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# Institutional Impact of Upward Transfer on Baccalaureate Degree Attainment



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## ABOUT THE ERDC

The research presented here uses data from the Education Research and Data Center, located in the Washington Office of Financial Management. ERDC works with partner agencies to conduct powerful analyses of learning that can help inform the decisionmaking of Washington legislators, parents, and education providers. ERDC's data system is a statewide longitudinal data system that includes de-identified data about people's preschool, educational and workforce experiences.

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## Executive Summary

Students follow multiple pathways to bachelor's degree completion but the relative impacts of these different pathways is not well understood. This study seeks to disentangle factors relating to student persistence to graduation by controlling for both student and institutional factors. Using a mixed effects linear regression model on a matched dataset, this study had two main findings:

- Participation in upward transfer was found to negatively impact probability of graduation by between 9.3 percent and 12.1 percent. Students following this pathway are thus significantly less likely to graduate than their direct entry peers.
- The administrative data used in this analysis showed evidence of institutional bias and selection bias. These biases were shown not to substantially impact the relationship between upward transfer and graduation. However, they did produce measureable shifts in the magnitude of transfer impact estimates.

Several additional factors were analyzed to verify the validity of this research. The importance of these points applies only to this study but may speak to its context relative to other research in the literature.

- In general the variables representing demographics, financial aid, and educational experience related in similar ways to graduation as compared to findings in the literature. The exception to this is minority status and expected family contribution which had insignificant impact on graduation across all models.
- In the context of higher education research, when multiple institutions are being studied, there is reason to apply mixed effects modeling and/or propensity score matching to control for selection and survivorship bias.
- Potential bias introduced due to the specification of the sample, as well as missing data relating to student ability, may have reduced accuracy of estimates and merits further study.

## Introduction

After graduating from high school, students in Washington pursuing higher education may choose to follow numerous pathways in pursuit of a bachelor's degree. Two of these pathways, upward transfer and direct entry, have become common routes to graduation within Washington state public four year institutions. This study seeks to disassociate the pathway effect from both the institutional and selection biases inherent to this type of research, and estimate the impact of choosing to follow the upward transfer route on graduating with a bachelor's degree.

### Pathways

Every year in Washington, 62 percent of recent public high school graduates enroll in college (Management, 2019). While many students choose to attend a four year school directly out of high school, not all will choose to follow this direct entry pathway. Some students choose the upward transfer pathway that allows college enrollees to begin their higher education at one of the state's community colleges and later transfer to a four-year school to complete their bachelor's degree. This allows students who otherwise might have attended a four year school to save a portion of the cost of tuition (Belfield, 2017), prove their academic ability (Dowd, 2008), or catch up on their coursework (Greene, 2017).

The number of students who follow the upward transfer accounts for a sizeable portion of graduates at public four year schools in Washington. The state has thirty four community and technical college (CTCs) and six public, four year institutions which enrolled a combined total of 288,702 students in 2017 (WA Office of Financial Management, 2019). On average, 34 percent of these students will transfer at least once in their college career (WA Student Achievement Council, 2017). Of those who go on to earn their bachelor's degree, three out of ten will have transferred credits from a CTC (WA Student Achievement Council, 2017).

However, those who follow the upward transfer pathway face a host of challenges that direct entry students are insulated from. Students who begin at CTCs are often more limited in their course options at the beginning of their higher education and do not benefit from as strong a positive peer effect as direct entry students (Brand, 2014). Transfer students in our data are far more likely to share a classroom with students who will take remedial classes or who are from a low income household than direct entry students. These issues may be partially offset by lower tuition costs, additional support resources for remedial learning, lower textbook costs, and in some cases, a pre-determined path for transfer to a four year school.

