TRANSFER PARTNERSHIPS SERIES

Identifying Effective and Equitable Institutions for Transfer Students: Exploring the Contribution of the Pair in Multilevel Models

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Community college is a gateway to postsecondary education for millions of college students in the United States yet only 13% of those intending to earn a bachelor's degree do so within six years of enrolling (Shapiro et al., 2017). The process of transferring from one postsecondary institution to another is fraught with structural, financial, and information barriers that have attracted attention from researchers, practitioners, and policymakers (see, for example, Humphries, McCambly, & Ramaley, 2015; Wheatle, Taylor, Bragg, & Ajinkya, 2017; and Western Interstate Commission on Higher Education, 2016). The literature on the postsecondary transfer process tends to examine either the policies and practices of the sending community college or, less frequently, the receiving baccalaureate-granting university, but rarely looks at policies and practices that transcend both levels (Jenkins & Fink, 2016; Taylor & Jain, 2017). Recognizing the transfer student's experience begins at the community college and continues to and through the four-year university, Bahr, Toth, Thirolf, and Masse (2013) recall the adage that "it takes two to tango" to wittily point out that extant transfer research minimally acknowledges "both the community college and the four-year institution share responsibility for the outcomes of community college transfer students" (p. 461). Like Fink and Jenkins (2017), this Data Note contends that the "effectiveness of partnerships between community colleges and universities in supporting transfer student success is critically important" (p. 308).

To explore the impact of community colleges and four-year institutions on transfer student outcomes, we leverage administrative data from three states to model transfer students as nested within institutional pairs. We believe such an approach makes both theoretical and methodological contributions to the postsecondary transfer literature. Theoretically, we move beyond studying community colleges and four-year universities as autonomous organizations to examine, as we and colleagues have in previous work, how institutions operating in relationship to one another (which we define as institutional pairs) reveal the outcomes of African American and Latinx students within the transfer process (Meza, Bragg, & Blume, 2018; Yeh & Wetzstein, 2018). We advance this approach in order to prioritize equity in baccalaureate attainment as an outcome of transfer pair performance. Empirically, we explore the extent to which hierarchical generalized linear models (HGLMs) allow us to control for within-pair correlation and student characteristics to isolate institutional pairs associated with the highest and lowest odds of baccalaureate attainment.

METHODS

Cheslock and Rios-Aguilar (2011) note that multilevel analysis is recommended in postsecondary research given that "students are nested within schools, faculty are nested within higher education institutions, and higher education institutions are nested within states" (p. 85). We employ a series of multilevel models to understand the contribution that student level variables have on transfer student success as well as the contribution of the institutional pair, as a unit. These multilevel models determine the extent to which institutional pairs are an effective way to conceptually group transfer students and predict baccalaureate degree

attainment, particularly for underrepresented students of color whose results may be underestimated and potentially misrepresented in other statistical techniques. Specifically, we address the following research questions:

1) To what extent does intra-class correlation warrant the use of multilevel modeling when examining the effects of institutional pairs on a transfer student's probability of baccalaureate degree attainment?

2) To what extent do institutional pairs predict transfer student baccalaureate degree attainment, controlling for student-level and pair-specific characteristics?

We use administrative student data from three states to explore the extent to which institutional pairs predict the baccalaureate degree attainment of transfer students. The data we use from these three states are part of a much larger data set assembled for the national Credit When It's Due (CWID) initiative involving 16 states in implementing reverse credit transfer policy and program reform to facilitate associate degree attainment (Taylor et al., 2017).

Table 1

Data Summary by State

Students	Southern State	Northern State	Midwestern State
Observations (complete student records)	11,997	21,735	29,054
Pell recipients (%)	36.2%	45.7%	50.6%
Female (%)	63.9%	57.1%	54.9%
African American (%)	21.9%	6.8%	11.3%
Latinx (%)	3.8%	3.1%	3.4%
BA attainment among population analyzed (%)	24.4%	45.3%	57.8%
Institutional pairs (n)	196[1]	144	112

RESULTS

Our multilevel analysis reveals substantial within-pair correlation (>0.10) in the Southern and Midwestern States (Table 2). At the same time, we find that baccalaureate degree attainment in the Northern State is less correlated within pairs, meaning the community college-university

pairs are less predictive of this outcome, but the correlation coefficient's value near 0.05 still meets the threshold for use of multilevel modeling (Raudenbush & Bryk, 2002).

Table 2

Correlation by State

State	Correlation Coefficient
Southern State	0.129
Midwestern State	0.121
Northern State	0.043

Within-pair correlation in terms of BA attainment, as is observed to varying degrees in the states, means that students nested within a particular transfer pair are not only similar to one another within the pair but also systematically different from students in other pairs. This characteristic of the data thus violates a fundamental assumption of linear regression that data are independent (Garson, 2013). Such non-independence, in turn, potentially leads researchers to draw incorrect conclusions based on biased results and hence serves as the primary empirical justification to use multilevel models (Garson, 2013; Raudenbush & Bryk, 2002). Furthermore, researchers are at risk of generating biased estimates when analyzing highly consequential outcomes such as the odds of baccalaureate attainment for transfer students. In other words, spurious results may emerge from a hypothesis that a student-level characteristic such as race or socioeconomic status is associated with baccalaureate attainment if researchers fail to account for how such characteristics vary across pairs and within pairs.

