The Journal of Higher Education

ISSN: 0022-1546 (Print) 1538-4640 (Online) Journal homepage: https://www.tandfonline.com/loi/uhej20

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To cite this article: Dirk Witteveen & Paul Attewell (2019): The Vertical Transfer Penalty among Bachelor's Degree Graduates, The Journal of Higher Education, DOI: 10.1080/00221546.2019.1609323

To link to this article: https://doi.org/10.1080/00221546.2019.1609323

Published online: 24 May 2019.

THE JOURNAL OF HIGHER EDUCATION
https://doi.org/10.1080/00221546.2019.1609323

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The Vertical Transfer Penalty among Bachelor's Degree Graduates

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ABSTRACT
Numerous studies have investigated the consequences of vertical transfer on students' higher education outcomes in comparison to "native 4-year students"—those who went straight from high school into a bachelor's program. However, the long-term labor market outcomes for vertical transfer students are understudied. Using nationally-representative data from the National Survey of College Graduates 2015, we estimate the relationship between starting in a community college (vs. at a 4-year college) and postcollege earnings and employment, in ways that correct for selection bias and overdispersion. We estimate a roughly 14% earnings disadvantage for baccalaureates who started at a 2-year rather than 4-year institution, regardless of college major. No effect was found on graduates' employment chances.

ARTICLE HISTORY
Received 4 August 2018
Accepted 13 April 2019

KEYWORDS
Community college; vertical transfer; four-year college; labor market outcomes; employment; earnings disadvantage

Introduction

A majority of community college entrants aspire to complete a bachelor's degree (Horn & Skomsvold, 2011), and about one third of all community college students transfer to a 4-year college within 6 years to do so (Jenkins & Fink, 2016). Scholars therefore refer to a "short route" and a "long route" to the BA, where the latter describes undergraduates who begin at a community college and later transfer to a 4-year institution. Policy makers and researchers stress the importance of so-called vertical transfer or the long route for low-income, racial, and ethnic minorities' access to higher education and, eventually, to the bachelor's degree (National Center for Public Policy and Higher Education, 2011).

Numerous studies have investigated the consequences of vertical transfer on students' educational performance in comparison to "native 4-year students," who went straight from high school into a bachelor's degree program. Those analyses have typically concentrated on grades and graduation, credit transfer, and the social and academic integration of transfer students, and sometimes on what is called "transfer shock"—lower grades after transferring

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(Monaghan & Attewell, 2015). In addition, the financial costs of the long route to a bachelor's degree have been studied, including assessments of the total tuition and fees paid and the accumulation of loan debt, comparing vertical transfer students and native 4-year students (Hu, Ortagusb, & Kramer, 2017).

However, the long-term labor market outcomes for vertical transfer students and native 4-year students have barely been studied. To our knowledge, only one paper by Xu, Smith Jaggars, Fletcher, and Fink (2018) estimates the effects of transferring from a 2-year to a 4-year program on postcollege labor market outcomes. Using administrative data from Virginia and employing a matching strategy to account for selection into either route, they found a significant earnings penalty of about $900 quarterly among employed individuals 8 years leaving higher education.

The present paper first summarizes research on the short-term educational and financial discrepancies between the short route and the long route to the bachelor's degree. We then turn to the long-term labor market consequences —on employment and earnings—of starting at a community college, by presenting the currently known facts as well as a theoretical framework for subsequent questions. Using a large nationally representative dataset of college graduates, we examine the correlates of vertical transfer on postcollege labor market outcomes and discuss policy implications of our findings.

Literature

Graduation, delay, and debt

The longer route to the BA—transferring from a community college—is generally considered cheaper. The evidence for this monetary advantage comes from policy-oriented studies (American Association for Community Colleges [AACC], 2016), reviews (Belfield & Bailey, 2011), and several empirical studies (Barreno & Traut, 2012; Goldhaber & Peri, 2007; Wood & Harrison, 2014). However, it is important to note that these cost–benefit analyses only take into account the tuition and fees—the immediate financial burdens of higher education students.

The longer route also comes with some risks. Students who start in a community college and transfer to a 4-year college have a lower chance of graduating than native 4-year college students. Jenkins and Fink (2016) report that 42% of vertical transfer students graduate with a bachelor's degree, considerably fewer than native 4-year students. Other empirical studies have also documented a lower graduation chance of transfer students (Hu et al., 2017; Kienzl, Wesaw, & Kumar, 2012; Long & Kurlaender, 2009; Monaghan & Attewell, 2015; Reynolds & DesJardins, 2009). This negative effect may have several causes. Vertically transferring students may have to

retake coursework because of the specific requirements and policies of the four-year institution (Hu et al., 2017; see also Townsend & Wilson, 2006). Some scholars have also suggested that transfer students experience a temporary drop in Grade Point Average (GPA) after transfer (Bahr, Toth, Thirolf, & Masse, 2013).

However, the negative impact on the likelihood of graduation has been disputed by other studies that have found no significant difference in graduation rates of the short and long routes after adjusting for selection biases (Dietrich & Lichtenberger, 2015; Melguizo, Kienzl, & Alfonso, 2011; Miller, 2007; Xu et al., 2018). Leigh and Gill (2003) found that, conditional on the desired number of years of schooling, transfer students obtain on average more education than 4-year college students do. Xu et al. (2018) argue that the significant negative effect on graduation found in earlier studies is partially the result of methodological choices, such as selecting samples that disproportionally represent minimally selective 4-year schools.

Vertical transfer is also associated with several unobserved or understudied indirect costs. For example, transferring increases students' time to degree by about 2 to 3 months on average (Hu et al., 2017). This increased time to degree for transfer students is most common among graduates who attended less-selective public institutions because of fewer sources and higher student employment (Bound, Lovenheim, & Turner, 2012). Monaghan and Attewell (2015) found that transfer students also suffer delay from nonenrollment spells during the vertical transition. The transition may be more difficult depending on a student's demographic background (Mooring & Mooring, 2016) and the extent to which a student becomes socially integrated in the 4-year college (Ishitani & McKitrick, 2010). All of these effects are likely to be exacerbated for those transfer students who fail to graduate because their forgone earnings are not compensated with a postcollege earnings boost from obtaining a bachelor's degree.