Despite their differences, students from both direct entry and upward transfer pathways graduate at a similar rate once they enter the four year school. However, a similar result does not necessarily mean that the pathways are equivalent. The schools transfer students



attend at the beginning of their higher education and the schools they ultimately graduate from may influence graduation rate in ways not shown in normal models. Since policies on the awarding of transfer of credits differ among schools, the progress a transfer student makes in community college may not be shown in four year college transcripts. Similarly, students who fail to make progress in community college may drop out before entering the upward transfer pathway while students who select the direct entry pathway and fail to graduate are fully accounted for. These issues represent a selection bias and a survivorship bias respectively and are not generally accounted for in previous papers in this series (Greene, 2019).

## Transfers in the Literature

Upward transfer has been a major topic in higher education research for decades (Bahr, 2013). Yet the majority of studies on the topic fail to account for significant potential student selection bias stemming from the transition between CTCs and four-year schools, and survivorship bias between initial enrollment and graduation. To account for these potential issues, it is first necessary to put the impacts of these biases in context.

**Selection bias** arises when individuals included in the sample may fundamentally differ from that of the population. For example, this study includes all students who graduate from Washington high schools who pursue a bachelor's degree from one of Washington's six public four year institutions. Students who enroll in a private school or an out of state school after high school are excluded from this analysis. Thus, those who follow pathways to a bachelor's degree other than the two identified pathways are excluded from this analysis even though they could easily have qualified given slightly different circumstances.

Selection bias in transfer research has been repeatedly identified as a stumbling block to accurate analysis, yet the literature is relatively sparse in examples where this issue has been controlled for. Depending on your perspective, selection bias can arise from the student's choice of school, or the student's path to a degree. In general, researchers select one of two methods to control for the selection bias: either they apply a fixed effects model, or they apply an instrumental variable (IV) model (Melguizo, 2009; Wang, 2017; Long, 2009) to their analysis. As both approaches are similar, the effective impact on their results is also similar.

**Survivorship bias** occurs when students who qualify for the study are removed from the analysis due to factors related to the specification of the analysis. The remaining observations are therefore related in ways the analysis cannot directly detect. This study, for example, narrows the sample to students who attend Washington public higher education, complete forty credit hours, and choose to pursue their bachelor's degree from one of six public Washington universities. This means that students who began their college career in community college with the intent to transfer but eventually do not are excluded.

Acknowledgement of survivorship bias is far more common within the literature. Multiple studies control for transfer students entering four year schools after attrition

at the CTC level by adopting a propensity score matching methodology (Monaghan, 2014; Xu D. S., 2016; Xu D. J., 2018; Wang, 2017; Lichtenberger E. ..., 2013; Long, 2009; Lichtenberger E. a., 2017; Doyle, 2009). These studies attempt to control for differential outcomes across CTC and four-year students by focusing on differences between students who might be predicted to have reached the same point in their education regardless of their previous experiences.

While survivorship and selection bias may be somewhat commonly addressed, the literature holds few examples of research that controls for *both* selection and survivorship bias. Two known papers utilize the combination of IV and propensity score matching to implement their analysis with inconclusive results (Wang, 2017; Long, 2009). Long (2009) finds an impact on results after controlling for both biases while Wang (2017) finds a null effect on their results. These differences may stem from the frame of reference, as Long (2009) focuses on comparing upward transfer and direct entry students while Wang (2017) focuses on subsets of students completing upward transfers. However, in both cases the use of IV in combination with limited datasets may result in over fitted findings.

## Persistence in the Literature

The literature also identifies the student characteristics attributable to transfer student persistence to graduation. Previous studies have found grade point average (GPA) (Greene, 2019; Gao, 2002), full-time attendance (Greene, 2019), and not enrolling in Science, Technology, Engineering, or Mathematics (STEM) (Greene, 2019; Lakin, 2016) were significantly related to graduation for both direct entry and transfer students. Other variables such as age, race, and financial aid have been shown to impact student graduation rates (Long, 2009; Lichtenberger E. a., 2017).

