		2606.362	1511.242
Passed reading placement test on first try	—		0.219	0.413
Passed math placement test on first try	—		0.355	
Passed writing placement test on first try	—		0.453	
Transfer semester	—		6.194	2.807
Two-year college: College 3	—		0.152	
Two-year college: College 6	—		0.115	
Two-year college: College 10	—		0.117	
Two-year college: College 11	—		0.065	
Two-year college: College 12	—		0.047	
Two-year college: College 13	—		0.114	
Two-year college: College 14	—		0.119	
Two-year college: College 15	—		0.154	
Two-year college: College 16	—		0.019	
Two-year college: College 17	—		0.096	
Two-year college: College 18	—		0.03	

Note: Proportions may not add to one due to rounding.

Source: MetroU administrative data.

4 Incorporating Transfer Students into the Estimation of College Effects

As discussed in the "Introduction," transfer students comprise about two-thirds of the overall student population at MetroU's four-year and comprehensive colleges. Accordingly, an understanding of the overall effectiveness of MetroU colleges is incomplete without the consideration of these students. I begin by examining the naive estimates of ten-year, within-transfer-college and any-college BA completion rates for students who transfer from a two-year to a four-year college or program between the fall of 2001 and the spring of 2008 in Table 3.

Table 3: BA Completion Rates for Fall Enrollees in MetroU's Senior and Comprehensive Colleges among Transfer Students

	Ten-year Within-College BA Rate (%)	Average Within-College Ten-year BA Completion Rate across All MetroU Colleges (%)	College Ranking Using Within-College Ten-year BA Rate	Ten-year Any College BA Rate (%)	Average Any College Ten-year BA Completion Rate across All MetroU Colleges (%)	College Ranking Using Any College Ten-year BA Rate
College 1	71.6	56.3	1	77.5	63.9	1
College 2	61.2	56.3	3	66.4	63.9	4
College 3	61.1	56.3	3	68.4	63.9	2
College 4	55.5	56.3	6	63.9	63.9	5
College 5	50.0	56.3	7	62.5	63.9	5
College 6	62.2	56.3	2	69.6	63.9	2
College 7	48.8	56.3	7	60.5	63.9	9
College 8	60.0	56.3	3	63.7	63.9	5
College 9	40.1	56.3	10	50.3	63.9	10
College 10	51.7	56.3	7	57.0	63.9	8
College 11	36.5	56.3	11	44.6	63.9	11

Note: Rankings are constructed based on the presence of statistically significant differences in the mean BA completion values of each college using pairwise tests. Non-significant differences are signified by "ties." So, the average, ten-year within-college BA completion rate in College 2 differs significantly from that posted in College 1, but the difference between College 5 and College 7 is not statistically significant.
Source: MetroU administrative data.

As with the four-year beginning students, Table 3 conveys that substantial variation exists

both between and within colleges in transfer students' BA completion rates. In terms of between-college differences, the range of BA completion rates spans nearly 40 percentage points when observing the within-college figures, and around 30 percentage points when examining the any-college rates. That said, these between-college differences are not all statistically different, as Colleges 2, 3, and 7 are statistically identical when examining the within-college BA completion rates and Colleges 4, 5, and 8 are statistically identical according to the any-college rates. Turning to within-college differences, these discrepancies are also quite large, though the proportion of graduates and non-graduates are more skewed towards completion for transfer students. This result suggests that some MetroU colleges may prove more effective for transfer students as compared with four-year beginners, a hypothesis I turn to below.

First, however, I define between-college effects for the distinct group of transfer students using the ENT approach. Unlike the models I calculate for four-year beginners, these analyses incorporate information concerning students' experiences in two-year colleges, since these have transpired prior to four-year entry and likely impact transfer students' BA completion outcomes. The results, produced in Table 4, again are expressed first as an odds ratio taken from each, separate logistic regression model, where the ratio expresses the difference between students attending the focal college and students attending the non-focal college. They then are expressed as the percentage point difference between the predicted actual and counterfactual within-college, ten-year BA completion rates for students attending the focal college; these two sets of results are quite equivalent due to the strong covariate balance, as they were for freshmen.