Finally, although long-term financial consequences may accumulate for vertical transfer students, those who did not graduate may lose some financial savings that they earlier gained from starting in the more affordable community college system. Empirical evidence on the net price of the different routes within higher education remains unclear. González Canché (2014) reports that an initial enrollment at a community college does not reduce a student's total loan debt compared to similar students who start in a 4-year program.

Postcollege outcomes

A much smaller body of research focuses on the postcollege employment chances and earnings from taking the community college to BA route. Hilmer, 1997) studied male college graduates in the High School and

Beyond Survey of 1980. His study primarily concerned the return to college quality on postcollege earnings. The results were twofold. About 12 years after high school attendance, community college transfer students displayed a significantly lower average hourly wage. However, transfer students who graduated from the highest quality 4-year colleges gained slightly more from their institution's reputation than native 4-year graduates. Hilmer attributes this to a labor market pay-off from characteristics of transfer students that also explain their path to the best universities, such as unobserved motivation or grit.

In a working paper by Miller (2007), matching and instrumental variables approaches suggest a significant and substantial negative effect of starting in a community college and transferring to a 4-year institution on respondents' 2005 earnings ($6,800 less). However, this effect becomes indistinguishable from zero if the analyses are limited to students who graduated with a bachelor's degree. In other words, successful vertically transferred students do not experience an earnings penalty. Although sample sizes are large in Miller's study, the sample includes only public college attendees and administrative data from Texas.

Using the 1979 National Longitudinal Survey of Youth, Light and Strayer (2004) found no statistical difference in hourly wages between transfer students who obtained a bachelor's degree and native 4-year college graduates. The authors also argued that transfer students received an indirect wage benefit in comparison to students who did not transfer because transferring has a positive net effect on chances of graduation. Their study used an 11-dimensional decomposition model to account for heterogeneous effects but did not adjust for selection bias (into treatment).

Most recently, Xu et al. (2018) estimated employment chances and earnings for transfer students and native 4-year students in Virginia, measured in 2012 (8 years after graduation). Using propensity-score matching, they compare transfer and nontransfer students after matching on the likelihood of number of credits taken. Among all employed respondents, the authors found significantly lower earnings for transfer students as a whole (–$891), as well as for transfers who were BA graduates only (–$947).

In sum, the literature on the labor market payoffs of transferring from a community college to a bachelor's degree program (and graduating) has been understudied. In addition, the results are inconsistent, as three studies report an earnings penalty (of which one disappears for graduates) and one study reports a null finding.

Analytical strategy

Because community college enrollment has grown in recent years and is increasingly presented as a valuable and affordable pathway to the bachelor's

degree, we will revisit the labor market outcomes of vertical transfers with recent nationally-representative data. Do vertically transferred college graduates have the same employment chances as native 4-year college graduates? And, conditional on having a job, are there earnings discrepancies that can be associated with taking the long route rather than the short route?

As noted by Xu et al. (2018), estimating the impact of vertical transfer requires researchers to define a "successful" transfer. In this study, we only cover those who completed a BA among transfer and native 4-year students. Our data source and analyses do not include those who failed to graduate. We therefore believe that any disadvantage between vertical transfer graduates and native graduates that we observe will be an underestimation of such discrepancies for the population of transfer students as a whole, including those who did not graduate.

In addition to estimating the vertical transfer penalty, we explore one important interaction. As shown in research by Hilmer (1997), returns to college major vary across graduates who took different routes toward their degrees. We therefore examine whether BA graduates' labor market outcomes are affected by the interaction between starting in a community college (or not) and the choice of college major in the last institution attended. Do the employment chances and earnings of vertically transferred graduates vary depending on their major, compared to their 4-year counterparts?

Data

We use nationally-representative data from the National Survey of College Graduates of 2015 (NSCG 2015), a survey conducted by the National Science Foundation (NSF, 2015) on a sample of bachelor's degree graduates (or higher) drawn from the American Community Survey (ACS). The NSCG survey of 2015 consists of 91,000 cases and is representative of 58 million bachelor's degree holders in the United States. This sample was drawn from the 2009 ACS, the 2011 ACS, the 2013 ACS, and the 2010 National Survey of Recent College Graduates (with a response rate of 70%). The sampling frame for these sources was based on demographic group, highest degree, bachelor field, and occupation. NSCG provided sample weights based on sampling selection and nonresponse, as well as corrections for complex sampling techniques (trimming procedures, raking procedures, overlap procedures).

In addition to demographic variables including gender, race, ethnicity, and highest parental education, respondents answered detailed questions about their enrollment history, including community college attendance, the time period, and reason for attendance. Regarding the institution from which the respondent ultimately graduated with a baccalaureate degree, the NSCG survey contains information about the institution type (Carnegie classification), college major, and possible postgraduate attendance and graduation. NSCG reported

a nonresponse rates up to 0.6% for employment status and work activity, and a 10% nonresponse for earnings throughout the entire sample. (NSCG utilized a hot deck imputation to compensate for missing earnings).

The key independent variable is a broad definition of the long route toward the bachelor's degree: any community college enrollment that occurred after secondary education and prior to enrollment in a 4-year degree program. Dual enrollment in high school and in a community college is not included in our definition. This definition captures 70.3% of community college attendees in the NSCG data. Other forms of community college-going include credit taking before high school graduation, enrolling after or during attempting a bachelor's degree, and enrolling after graduating with a bachelor's degree.

With this definition, we focus specifically on accurately measuring the timing of community college attendance among the most recent generation of higher education attendees—one that took place in the phase of decision making after high school completion. This is a highly policy-relevant definition considering community college's potential stepping stone function before starting a bachelor's degree program.

Conditional on community college being the first level of entry into higher education, there may be all kinds of reasons (and strategies) for the timing of the actual vertical transfer. For example, having to complete the associate's degree to be allowed access to a connected 4-year program, versus enrolling for several (cheaper) semesters to make a head start for a bachelor's degree, or a sudden change of occupational ambition for which a bachelor's degree is required instead of an associate's degree. These levels of detail in students' motivation for the vertical transfer cannot be explored using these data. However, the variety of decision-making scenarios upon leaving secondary education are all part of the "gateway function" of a bachelor's degree.