However, the literature describes an institutional impact that is not explored in previous work in this series. This impact, particularly from the aspect of the four year school, is described as having significant post transfer effects on student persistence (Bailey, 2005). Factors including student-faculty ratios, percentage of faculty that are full time, total expenditures, and tuition and fees have been shown to impact student graduation rates for all students (Goenner, 2003) while institutional sector and selectivity have been shown to directly impact transfer students (Jenkins, 2016).

Students who attend Washington four year institutions likely face institutional impacts based on the school at which they choose to pursue their bachelor's degree. This choice may influence their persistence to graduation in ways that simple fixed effects models may fail to reflect. Previous studies have only controlled for student selection at initial enrollment and failed to control for variations resulting from the selection of the four-year institution as part of the transfer pathway. The addition of random effects, effectively grouping results by four year institution, can further control for selection bias related to the institution a student attends to complete their bachelors' degree (Clarke, 2010).

## Data

The goal of this study is to analyze the impact of upward transfer on the likelihood of graduating with a bachelor's degree. The Office of Financial Management (OFM) holds data in the Public Centralized Higher Education Enrollment System (PCHEES) database on students who attended public universities in Washington. While most community college transfer students transfer to Washington public universities, students do not exclusively follow this path. Some students may transfer to private, out of state, or even other community colleges. As OFM's datasets do not include information on 4-year schools beyond Washington's 6 public four year institutions, only students who attended one of these schools will be included in this study. Students who transfer to other community colleges in the state are also excluded as, even though some community colleges do offer bachelor's degrees, it is unclear if this type of transfer is with the intent to earn a bachelor's degree or a relocation.

OFM holds relevant higher education student data beginning with the 2004-2005 school year and continuing through the 2017-2018 school year. The sample used for this study is drawn from students enrolled during the fall quarter / semester of 2009 in any of the Washington public 2-year or 4-year institutions. To be included, students at a 2-year institution had to have transferred to a 4-year institution with 40 or more credits before earning their first baccalaureate degree. Summary statistics for the base dataset are available in Table A1 in the Appendix.

## Model

This analysis consists of two parts: a propensity score match and a mixed effects model. Because direct entry students differ from transfer students in a number of measurable ways, propensity score matching was used to control for student characteristics. This technique utilizes a linear regression model to identify similar students between the two groups, who were matched using the nearest neighbor methodology explained in (Rosenbaum, 1983). To ensure an institutionally representative dataset, the matches were based on cohorts of transfer students identified by the community college and limited to students who attended the same 4-year school.

The basis for institutional analysis is the mixed effects model. The impact of schools on graduation are considered to be random (unrelated to the other variables in the model). This modeling is used to estimate the impacts of datasets where the data can be broken down into clear subsets of the whole dataset. In this study, 4-year schools are the random effects variable and act as subsets, as their impacts on persistence are limited to those students who attend the school. The fixed effects portion of the mixed effects model is the set of student variables representing the student's demographic, financial aid, and academic experience characteristics.

The linkage for this analysis is the logit regression model where the outcome (dependent) variable is binary. In logit models independent (control) variables are treated as linearly related to the outcome variable with the result being represented as the log likelihood of the outcome occurring given a set of inputs. Since the design of this research is focused on determining the impact of upward transfer, the logit regression allows us to discern the relative impact of each of the independent variables on the likelihood of graduation.

## Results

### Summary

Overall there were two main findings. First, participation in upward transfer was found to negatively impact probability of graduation. This effect was significant with an estimated impact on graduation probability of between 9.3 percent and 12.1 percent. After controlling for survivorship and selection bias, students following the upward transfer pathway suffered from a significant transfer penalty and were overall less likely to graduate than their direct entry peers.

The second result was that the administrative data used in this analysis showed evidence of institutional bias and selection bias. This bias did not substantially impact the relationship between upward transfer and graduation but did produce substantive shifts in the magnitude of transfer impact estimates. This would suggest that future work on similar datasets should consider checking for these biases as either part of the model or as a model fitting exercise.