We fit four stepwise versions of our HGLM and compare these results to generalized linear (non-hierarchical) versions of the models. This provides two sets of results, hierarchical and non-hierarchical, to examine how student-level and pair-level characteristics predict baccalaureate attainment when controlling for within-pair variation.

In this Data Note, we present results from the Southern State, the state dataset with the highest intra-class correlation (p = 0.129), to illustrate the careful consideration researchers must make when choosing analytical models. The results suggest that the use of a hierarchical model isolates a statistically significant negative association

[1] The number of institutional pairs is substantially higher in the Southern State because the data contain public and private colleges.

between Latinx students and the odds of baccalaureate attainment that would otherwise be absent in a conventional generalized linear model. The generalized linear model fails to show a statistically significant relationship but the fully specified HGLM model suggests the odds of baccalaureate attainment are 22.8% lower for Latinx students compared to all other students in the sample.[2] All other coefficients in this state's data remain stable across the hierarchical and non-hierarchical iterations of the model (see Table 3). The direction of the coefficients also align with extant research on transfer students that shows females have greater odds of baccalaureate attainment whereas African American and Latinx students are less likely to earn bachelor's degrees (Wang, 2009). The analysis in this state also suggests that once matriculated at a four-year university, Pell-eligible students are more likely to earn a baccalaureate degree compared to their higher-income peers.

With respect to this analysis, the use of hierarchical and non-hierarchical models reveals the potential bias and spurious findings that may arise when within-class correlation is left unaddressed, especially in the context of identifying racial inequities across baccalaureate degree attainment rates.

In the multilevel models the magnitude of the outcome for African-American students decreases in the multilevel models (2A and 3A) relative to the linear models (2B and 3B). The results for Latinx students are of greater consequence: the linear models (2B and 3B) suggest a nonsignificant effect of race for Latinx students on BA attainment but the multilevel models (2A and 3A) reveal a decreased odds of BA attainment. This is the type of spurious Type I error found in the non-hierarchical model that illustrates the potentially problematic results when within-group bias is unaccounted for in statistical models.

Salient to Research Question #2, our analyses across three states reveal a valuable insight into the predictive value of institutional pairs analyzed within a multilevel framework. We find that while most institutional pairs are not distinguishable from zero in predicting the odds of baccalaureate degree attainment, there are a noteworthy number of pairs that substantially increase (and decrease) the odds of degree attainment when controlling for all other student-level and pair-level characteristics. An institutional pair can range from more than doubling the odds of degree attainment to a decreased odds of degree attainment by nearly 75%.

Table 3

HGLM Coefficients (A) and GLM Coefficients (B), Southern State

	Model 1A	Model 1B	Model 2A	Model 2B	Model 3A	Model 3B
	Empty (Intercept only)		Demographics		Demographics and pair distance	
Constant	-1.235*** (0.063)	0.246*** (0.004)	-1.998*** (0.100)	-1.899*** (0.086)	-2.379** (0.125)	-1.899*** (0.085)
African American			-0.820*** (0.072)	-1.041*** (0.062)	-0.819*** (0.071)	-1.021*** (0.062)
Latinx			-0.294*** (0.118)	-0.133 (0.113)	-0.259*** (0.116)	-0.105 (0.113)
Gender (Female)			0.256*** (0.049)	0.238*** (0.047)	0.264*** (0.049)	0.246*** (0.047)
Pell Eligible			1.179*** (0.046)	1.068*** (0.044)	1.180*** (0.046)	1.069*** (0.045)
Distance (10 mile increments)					0.051*** (0.01)	0.032*** (0.01)
AIC	12,888.3	13,861.5	12,141.7	12,600.2	12,120.4	12,565.2
BIC	12,903.2	13,876.3	12,186.1	12,637.1	12,172.1	12,609.6

[2] To ease interpretation, we interpret coefficients as log odds e.g. the Latinx coefficient of -0.259 in this example equals $e^{(0.035)}$ – 1 = 0.7721 – 1 = -0.228, which is interpreted as a 22.8% decrease in the odds of baccalaureate degree attainment.

SCHOLARLY SIGNIFICANCE AND POLICY IMPLICATIONS

This study provides a novel identification strategy to advance the theoretical and empirical analysis of institutional pairs as a central factor in the postsecondary transfer process. Bahr et al. (2013) argue that the "narrow focus on the community college" in transfer student research is "oddly myopic" in that this research "neglects half of the equation, namely, the four-year institution" (p. 461). The consequence of this neglect leaves "unstudied the effectiveness of partnerships between pairs of two- and four-year institutions" (Xu et al., 2018). We present a robust and viable identification strategy on which future theoretical and empirical work can build. More precision in estimating baccalaureate-degree attainment for institutional pairs within states would seem to be an important step forward in being able to more carefully identify transfer partnerships that inform policy and practice.

Though numerous studies have identified equity as an important issue pertaining to transfer (Bragg, Taylor, Giani, & Soler, 2016), and some have attempted to examine racial and/or income inequities for transfer students (Wang, 2009; Crisp & Nunez, 2014), we explicitly call on both the community colleges *and* four-year universities to improve the postsecondary transfer processes. Despite these studies, major gaps remain in the national research on transfer. Our study makes a modest contribution to this gap – and to the highly relevant area of education policy – by centering our analysis on pair "effectiveness" and the implication of considering racial equity relative to pairs.

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