To measure the impact of a vertical transfer on labor market outcomes of the current labor force, we limit our study sample to individuals who are not currently enrolled in education and who were between ages 25 and 40 in 2015. This early career age restriction serves two purposes. First, it allows us to accurately quantify a possible earnings penalty because salaries (and incomes more generally) among this younger age group are less affected by career-specific steps on the occupational job ladder, which are likely to be largely exogenous to the relationship between the higher educational pathway and the labor market outcomes. Second, *vertical transfer* has a different meaning for students and policy makers today than several decades ago. By focusing our analyses on the most recent cohorts of college graduates we practically concentrate on a generation for whom the long route the bachelor's was a strategized effective, pragmatic, or cheap pathway. Nonetheless, we perform a sensitivity analysis to estimate the vertical transfer effects among the entire workforce population (ages 25 to 64).

We use employment (a dummy variable) as our first dependent variable and, among those who are employed, we then predict earnings (i.e., salary) in early 2015. The latter variable was top coded at $500,000. The reference period for employment status and earnings is February 1, 2015

Estimation

We take three different approaches to estimating employment chances and earnings differentials. First, we present a logistic regression to predict the likelihood of employment and an ordinary least squares (OLS) regression on the logged annual earnings among employed individuals. In both these models we use a dummy variable for the two routes to the bachelor's degree: vertically transferred students versus native 4-year students. In a series of nested models, we adjust for a range of individual-level, several college-related factors, region of residence (or employment), and labor market experience (respondents' age). Each of these factors are associated with labor market differentials (discussed later).

By using the natural log of earnings, we have accounted for some of the skewness in the dependent variable. However, statisticians have convincingly argued that taking the natural log of earnings does not sufficiently adjust for its distribution being heavily skewed to the right and overdispersed (Hardin & Hilbe, 2012; Hilbe, 2011, 2014). Our second type of model therefore employs a negative binomial (NB) regression, as a robustness check. The NB model is a generalization of a Poisson regression but includes an extra parameter to model the overdispersion in the dependent variable. The confidence intervals for the NB model are likely to be narrower compared to a traditional Poisson regression.

Third, we run a series of augmented inverse-probability weighted (AIPW) regressions to isolate the labor market returns for both types of graduates while adjusting for selection into treatment in a more rigorous way than is possible through the estimation of the average treatment effect (ATE) in OLS regressions (Funk et al., 2010; Imbens, 2004). Treatment models such as AIPWs seek to overcome the problem of differential selection into treatment by weighting the average effects of treatment levels for comparable subjects, using predictors observable prior to the treatment and including those that are associated with the treatment (Z). They separate the analysis into two steps: estimation of a "treatment model" (using observed factors to predict each participant's treatment status), followed by an estimation of the outcome (logged earnings) in a "prediction model" that is based on the same observed factors plus the treatment variable.

Equations (1) and (2) display our most elaborate specification of the AIPW model. The first step in estimating the effect of a vertical transfer on

earnings is a multivariate design in which we control for well-known correlates of labor market outcomes; participation and earnings levels. This vector ($\boldsymbol{X}$) includes gender, race/ethnicity, and age (seniority). We also add parental background to the model, which is known to influence job access and earnings in the beginning of one's career, even after obtaining a college degree. We use a marital status and a nominal variable for offspring—consisting of "no children" and age-group of the oldest child—as proxies for family responsibilities that may either compromise employment chances or increase earnings because of economic necessities.

Separate from these individual characteristics, we include a factor ($\boldsymbol{R}$) for the region of residence in 2015 (10 in total) or the region of employment ($\boldsymbol{L}$) in the earnings predictions. This is because employment opportunities and earnings levels may vary substantially between US regions. For instance, in our study sample of college graduates younger than age 40 we find average earnings ranging between $51,000 in East South Central to about $73,000 in New England.

In addition, we include a series of factors specific to higher education that are associated with varying degrees of earnings potential among bachelor's degree holders. These ($\boldsymbol{F}$) include the Carnegie score (the best available indicator of college type or selectivity), college major group (eight categories), and whether one obtained a postgraduate degree (master's, PhD, or other higher professional degrees).

Importantly, the natural log of annual earnings (w) is predicted by a binary measure of "vertical transfer" (q), which is conditional on the inverse probability weights of factors that contribute to the likelihood of individuals to be selected into community college attendance after high school completion, rather than an immediate transition into the 4-year college system. We provide balance statistics for the propensity score matching of the potentially confounding variables.

In this treatment model (vertical transfer vs. native 4-year) we rely on a vector representing all previously discussed pre-higher education student characteristics ($\boldsymbol{X}$)[1], as well as two additional variables that account for varying degrees of access to community colleges and 4-year colleges: a 10-category variable for region of origin and a dummy variable for being foreign-born—indicated with vector ($\boldsymbol{C}$).

$$\ln w_i = (q_i|\boldsymbol{X}_i, \boldsymbol{C}_i)\beta + \boldsymbol{X}_i\gamma + \boldsymbol{L}_i\omega + \boldsymbol{F}_i\phi + \varepsilon_i \tag{1}$$

Equation (2) specifies the prediction of employment in 2015 (Y), using the same set of predictors for the treatment model and the outcome model.

$$Y_i = (q_i|\boldsymbol{X}_i, \boldsymbol{C}_i)\beta + \boldsymbol{X}_i\gamma + \boldsymbol{R}_i\omega + \boldsymbol{F}_i\phi + \varepsilon_i \tag{2}$$

Findings

Descriptive statistics

Table 1 reports the descriptive statistics for the dependent variables and all independent variables as used for the outcome model or the treatment model or both. The two most-right columns report proportions and averages for the vertical transfer students and the native 4-year students, separately. Among the study sample of college graduates, 14.6% attended a community college after high school graduation and before 4-year college attendance.

Being employed does not seem to vary much by type of route taken to the bachelor's degree. As seen in the top row of Table 1, about 90% of vertical transfer students and native 4-year students are employed in the observation year. However, there seems to be a substantial earnings difference among those employed; vertical transfers earn on average $55,564, whereas native 4-year graduates earn on average $69,592.

Several covariates could explain both the small employment gap and the large earnings gap. The second part of Table 1 lists the selected independent variables for our multivariate analysis, as well as the average share of employment and average earnings by variable subgroup. These figures indicate some noteworthy differences in the composition of the two routes to the bachelor's degree. Here we will discuss the most striking descriptive observations.