### Details

Primary results for this study derive from comparisons between logistic regression models representing both matched and unmatched datasets. The most basic treatment of the analysis is a generalized linear model (GLM) logistic regression applied to the whole dataset. Raw results of this model (fixed effects, unmatched) are presented in Table A1 in the Appendix. The interpretation of the coefficients of a logistic regression are somewhat different from standard regression results -- the resulting values are log odds (logits) and represent a smoothed probability function. Generally, only the sign of the coefficient is interpretable.

It is necessary to convert the results using marginal standardization as described in Muller and MacLegouse (2014) to more directly interpret the coefficients. This method proportionally adjusts the variable of interest to a weight for each level of confounding factors. In effect, predicted probabilities of the output are calculated for every observed confounder value and later combined as a weighted average for each exposure level. Thus, the probabilities found in Table A2 in the Appendix represent the probability of graduation (relative to average).

Students who were full time enrollees or STEM majors were more likely to graduate. Students receiving more aid and who had higher first quarter GPAs were more likely to graduate with



cumulative effect. Conversely, students who were upward transfers, male, eligible for Pell grants, or took remedial education classes were less likely to graduate. Older students were also less likely to graduate with cumulative effect. Being a minority student or amount of expected family contribution were unrelated to probability of graduation.

All these results are consistent with relationships found in the literature. However, the purpose of this research is to determine if there is a difference in graduation probability between students who follow upward transfer and direct entry pathways. The GLM model used here controls for selection bias (as it is a fixed effects model). Therefore, before controlling for survivorship bias and institutional effects, this study finds that following the transfer pathway decreased the probability of graduation by 9.3 percent relative to the direct entry pathway.

The next step was to control for institutional effects by estimating the impact of the fixed effects model on a school by school basis, separating the sample by four year institution. This model resulted in minority status becoming significant and positively related to graduation. Significance for other variables did not change. Of particular interest was the decrease in the graduation rate attributable to the transfer pathway. Students following this pathway, after controlling for selection bias and institutional bias, were 10.2 percent less likely to graduate, as the mixed model attributed more of the impact on graduation to the transfer pathway. Other variables showed minor movement in coefficients with the exception of remedial education. When controlling for selection bias and institutional bias, the impact of remedial education on graduation was less than half, in absolute terms, than it was before.

In addition to controlling for institutional bias, this study seeks to control for survivorship bias by applying propensity score matching. Propensity score matching uses descriptive characteristics of the students (that are independent of their choice of institution) to adjust the sample to be more evenly balanced between transfer and direct entry students. The matched variables (gender, race, age, remedial education, Pell eligibility) represent a student's demography and academic preparation. Transfer status represents the factor the matched dataset is seeking to balance.

The result of the propensity score matching was a reduction of 14,314 observations (all from the direct entry pathway) to create a matched dataset with 12,318 observations in both the upward transfer and the direct entry pathways (n=24,636). Adjusted data carries slightly different variable characteristics compared to the broader dataset. Summary statistics of the modified dataset are available in Table A1 in the Appendix. Using the matched data, the original fixed effects model was re-run to produce the selection bias and survivor bias controlled model. The results and related probabilities of this analysis can be found in A2 in the Appendix for both the matched fixed effects model and the matched mixed effects model. The results from this model are substantially similar to that of the un-matched dataset with minor changes in coefficients.

## Conclusion

First and foremost, this study found that upward transfer was significantly correlated with decreased graduation rates after correcting for multiple possible biases. This result was robust among several different perspectives on how students progress through their education pathways. These findings support the notion that students entering four year institutions through the transfer pathway inherently have a disadvantage compared to those entering directly. The reason for a transfer penalty found in this study is not entirely clear from this analysis. However, this penalty may relate to student ability, student socio-economic status, and institutional factors which are not fully controlled for in this research.