The results in Table 4 show some notable differences between the average college effectiveness measures generated for four-year beginners and those displayed here for transfer students. First, while Colleges 4, 5, and 8 possess relatively neutral effects for average, four-year beginners, their impacts are much more pronounced for transfers. Colleges 4 and 8 increase transfer students' likelihood of BA completion by 3 and 7 percentage points, respectively, above the counterfactual rate that would be produced if these students were to attend the average, non-focal MetroU college. Meanwhile, College 5 lowers transfer students' likelihood of completion by 5.1 percentage points as compared with the counterfactual. Second, whereas Colleges 2 and 3 have negative effects on the average BA completion likelihood of four-year beginners, they appear to have relatively neutral effects for transfer students. That said, the remainder of the colleges

demonstrate more similar effects on both transfer students and four-year beginners. Though the size of these effects varies depending on the focal group (for example, College 1 possesses a smaller positive effect and College 11 posts a much more negative effect), the direction and statistical robustness of the effects remains the same.

Table 4: Entropy Balanced Measures of College Effects on Ten-year, Within-College BA Completion Rates for Two-to-Four-Year Transfer Students

	Odds Ratio	Standard Error	Dev. from Counter-factual Mean (percent-age points)	Chi-square test value
College 1	1.155*	0.067	2.7	0.034
College 2	1.002	0.056	0.1	0.966
College 3	1.172	0.199	3.2	0.430
College 4	1.145**	0.042	3.1	0.001
College 5	0.800***	0.049	-5.1	0.000
College 6	1.791***	0.124	12.6	0.000
College 7	0.955	0.052	-1.1	0.370
College 8	1.378***	0.066	7.2	0.000
College 9	1.228	0.145	4.2	0.150
College 10	0.710***	0.076	-7.7	0.000
College 11	0.127***	0.759	-35.9	0.000

Notes: College effects are estimated using the ENT approach. For the odds ratio results, *p<0.05; **p<0.01; ***p<0.001. Control variables include student race, family income, Pell Grant status, the interaction between race and Pell Grant status, state grant aid status, special college program status, age, sex, citizenship status, dependent status, single parent status, place of permanent resident, total financial aid awarded prior to four-year college entry, whether or not a student is disabled, whether or not a student speaks proficient English, whether students attended a public or a private high school, whether the college geographically proximate to a student's high school, whether or not a student started college in the 15 months following high school graduation, high school GPA, high school GPA squared, math state test scores, English state test scores, number of college-applicable high school credits, number of MetroU colleges to which the studies applied, the year and month of initial college entry, the semester of transfer, number of college credits accumulated, two-year GPA, whether or not a student has received an associate's degree, remedial status, best English and math college placement test scores, financial aid disbursed by the two-year college, and whether students have applied to and been accepted at a four-year college.
Source: MetroU administrative data.

Yet the results in Table 4 do not provide a direct comparison of college effectiveness for four-year beginners and transfer students. I gain greater insight into this issue by calculating within-college effects for the combined sample of four-year beginners and transfer students using

ENT models, where transfer status serves as the treatment. I balance the four-year beginning and transfer student samples by relying on pre-college characteristics, but I control for a variety of two-year experiences in the outcome model, as described in the "Methods" section above.

Table 5: Within-College Differences in College Effects for Four-year Beginners and Two-to-Four-Year Transfer Students

	Odds of BA Completion for Transfers versus Freshmen	Standard Deviation
College 1	1.059	0.180
College 2	1.264	0.320
College 3	0.419***	0.196
College 4	1.042	0.252
College 5	1.108	0.345
College 6	0.820	0.267
College 7	0.777	0.307
College 8	0.967	0.231
College 9	0.720	0.218
College 10	1.141	0.225
College 11	1.019	0.329

Notes: College effects are produced using the ENT approach. Values are expressed as odds ratios, *p<0.5; **p<0.01; ***p<0.001. Control variables include student race, family income, Pell Grant status, the interaction between race and Pell Grant status, state grant aid status, special college program status, age, sex, citizenship status, dependent status, single parent status, place of permanent resident, total financial aid awarded prior to four-year college entry, whether or not a student is disabled, whether or not a student speaks proficient English, whether students attended a public or a private high school, whether the college geographically proximate to a student's high school, whether or not a student started college in the 15 months following high school graduation, high school GPA, high school GPA squared, math state test scores, English state test scores, number of college-applicable high school credits, number of MetroU colleges to which the studies applied, the year and month of initial college entry, the semester of transfer, number of college credits accumulated, two-year GPA, whether or not a student has received an associate's degree, remedial status, and whether students have applied to and been accepted at a four-year college, and transfer status.
Source: MetroU administrative data.