Regarding race, the 4-year college group has a larger share of White and Asian graduates when compared those who started in a community college. Black (10.2%) and Hispanic (15.2%) graduates make up a larger share of the long route compared to the short route—7.5% and 9.3%, respectively.

Parental background as measured by highest parental educational attainment also seems associated with choice of pathway toward the bachelor's degree. About 60% of graduates who were never enrolled in a community college have parents with at least a bachelor's degree, while only 42.6% of vertically transferred graduates had parents with an BA, MA, PhD, or professional degree (e.g., JD).

Some of the variables indicating the type of higher education experience also suggest a different composition of the transfer student and the native 4-year student. The latter is more likely to have graduated from a Research-I institution (17.7% vs. 24.7%). Furthermore, among those who started in a community college only 23.5% obtained a postgraduate degree (a master's or higher), compared to 37.6% for individuals who were native 4-year students. Finally, the two groups of interest do not noticeably vary on their composition by college major.

Regression approach

The most straightforward way of predicting the effect of a vertical transfer on postcollege outcomes fits a logistic regression on the employment dummy

Table 1. Descriptive statistics of the dependent and independent variables.

	All graduates	Vertical transfer	Native 4-year
Proportion		14.6%	85.4%
Dependent variables			
Employed	.901	.896	.902
Mean earnings among employed	$66,857	$55,564	$69,592
Control/propensity score variables			
Gender			
Male	.442	.441	.442
Female	.558	.559	.558
Race/ethnicity			
White	.678	.653	.685
Black	.080	.102	.075
Hispanic	.105	.152	.093
Asian	.122	.078	.133
American native	.014	.015	.014
Region of origin			
New England	.048	.017	.055
Middle Atlantic	.131	.086	.142
East North Central	.155	.112	.166
West North Central	.078	.080	.077
South Atlantic	.118	.132	.114
East South Central	.041	.047	.040
West South Central	.076	.107	.068
Mountain	.048	.065	.043
Pacific	.129	.186	.115
Place of birth			
US born	.177	.168	.180
Parental education			
Did not complete high school	.034	.044	.031
High school (or General Education Development)	.150	.222	.133
Some college/2-year degree	.215	.293	.196
Bachelor's	.279	.246	.287
Master's (or equivalent)	.211	.147	.226
Professional degree	.055	.027	.062
Doctorate	.056	.020	.065
Carnegie classification			
Research university I	.270	.195	.290
Research university II	.079	.074	.081
Doctorate granting I	.069	.063	.071
Doctorate granting II	.066	.071	.065
Comprehensive I	.306	.394	.283
Comprehensive II	.026	.036	.024
Liberal arts I	.053	.010	.065
liberal arts II	.078	.090	.075
Other	.052	.068	.048
College major			
Computer and mathematical sci.	.057	.049	.059
Bio-, agricultural, life sciences	.079	.080	.079
Physical and related sciences	.020	.011	.022
Social sciences	.163	.149	.167
Engineering	.073	.040	.081
Science-related fields	.088	.095	.087
Other technical nonscience fields	.501	.565	.485
Other/not classified	.019	.010	.021
Age			
In 2015	32.8	33.2	32.7

(*Continued*)

Table 1. (Continued).

	All graduates	Vertical transfer	Native 4-year
Obtained MA (or higher) after BA			
Yes	.349	.235	.376
Marital status (in 2015)			
Single	.289	.294	.288
Married/cohabiting	.680	.656	.686
Divorced	.031	.050	.026
Age offspring (in 2015)			
No children	.508	.487	.513
< 2 years old	.088	.068	.093
2– 5 years old	.156	.131	.162
6– 11 years old	.167	.185	.163
12– 18 years old	.070	.114	.059
> 18 years old	.011	.015	.009
Region employment (among employed)			
New England	.047	.023	.053
Middle Atlantic	.131	.071	.146
East North Central	.129	.091	.139
West North Central	.064	.071	.062
South Atlantic	.168	.162	.170
East South Central	.044	.072	.037
West South Central	.091	.129	.082
Mountain	.057	.067	.055
Pacific	.169	.208	.159

Source. Authors' calculations of the National Survey of College Graduates 2015 (N = 37,276).
Notes. Sampling weights are applied. The parental education variable contains 1.9% missing values (excluded from the calculations in this table).

and fits an OLS regression on the logged earnings among employed individuals. Tables 2 and 3 present the outcomes of these analyses. The regressions are nested such that Model 1 reflects the bivariate coefficients, whereas Model 2 adds all (precollege) demographics. Model 3 further adjusts for college-related factors (Carnegie classification, college major, postgraduate degrees), respondent's age (a correction for work experience after college), proxies for family responsibilities (marital status, offspring's age), and region of residence in the interview year. For the earnings predictions only, the latter region variable represents that of where one is employed.

Table 2, focusing on postcollege employment, indicates that odds ratios for transfer are not significant, suggesting a near equal chance of being employed after starting in a 2-year college. We will however reevaluate this estimate in more advanced models.

Table 3 estimates the logged earnings of employed college graduates between ages 25 and 40. The coefficients approximate the percent increase or decrease of annual earnings per unit increase of the independent variable. The baseline model 1 suggest a strong negative impact of having vertically transferred before obtaining a BA degree: −.192. Subsequent models add precollege demographics (model 2) and college, postcollege, and labor market covariates (model 3). The effect size drops to a deficit of −.147 and −.098, respectively, and remains significant with a p

Table 2. Odds ratios from a logistic regression predicting employment in 2015.