Second, this study found that there was bias inherent in the studied sample. This is not surprising in so far as there is an obvious correlation between institution and the transfer pathways inherent in direct transfer agreements several of the schools in the sample have signed with community colleges. This in effect may have shifted some of each school's low income, direct entry students to the upward transfer pathway as a money saving mechanism. This concept is corroborated by the significant, positive relationship found between intent to transfer and upward transfer by Greene (2017).

Another outcome of this study was corroborating relationships between demographics, aid, and student experience with graduation. Much like previous studies in the literature, this study found that traditional influences on graduation such as gender, income, full/part time status, age and STEM status maintained their respective relationships. However, minority status was found to be a small and insignificant influence on graduation. This is a departure from the literature, and the reason for this lack of relationship is unclear, warranting further study.

Finally, the use of both propensity score matching and mixed models was tested in this research. Unlike simpler modeling like fixed effects, these models sought to control for bias in a way that is not common within education research. The improvement resulting from the chained use of these methods is unclear from this single application, but potential benefits from this methodology indicate that further use of these techniques in other research may be warranted. In this application, the large dataset likely muted the value of propensity score matching relative to mixed modeling, but the application of the technique likely removed some bias inherent in outliers within the direct entry pathway.

## Further Research

The result that upward transfer is significantly related to decreased graduation is not precisely in line with the previous study in this series (Greene, 2019) which found no difference between the two groups. The reasoning for this difference is unclear but may be related to bias in the initial dataset. Another issue with this analysis was a relatively high rate of missing data on the only student ability variable included in the model. While GPA was available for most schools, Evergreen College does not assign grades during the student's first year and therefore does not calculate a GPA. This resulted in a 99 percent missing rate for first quarter GPA in our sample leading to the exclusion of the

school from analysis. Removal of the variable from analysis was determined to be more impactful on results than the inclusion of an additional school<sup>1</sup>. As Evergreen College does not assign first year GPAs future research should focus on pre-enrollment and/or late college student ability measurements.

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1 A matched mixed effects model which included Evergreen College data but excluded GPA was run to determine the impact of the tradeoff. A Cook's distance test was applied to the results which found that relatively little of the model was dependent on the Evergreen College portion of the data.

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## Appendix: Tables

Table A1. Summary statistics

Summary Statistics	Full Dataset	Matched Data
Sample Size	38930	24636
Graduate	0.8484	0.8048
Male	0.4753	0.5085
White	0.6605	0.6046
Age <sup>^</sup>	0.05961	0.09685
Pell Eligible	0.3068	0.477
Remedial Education	0.3213	0.5082
STEM	0.2196	0.2281
Transfer Student	0.3159	0.5
Full Time Student	0.9128	0.883
Expected Family Contribution*	0.2858	0.2632
Total Aid*	1.174	1.572
First Quarter GPA	3.102	3.091

\* Variable is represented in \$10,000 increments

<sup>^</sup> Variable is represented in age minus 18 years

Table A2. Model results

	Logit	Mixed Effects	Matched Logit	Matched Mixed Effects
Age	-1.9% **	-2.0% **	-2.5% **	-2.5% **
Expected Family Contribution	-0.3%	0.0%	0.0%	0.2%
First Quarter GPA	7.0% ***	7.0% ***	8.3% ***	8.4% ***
Full Time Student	8.3% ***	8.3% ***	9.8% ***	10.0% ***
Male	-3.0% ***	-2.9% ***	-2.8% ***	-2.7% ***
Pell Eligible	-6.5% ***	-5.7% ***	-7.7% ***	-7.0% ***
Remedial Education	-5.3% ***	-2.2% ***	-6.0% ***	-2.9% ***
STEM	2.8% ***	2.5% ***	2.5% ***	2.3% ***
Total Aid	1.4% ***	1.2% ***	2.0% ***	1.7% ***
White	-0.1%	1.0% **	-0.1%	1.2% *
Transfer Student	-9.3% ***	-10.2% ***	-10.9% ***	-12.2% ***

\*Significant at 95% Level



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