As Table 5 shows, freshmen and transfer students actually achieve quite comparable BA completion results in all colleges save for College 7, where transfer students have considerably lower odds than four-year beginners of attaining a BA. These findings align with existing research demonstrating that once adequate controls are incorporated into statistical models, transfer students and four-year beginners graduate at equivalent rates (Monaghan and Attewell 2015). However, statistical controls arguably are less important to the actual experiences of transfer

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students, a group on average comprised of a higher proportion of underrepresented minority and Pell Grant students with less adequate academic preparation. Given these persistent demographic dynamics, transfer students' overall likelihood of BA completion as compared with four-year beginners remains lower in a world without statistical controls. In short, the fact that colleges appear to perform comparably for transfer students and four-year beginners suggests that they are unable to play a compensatory role for the former group, reinforcing existing inequality produced by discrepancies in student background.

5 Explaining College Effects among Transfer Students

As with four-year beginners, I examine some potential explanations for differences in college effects among transfer students in this final section. As Figure 1 demonstrates, none of the college characteristics examined as possible mechanisms, including the racial and economic compositions of the student body, the transfer-out rate, or college size, correlates strongly with the college effects established. Considering that the transfer-out rate and college size appear correlated with college effectiveness for four-year beginning students (see the main body of the text), these findings raise the question of whether the transfer-out rate and college size differently impact the likelihood of BA completion for four-year beginners versus transfer students.

I address this question by incorporating both transfer students and four-year beginners, as well as interactive effects between transfer status and both the transfer-out rate and size, into an additional regression equation. I equalize transfer students and four-year beginners along a variety of dimensions, such as the need for remediation and BA receipt, as described in the "Methods" section. The results, reported in Table 6, indicate that while the transfer-out rates equally impact four-year beginners and transfer students, larger college size increases transfer students' odds of BA completion at a substantially lower rate than that of freshmen. Accordingly, the qualities for which college size proxies differently impact four-year beginners and transfer students. In addition, as demonstrated in Table 7, the incorporation of college-level variables does not explain between-college variation in BA completion outcomes among transfer students. As the coefficient on the random intercept (b=0.18) conveys, substantial unexplained variation in random intercepts remains despite the incorporation of college characteristics.

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Figure 1: The Relationship between College-level Characteristics and College Effects for Transfer Students