	Model 1 Baseline	Model 2 Demographics	Model 3 Full model
Origin institution (ref = native 4-year)			
Vertical transfer	.931	.930	.954
	(.131)	(.134)	(.142)
Gender (ref = male)			
Female		.282***	.283***
		(.036)	(.038)
Race/ethnicity (ref = White)			
Black		1.561	1.673
		(.381)	(.448)
Hispanic		1.012	1.191
		(.213)	(.252)
Asian		.678	1.018
		(.083)	(.164)
American native		1.470**	1.763
		(.820)	(1.025)
Parental education (ref = BA)			
Did not complete high school		.830	.863
		(.278)	(.260)
High school (or General Education Development)		.911	1.034
		(.163)	(.187)
Some college/2-year degree		1.143	1.186
		(.174)	(.188)
Master's (or equivalent)		1.178	1.132
		(.181)	(.180)
Professional degree		1.467	1.289
		(.316)	(.283)
Doctorate		1.482	1.296
		(.363)	(.316)
Unknown		1.254	1.343
		(.460)	(.526)
Carnegie (ref = research university I)			
Research university II			1.061
			(.262)
Doctorate granting I			.867
			(.218)
Doctorate granting II			.876
			(.247)
Comprehensive I			1.131
			(.193)
Comprehensive II			1.055
			(.464)
Liberal arts I			.959
			(.260)
Liberal arts II			.629*
			(.144)
Other			.988
			(.333)
Unknown			.407***
			(.079)
BA major (ref = social sciences)			
Computer and mathematical sci.			1.134
			(.215)
Bio-, agricultural, life sciences			.879
			(.177)

(*Continued*)

Table 2. (Continued).

	Model 1 Baseline	Model 2 Demographics	Model 3 Full model
Physical and related sciences			1.522
			(.442)
Engineering			1.643*
			(.365)
Science-related fields			2.246***
			(.428)
Other technical nonscience fields			1.372*
			(.176)
Other/not classified			.918
			(.286)
Age			
In 2015			.994
			(.017)
Obtained MA (or higher) after BA			
yes			2.424***
			(.275)
Marital status (ref = single)			
Married/cohabiting			1.127
			(.176)
divorced			2.927***
			(1.142)
Age offspring (ref = no children)			
< 2 years old			.585**
			(.110)
2– 5 years old			.413***
			(.066)
6– 11 years old			.352***
			(.062)
12– 18 years old			.424***
			(.101)
> 18 years old			1.064
			(.795)
Region of residence (ref = East North Central)			
New England			.989
			(.267)
Middle Atlantic			.687
			(.139)
West North Central			.741
			(.191)
South Atlantic			.841
			(.168)
East South Central			1.097
			(.392)
West South Central			.802
			(.184)
Mountain			.706
			(.177)
Pacific			.624*
			(.129)
Summary statistics			
R^2	.000	.051	.116
prob. > χ^2	.610	.000	.000

Source. Authors' calculations of the National Survey of College Graduates 2015 (N = 37,276).
Notes. Robust standard errors (between parentheses) and sampling weights are applied.
Significance: ***p < .001, **p < .01, *p < .05 (two-sided).

Table 3. Ordinary least squares estimates predicting logged earnings in 2015 (among employed).

	Model 1 Baseline	Model 2 Demographics	Model 3 Full model
Origin institution (ref = native 4-year)			
Vertical transfer	−.192***	−.147***	−.098***
	(.034)	(.033)	(.034)
Gender (ref = male)			
Female		−.325***	−.284***
		(.029)	(.029)
Race/ethnicity (ref = White)			
Black		−.193***	−.106*
		(.045)	(.044)
Hispanic		−.152	−.135*
		(.078)	(.068)
Asian		.188***	.076
		(.033)	(.040)
American native		−.293	−.251
		(.168)	(.173)
Parental education (ref = BA)			
Did not complete high school		−.009	.004
		(.068)	(.059)
High school (or General Education Development)		−.079*	−.023
		(.038)	(.035)
Some college/2-year degree		−.035	−.026
		(.035)	(.035)
Master's (or equivalent)		−.033	−.073
		(.049)	(.046)
Professional degree		.067	−.010
		(.061)	(.058)
Doctorate		.028	−.023
		(.058)	(.052)
Unknown		−.201	−.097
		(.104)	(.116)
Carnegie (ref = research university I)			
Research university II			.007
			(.044)
Doctorate granting I			−.092
			(.061)
Doctorate granting II			−.167**
			(.062)
Comprehensive I			−.166***
			(.039)
Comprehensive II			−.156*
			(.070)
Liberal arts I			−.104
			(.061)
Liberal arts II			−.245***
			(.049)
Other			−.236**
			(.073)
Unknown			−.217***
			(.049)
BA major (ref = social sciences)			
Computer and mathematical sci.			.281***
			(.038)
Bio-, agricultural, life sciences			.091*
			(.036)

(*Continued*)

Table 3. (Continued).

	Model 1 Baseline	Model 2 Demographics	Model 3 Full model
Physical and related sciences			.118
			(.063)
Engineering			.338***
			(.042)
Science-related fields			.124**
			(.038)
Other technical nonscience fields			.012
			(.034)
Other/not classified			.280**
			(.088)
Age			
In 2015			.028***
			(.004)
Obtained MA (or higher) after BA			
yes			.230***
			(.024)
Marital status (ref = single)			
Married/cohabiting			.160***
			(.038)
Divorced			.107
			(.086)
Age offspring (ref = no children)			
< 2 years old			.099*
			(.044)
2– 5 years old			.019
			(.040)
6– 11 years old			−.037
			(.039)
12– 18 years old			−.152**
			(.055)
> 18 years old			−.268***
			(.072)
Region of employment (ref = East North Central)			
New England			.110
			(.066)
Middle Atlantic			.148***
			(.039)
West North Central			.069
			(.049)
South Atlantic			.098*
			(.040)
East South Central			−.128
			(.084)
West South Central			.134**
			(.043)
Mountain			.035
			(.052)
Pacific			.128**
			(.048)
Summary statistics			
R^2	.009	.073	.172
prob. > χ^2	.000	.000	.000

Source. Authors' calculations of the National Survey of College Graduates 2015 (N = 34,594).
Notes. Robust standard errors (between parentheses) and sampling weights are applied. Significance: Significance: ***p < .001, **p < .01, *p < .05 (two-sided).

value below .001. This suggests that about half of the total vertical transfer effect is explained by the most relevant individual level characteristics. In sum, these models suggest that a vertical transfer—the long route to the bachelor's degree – is associated with a substantial earnings decrement in the midcareer that cannot be attributed to the most important education-related factors.

Robustness checks: NB and AIPW

Because earnings are heavily skewed to the right, despite top coding and taking the natural log of earnings, a more conservative approach is used to reduce the bias caused by overdispersion. We fit a NB regression on the raw dollars earned in 2015. The results are presented in Table 4, organized in nested models from baseline to full model. The coefficients can be interpreted as the change in the log odds of dollar earnings for a one unit increase in the predictor.

The baseline model of the NB model suggests a similar bivariate relationship between vertical transfer and postcollege earnings: −.225 (Model 1). Some of this effect is mediated by demographic characteristics of the respondents (gender, race, ethnicity, parental education), as the coefficient drops to −.168 in Model 2. Further adjustments for college characteristics, age, postgraduate degrees, and region of employment lead to an estimated earnings disadvantage for vertical transfer of approximately 12.5% (model 3). In sum, the NB models confirm our earlier significant negative effect of the long route on bachelor's degree holders' earnings as found in the OLS models, yet with slightly bigger effect sizes.

One additional robustness check is a necessary step to also address selection bias. In our case, selection into treatment means that graduates who took the long route toward the bachelor's degree are different from those who started in a 4-year college. To apply a matching-based model (i.e., AIPW) the covariates associated with the treatment (vertical transfer) need to be weighted such that the treatment variable is balanced. Table 5 reports the balance summary for vertical transfer: the

Table 4. Negative binomial estimates predicting positive earnings in 2015 (among employed).

	Model 1 Baseline	Model 2 Demographics	Model 3 Full model
Origin institution (ref = native 4-year)			
Vertical transfer	−.225***	−.168***	−.126***
	(.028)	(.027)	(.026)
Summary statistics			
R^2	.001	.004	.009
Prob. > χ^2	.000	.000	.000

Source. Authors' calculations of the National Survey of College Graduates 2015 (N = 34,594).

Notes. Robust standard errors reported between parentheses. Demographics include gender, race/ethnicity, and parental education. The full model adds type of institution (Carnegie), college major, postgraduate degree, age, marital status, offspring, and region of employment. Robust standard errors and sampling weights are applied.

Significance: ***p < .001, **p < .01, *p < .05 (two-sided).

standardized ratios and the variance ratios. With regard to the latter, the raw differences between the two groups (transfer and native 4-year) are substantial, but after inverse probability weighting the balanced differences are close to zero, indicating a more reliable treatment variable. One exception is the "other" race group, which indicates a substantially higher variance ratio after the weighting process. There are only 39 cases in this category. We therefore believe that the weights on the other features in the model disproportionally shifted these individuals' reassignment to cause a high rebalanced variance. Excluding these cases does

Table 5. Covariance balance summary for selection into vertical transfer (earnings model).

	Standardized differences		Variance ratio	
	Raw	Weighted	Raw	Weighted
Gender (ref = male)	.017	−.006	1.000	1.000
Race (ref = white)				
Black	.014	−.061	1.044	.830
Hispanic	.187	−.039	1.453	.917
Asian	−.145	.061	.783	1.094
American native	.083	.069	1.786	1.626
Other	.016	.047	1.972	5.035
Parental education (ref = BA)				
Did not complete high school	.124	.037	1.794	1.206
High school (or General Education Development)	.164	−.051	1.405	.886
Some college/2-year degree	.194	−.033	1.303	.950
Master's (or equivalent)	−.181	.023	.756	1.031
Doctorate/professional degree	−.260	.065	.487	1.148
Unknown	.073	−.074	1.658	.559
Birth year	.188	.067	.982	.943
Region of origin (ref = East North Central)				
New England	−.174	.027	.364	1.127
Middle Atlantic	−.197	−.023	.605	.950
West North Central	.047	.018	1.163	1.061
South Atlantic	−.113	−.046	.881	.721
East South Central	.064	.032	1.385	1.180
West South Central	.115	−.034	1.440	.889
Mountain	.064	−.036	1.307	.850
Pacific	.241	.031	1.559	1.066
Foreign-born (ref = US-born)	−.065	−.034	.915	.955
Age of oldest child in 2015 (ref = no children)				
< 2 years old	−.071	.013	.821	1.036
2– 5 years old	.001	.068	1.002	1.135
6– 11 years old	.105	.049	1.254	1.115
12– 18 years old	.173	.001	2.067	1.003
> 19 years old	.071	.005	2.419	1.068
Summary statistics				
Number of observations	34,594	34,594		
Treated observations (vertical transfer)	5,001	15,025		
Control observations (native 4-year)	29,593	19,569		

Source. Authors' calculations of the National Survey of College Graduates 2015.
Notes. Overidentification test for covariate balance: $\chi^2 = 26.5$, prob>χ^2: 0.072.

not affect the estimates. Finally, the test for overidentification fails to reject the null-hypothesis (covariates are balanced) (see Imai & Ratkovic, 2014).

Subsequently, Table 6 documents the average treatment effects of vertical transfer on having employment (Model 1) and then on logged earnings among employed individuals (model 2). These models apply the IPW adjustment to the average treatment effects (ATEs)—accounting for selection into one of the two routes that is associated with gender, race, ethnicity, socioeconomic background (all precollege factors), and region of origin, as well as the main effects of all previously introduced predictors of the outcome variables.

In contrast to the logistic regression that does not account for selection bias, the odds ratio in the AIPW model does indicate a significant negative effect of vertical transfer on postcollege employment (.985 after correcting for selection bias). However, this odds ratio—effect size—is very small. When converting the odds ratio into an adjusted risk ratio (.987), the additional risk of nonemployment associated with vertical transfer is about 1.3%.[2]

The estimated effect of vertical transfer on earnings, conditional on employment, is however much more pronounced. Model 2 of Table 6 predicts the logged earnings in 2015. This coefficient approximates a percent change in earnings associated with taking the long route to the BA. The ATE is −.142, which is substantially higher than the estimates from the OLS regression (.098) and slightly higher than the estimates from the NB regression (.126), when adjusted for the most relevant covariates of labor market outcomes. Hence, without appropriate correction for selection into either vertical transfer or a native 4-year college route to the bachelor's degree, we would underestimate the (negative) effect of the long route on graduate's midcareer earnings.

In summary, after robustness checks to account for overdispersion and selection bias, we conclude that a vertical transfer has a significant

Table 6. Average treatment effects predicting employment and earnings in 2015.

	Model 1 Employed (odds ratios)	Model 2 earnings (β)
Origin institution (ref = native 4-year)		
Vertical transfer	.985***	−.142***
	(.0002)	(.001)
PO (Mean)	(.901)	10.881

Source. Authors' calculations of the National Survey of College Graduates 2015. N = 37,276 (employment model), N = 34,594 (earnings model).