(a) Percent Underrepresented Minority

(b) Percent Pell Grant Recipients

(c) Transfer-out Rate
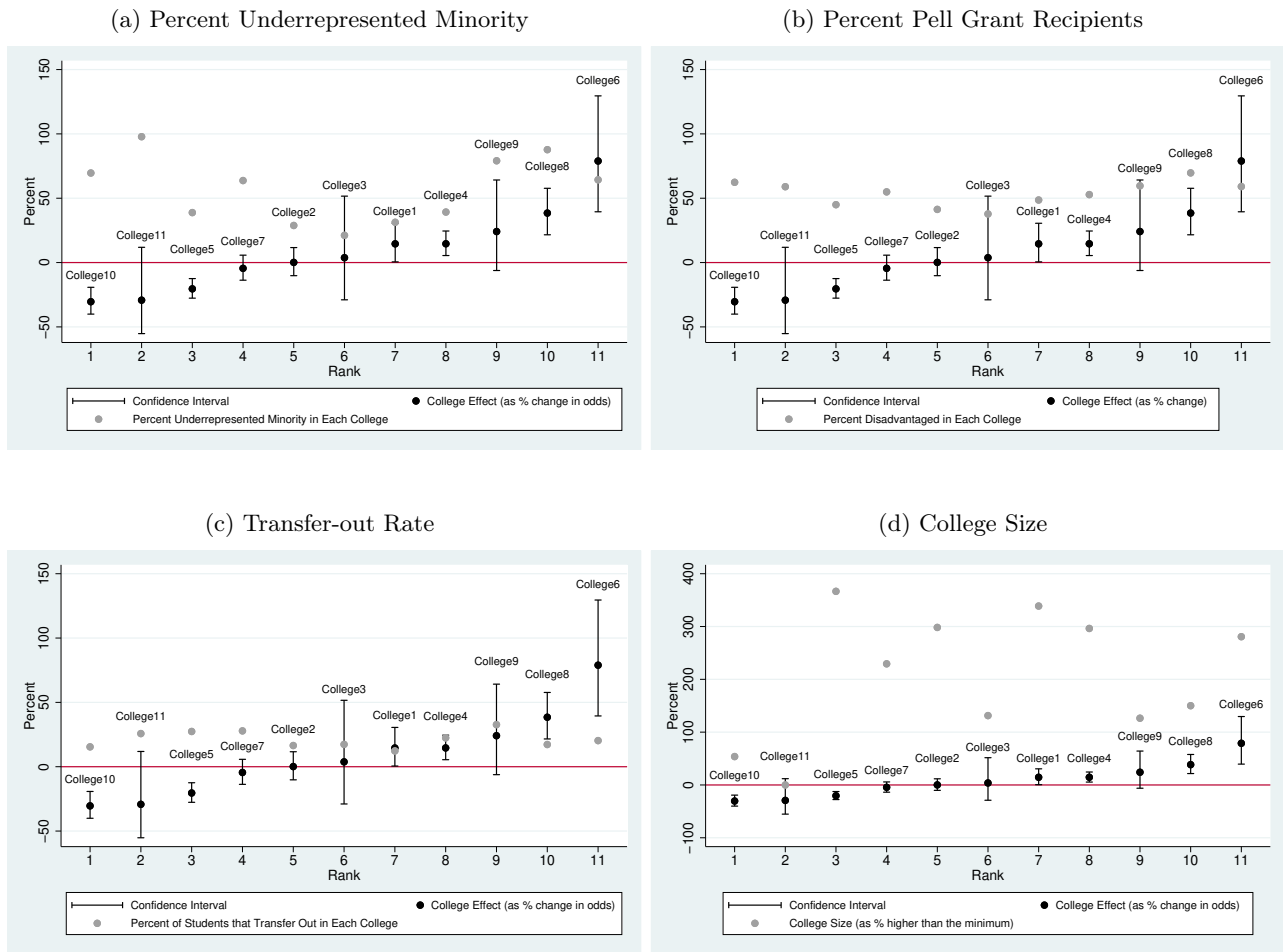
(d) College Size

Source: MetroU administrative data.

Table 6: Interactive Effects between Transfer Status and College Transfer-out Rate and Size on BA Completion, as Odds Ratios

	Coef.	Std. Err.
Individual-level controls	X	
Month, year, and application controls	X	
College transfer-out rate (std)	0.111	1.209
College size (std)	1.472*	0.156
College percent underrepresented minority (std)	0.791	0.822
College percent Pell Grant recipient (std)	3.541	1.512
College mid-selective rating	0.762	0.262
Transfer student	0.760***	0.090
Transfer*Transfer-out rate	1.001	0.232
Transfer*Size	0.835***	0.015
Applied to a four-year college	0.974	0.055
Accepted at a four-year college	1.072	0.026
Transfer semester	0.920***	0.006
Prior academic achievement	1.558***	0.008
Prior academic achievement squared	1.028***	0.005
Needed remediation	0.930***	0.018
Total two-year credits	1.021***	0.001
Earned an associate's degree	1.275***	0.025
Random effect (sd)	0.167***	0.012
Constant	0.491	0.730

Notes: The omitted category for "mid-selective rating" is non-selective rating.
*p<0.05, **p<0.01, ***p<0.001
Source: MetroU administrative data.

Future research should examine whether other college characteristics are more predictive of BA completion and explanatory of college-effects for transfer students, especially since none of the college-level characteristics included in the present analysis has a strong relationship with completion. Based on my interview research, some possible explanatory mechanisms for transfer students at the college level include efficiency of the credit transfer process, the clarity of the major declaration process, the extent of specific mentoring, advising, and academic support for transfer students, and the ability to connect with peers in students' selected major field of study (Ciocca Eller 2017).

Table 7: The Effects of College-level Characteristics on BA Completion for Transfer Students, as Odds Ratios

	Transfer Students	
	Coef.	*Std. Err.*
Transfer-out Rate (std)	0.863	0.072
Size (std)	1.312	0.226
Percent Underrepresented Minority (std)	0.917	0.186
Percent Pell Grant recipient (std)	1.147	0.170
Mid-Selective rating	0.622	0.181
Random Intercept (std. dev.)	0.181***	0.042
Individual-level controls	X	
Two-year college controls	X	
Month, year, and application controls	X	
Constant	-0.159***	0.044

Notes: The omitted category for "mid-selective rating" is non-selective rating.
*p<0.05, **p<0.01, ***p<0.001.
Source: MetroU administrative data.

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