Notes. The treatment model is predicted by demographics (gender, race/ethnicity, parental education, offspring), as well as region of origin (US), US/foreign-born, and birth year. The outcome model is predicted by all listed demographics, plus type of institution (Carnegie), college major, postgraduate degree, age, marital status, and region of residence (employment model only) or region of employment (earnings models only). Sampling weights are applied. Significance: ***p < .001, **p < .01, *p < .05 (two-sided), PO = Potential outcome.

disadvantage for college graduates' earnings in comparison to starting in a four-year college.

As mentioned before, we consider the youngest generation of bachelor's degree holders (ages 25 to 40) to be the most policy-relevant population to study the effects of vertical transfer. We performed a sensitivity analysis to see whether the transfer penalty for employment chances and earnings hold for the entire workforce (ages 25 to 64). As seen in Table 1, 14.6% in the original study sample had obtained a bachelor's degree via the long route. This average is slightly higher among the non-age-restricted sample (17.6%). The Appendix replicates Table 6's AIPW regressions on employment and earnings for 25- to 64-year-olds. Overall we find smaller effects; adjusted for selection into treatment, the average treatment effect of vertical transfer is estimated at −.081. With some caution regarding the interpretability of the meaning of a vertical transfer and the increased inaccuracy of earnings differentials of varying career phases, there is reason to believe that a vertical transfer penalty applies to later career phases as well.

College major

Does college major influence the earnings penalty of vertical transfer? To our knowledge, this question has not been explored in relation to vertical transfers in US higher education. However, college major has substantial consequences for one's earnings potential, and this may well be different for students who took the long route for various reasons. We do not make any assumption about why certain types of students (vertical or native) graduate with a particular bachelor's degree major. Instead, the research question here is whether all college majors have the same pay-offs for transfers and native 4-year students.

Table 7 reports those effects in a model predicting postcollege logged earnings (in an OLS) and the dollar earnings (in a NB), controlling for all demographics, college factors, and postcollege factors. Each row indicates the interaction of vertical transfer with one of the seven college major groups, where the reference category is native 4-year and that same college major. A significant negative coefficient (if any) therefore indicates an earnings disadvantage for taking the long route along with a particular college major. To be sure, negative effects are expected because vertical transfers are tested against native 4-year students in each of the estimations.

The OLS and NB coefficients of Table 7 suggests that vertical transfer students face earnings disadvantages in several major groups, largely as a function of simply having made a vertical transfer. However, we observe substantial variation in within-major earnings penalties across different major groups. Concentrating on the more conservative estimates from the NB regressions, social sciences (−28.2), computer and mathematical sciences

Table 7. College major interaction estimates predicting earnings in 2015 (among employed).

	Ordinary Least Squares		Negative Binomial
	β	%Δ	β
Ref = native 4-year			
Vertical transfer *			
Computer and mathematical sci.	−.261**	−22.9%	−.205**
	(.088)		(.063)
Bio-, agricultural, life sciences	−.189**	−17.2%	−.204**
	(.072)		(.075)
Physical and related sciences	−.121	−11.4%	−.149
	(.115)		(.113)
Social science	−.270***	−23.7%	−.282***
	(.074)		(.041)
Engineering	−.150	−13.9%	−.116**
	(.089)		(.040)
Science-related fields	−.128	−12.0%	−.087
	(.077)		(.062)
Other technical nonscience fields	−.017	−1.7%	−.079*
	(.050)		(.040)

Source. Authors' calculations of the National Survey of College Graduates 2015 (N = 34,594).
Notes. These are interaction coefficients from the full model including controls for gender, race/ethnicity, parental education, type of institution (Carnegie), postgraduate degree, age, marital status, offspring, and region of employment. Robust standard errors and sampling weights are applied.
Significance: ***p < .001, **p < .01, *p < .05 (two-sided).

(−.205), bio-, agricultural, and life sciences (−.204) are all associated with a strong earnings deficit for transfers. These earnings disadvantages are substantially higher than the earlier average treatment effects, in which earnings estimates were already adjusted for college major (ATE = −.142, Table 6). Overall, we observe postcollege earnings disadvantages associated with transfer in most college majors.

However, a small number of college major groups do not seem to suffer from a college transfer, compared to the native 4-year route, on average. These two exceptions, where transfers do not earn less than 4-year entrants, are baccalaureates in the physical sciences and science-related fields; a category consisting of health, science teaching, and other small majors. In addition, compared to their native 4-year college counterparts, vertically transferred students in the engineering major group display an earnings penalty just below the sample wide ATE (−.116, and nonsignificant in the OLS), while the (large) group called "other technical non-science fields" also indicates a relatively small vertical transfer penalty.

What do these large college major divergences in the vertical transfer penalty mean? First, these estimates compare the same college major with a different (longer) pathway toward graduation. The reported effect sizes are the combined effects of a vertical transfer and a particular college major group. Subtracting the overall vertical transfer penalty from these total effects would be a realistic estimation of the net additional earnings disadvantage

from graduating within that particular major group. We can therefore identify the social sciences as a college major group with a vertical transfer penalty that is twice as large compared to its counterfactual: graduating within these fields as a native 4-year college student.

Second, we note a college major earnings hierarchy in earnings that is comparable to the known college major payoff differentials, albeit in the form of ranking earnings penalties by major groups. For instance, the Science Technology Engineering and Math (STEM)-related majors generally yield higher earnings in the overall population of college graduates (see Pascarella & Terenzini, 2005). One explanation for observing a similar order in the vertical transfer earnings differentials is that some of these STEM- and health-occupational fields are known for their relatively standardized pay scales and job ladders. The structured employment within this fields could be one explanation for the disappearance of the vertical transfer "penalty," but we cannot determine for this with our data. In other words, the effect of the college major variation of the vertical transfer penalty is a function of a structure rather than unobserved individual-level features.

Third, it should be noted that the two college major groups with a nonsignificant vertical transfer penalty vis-à-vis the native 4-year groups account for only 10% of all vertically transferred students. Our analyses cannot address individual majors within these two broadly defined major groups, and thus the absence of vertical transfer penalties should be interpreted with some caution. Likewise, the social science group consists of many different college majors for which vertical transfer penalties might be substantially smaller.

Limitations

The striking earnings disadvantages for vertically transferred graduates was found after a rigorous modeling procedure that accounts for many factors associated with selection into initial community college enrollment. However, there are a few unobserved variables that we would ideally account for but could not because of data availability issues.

Unfortunately, NSCG data does not allow us to include measures of ability and motivation—two factors that might be confounders in a model predicting labor market success. On the one hand, not including these variables may overestimate the vertical transfer penalty because low academic performance may steer students into community college enrollment rather than 4-year college enrollment, as well as into lower skill (and lower pay) jobs. Thus, a human capital effect may distort the reported effect sizes. On the other hand, as this study applies to college graduates only, students who started their higher education careers in a community college displayed at least some

ability and persistence (or motivation) by successfully transferring and then completing the bachelor's degree.

The fact that this study only applies to college graduates may suggest that we underestimate the total vertical transfer penalty as those vertically transferred students who did not complete a BA (and are likely to earn less) are not included. Nonetheless, the selection on college completion is a limitation of this study and therefore our estimates should be interpreted with some caution when compared to studies on 4-year college attendees (i.e., Xu et al., 2018).

Finally, it should be noted that the vertical transfer study by Xu et al. (2018) contains not only a wider span of respondents (graduates and nongraduates), it also accounts for relevant college factors such as GPA and credits earned in community college and fouryear college. As mentioned before, their estimates however only represent the state of Virginia and focus on a cost–benefit analysis. However, given the agreement in terms of observing a substantial vertical transfer penalty, as also found nationwide in this study, we believe that the two studies complement one another.

Conclusion and discussion

Few studies have concentrated on the consequences that a vertical transfer has on postcollege labor market outcomes, and findings in earlier studies have been inconsistent. For example, one study reported an earnings penalty among graduates in Virginia, whereas a study of graduates in Texas reported a null finding. A comprehensive analysis on the labor market consequences of vertical transfer using national data has been absent.

Revisiting the impact of vertical transfer using nationally-representative US data, we find a significant earnings disadvantage (a roughly 14% decrement annually) for college graduates who started in a 2-year institution. However, no effect was found on graduates' employment chances. These findings proved robust to several alternative strategies for estimating the impact of vertical transfer on labor market outcomes: selection into treatment (starting in 2-year college) and overdispersion in the outcome variable (earnings). In addition, this earnings disadvantage cannot be negated or avoided by choosing a particular (high-paying) major, including many STEM majors. The exceptions are physics and science-related majors (e.g., health), where we did not find a transfer effect.

Some students initially attend community college because they have little choice: they may have no other college nearby and may need to commute. Others may be attracted by the idea that they will save money by taking the longer community-college route. As we have noted, prior researchers by no means agree whether students save money by following the longer vertical

transfer route. Our findings suggest that, putting short-term cost aside, vertical transfer students will earn significantly less after leaving college than their counterparts who began at 4-year institutions. That should give educational policy makers and advisors in high schools pause. The community college route to the BA entails important risks. Not only is there greater attrition along the way, but those who do make it to graduation are penalized in their level of income.

Our main policy recommendation is that high school advisors and others adequately inform students and families of the income risks associated with a transfer pathway, so they can balance the downside risk and upside benefits of the community college route. For those students who do take the long route, further research should focus on the mechanisms by which transfer students incur the earnings penalty. We suggest three possible school-to-work pathways that should be studied in greater detail regarding vertical transfer students and transfer graduates.

First, research has shown that connections established during the college years matter for one's professional trajectory into the labor market (e.g., Armstrong & Hamilton, 2011; Binder, Davis, & Bloom, 2016). Various forms of social capital, accessed through peers, friends, fraternities, sororities, and other clubs, and information (e.g., career advising, on-campus recruitment) may provide students with valuable connections and knowledge that facilitates a smooth transition into high(er) paying jobs and labor market sectors. However, access to these valuable sources is not straightforward for students of different backgrounds. It could be that transfer students may have a harder time integrating into a college's student population and social life because they are typically older or because they simply missed several early-college social events. As a result, vertical transfer students may not (equally) benefit from the social networks and information available in colleges.

Second, upon labor market entry, employers may perceive a vertical transfer on one's resume as a "signal" of lower competency or less skill despite the 4-year credential. In addition, although our models contain treatment adjustment and estimation controls for age, vertical transfer students may additionally suffer from lower rewards based on being perceived as a "late" or "delayed" graduate. As a consequence of these subtle and indirect forms of job access disadvantage, vertical transfer graduates of 4-year colleges may have to take a job that is typically below the earnings average of similar qualified native 4-year graduates.

Finally, it is possible that transfer students tend on average to enter less-prestigious colleges when they transfer, and that this affects their income levels after college. The data we analyzed did not include information on specific college attended, only on the general type of college, so we could not

test this possible mechanism. Obtaining evidence of this kind should be a priority for future research.

Notes

1. Marital status needed to be dropped from the vector of pre-higher education student characteristics (X) in the selection model (predicting vertical transfer) because the data do not allow for calculating the timing of marriage, cohabiting, or divorce, and thus whether this took place before or after selection.
2. In case of a relatively low prevalence in the reference group (P_{ref}) of the independent variable, one can convert the odds ratio into an adjusted risk ratio (RR) through: $OR/(1 - P_{ref}) + (P_{ref} * OR)$. Here, the prevalence of vertical transfer is .146.

Disclosure statement

No potential conflict of interest was reported by the authors.

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Appendix. Average Treatment Effects predicting Employment and Earnings in 2015 (Workforce: ages 25 to 64)

	Model 1 Employed (odds ratios)	Model 2 Earnings (β)
Origin institution (ref = native 4-year)		
Vertical transfer	.999***	–.081***
	(.0001)	(.001)
PO (Mean)	(.862)	10.971

Source. Authors' calculations of the National Survey of College Graduates 2015. N = 73,451 (employment model), N = 66,021 (earnings model).

Notes. The treatment model is predicted by demographics (gender, race/ethnicity, parental education, offspring), as well as region of origin (US), US/foreign-born, and birthyear. The outcome model is predicted by all listed demographics, plus type of institution (Carnegie), college major, postgraduate degree, age, marital status, and region of employment (earnings models only). Sampling weights are applied.

Significance: ***p < .001, **p < .01, *p < .05 (two-sided).