The Community College Penalty and Bachelor's Degree Completion: Fact or Fiction?

Eric J. Lichtenberger and Cecile Dietrich

Research Highlights

Rationale:

Research examining the relationship between initial community college enrollment and bachelor's completion have shown mixed results with some studies indicating a clear penalty for community college enrollment and other studies showing no penalty, partly due to the point at which the given study began tracking the community college students: at initial community college entrance or after vertical transfer to a four-year college. We adopted the latter view while simultaneously controlling for student background characteristics, as well as high school and college contexts.

Purpose:

To examine the impact of taking the community college to four-year transfer pathway on bachelor's degree completion.

Methods:

Data sources: Data from ACT and the National Student Clearinghouse specific to the Illinois public high school graduating class of 2003. Postsecondary outcomes were nationally tracked from 2003 through 2010.

Participants: Prior to propensity score matching, 23,676 high school graduates who matriculated to college were followed over seven academic years: included 2,154 community college transfer students and 21,522 four-year rising juniors.

Research Design: Quantitative and quasi-experimental; nearest neighbor propensity score matching with a post-treatment adjustment. Matching with replacement was used.

Analysis: Estimates of treatment effect made by matching community college transfers with observationally equivalent rising four-year college juniors graduating from the same high schools and attending equally selective four-year colleges.

Findings:

- Prior to matching, the academic profile of the community college transfer students was significantly weaker from that of the rising four-year college juniors.

- 85% of the community college transfer students identified in the study had earned a bachelor's degree within five academic years of transitioning to a four-year college.

- *No community college penalty was evident.* Community college transfer students were just as likely to complete a bachelor's degree as rising four-year college juniors when matching on key factors.

Policy Implications:

The community college to four-year pathway is a viable option for many students in terms of bachelor's degree completion. As a result, policymakers should:

- Continue to develop baseline information about statewide transfer performance as the state's longitudinal data system is fully implemented (Wellman, 2002);

- Set goals for institutional performance related to community college to four-year transfer (Wellman, 2002);

- Help community college transfer students face their financial aid future by developing information and incentives that fully span their undergraduate enrollment from a community college to a four-year institution (Wellman, 2002; Handel, 2011).

ABOUT THE AUTHORS

Eric J. Lichtenberger, PhD, is the Associate Director for Research of the Illinois Education Research Council and an Assistant Research Professor at Southern Illinois University Edwardsville.

Cecile Dietrich, PhD, has expertise in both quantitative and qualitative research methods and data analysis and experience in applying these methods to educational research. Her background and interests include human development, gerontology, health/life sciences, mathematics, and science, technology, engineering, and mathematics (STEM) education. She has conducted applied research for a variety of organizations, including Virginia Tech, Radford University, the World Bank, private engineering education consultants, faith-based and other non-profit organizations.

Suggested citation:

Lichtenberger, Eric J. & Dietrich, Cecile. (2013). *The community college penalty and bachelor's degree completion: Fact of fiction?* (IERC 2013-1). Edwardsville, IL: Illinois Education Research Council at Southern Illinois University Edwardsville.

Table of Contents

Background: Community College Enrollment and Bachelor's Degree Completion

For the past twenty years, studies examining the relationship between initial community college enrollment and bachelor's completion have shown mixed results with some studies showing a clear penalty for community college enrollment and other studies showing no penalty. Generally, the penalty, or the lack thereof, is determined by the point at which the given study commences tracking the community college students.

For the studies that begin tracking at initial community college enrollment, there is evidence of a penalty or decreased likelihood of degree completion associated with the community college experience (Alfonso, 2006; Doyle, 2009; Long & Kurlaender, 2009; Sandy, Gonzales & Hilmer, 2006). These studies compare the outcomes of an entire cohort or multiple cohorts of community college entrants to the outcomes of students who directly enter four-year colleges. For the most part, the outcome being measured, bachelor's degree completion, can only be attained at a four-year college. This arguably leaves the community college entrants at somewhat of a disadvantage in that bachelor's degree completion is conditional upon an additional step for the community college students, transferring to a four-year institution.

Furthermore, while the previously mentioned studies generally limit the community college group to those who aspire to complete a bachelor's degree, recent research suggests that most students maintain such expectations, particularly high school graduates as they prepare to make the postsecondary transition. For example, 82% of Illinois high school graduates had the goal of obtaining a bachelor's degree or higher (Smalley, Lichtenberger, & Brown, 2010). Therefore, using degree aspirations as a way to create study groups to determine if the community college penalty exists could be too inclusive. Further, degree aspirations might diverge from a community college student's more immediate goals. As argued in Smalley, Lichtenberger, and Brown (2010) the goals of community college entrants are oftentimes difficult to determine, while most, if not all, four-year college entrants maintain the goal of earning a bachelor's degree. When it comes to community college students as they relate to direct four-year college entrants, goals and aspirations do not necessarily translate to parallel academic preparation or one's ability to navigate the higher education system.

Research has shown that as a group, community college entrants are less prepared for college than students who directly enter four-year colleges (Adelman, 2006; Lichtenberger & Dietrich, 2012a; Sandy, et al., 2006) and they are less cohesive as a group in terms of college readiness (Lichtenberger & Dietrich, 2012a).

These results call to question whether it is valid to compare students enrolling at a community college and aspiring to earn a bachelor's degree with those directly enrolling at a four-year college, when direct four-year college entrants are generally better-prepared for college, more cohesive as a group regarding both goals and preparation, and are enrolled at institutions that award bachelor's degrees.

Other research takes a more conditional approach and censors community college entrants who fail to make the transition to a four-year college. As a result, these studies use comparisons between community college entrants who make the transition or vertically transferred to a four-year college and students who directly entered four-year institutions. In these studies, the students who directly entered four-year colleges have persisted to the point of transfer for the community college students. That is, the comparison is made between rising juniors who directly entered a four-year college and community college students who transferred to a four-year college at a point that would suggest junior-level status assuming all coursework was successfully transferred. At that point, the goals and aspirations of the two groups of students are arguably more comparable.

When researchers compare transfer students with native juniors, the results show no penalty for initially enrolling in community college (Glass & Harrington, 2002; Lee, Mackie-Lewis & Marks, 1993; Melguizo, Kienzl & Alfonso, 2011; Melguizo & Dowd, 2009). In other words, community college transfer students are just as likely to earn a bachelor's degree as students with similar characteristics who directly enrolled at four-year colleges.

Using a Quasi-experiment to Test the Community College Penalty Assumption

While arguments can be made for both approaches to tracking community college students as they potentially progress towards bachelor's degree completion—at community college entry or after vertical transfer—we decided to test the community college penalty assumption by narrowing the community college group down to those who transfer and make the transition to a four-year college. To create a valid comparison group, we ensured that the direct four-year college entrants persisted to rising junior status, which creates a point of entry parallel to that of the community college transfer students.

Our comparison group structure allowed us to adopt counterfactual thinking to explore what would have happened if community college students had instead enrolled at a four year institution. Citing previous psychological and philosophical writings, Epstude and Rouse (2008) define counterfactual thinking as representations of alternatives to events. These alternatives point towards a juxtaposition between one event and the hypothesized alternative. In our case, we are concerned with whether or not community college transfer students were penalized by opting to enroll at a community college upon high school graduation as opposed to directly enrolling at a four-year institution. Our approach is similar to that taken by Melguizo, Kienzl and Alfonso (2011).

To explore whether or not a penalty in community college enrollment exists, we used propensity score matching (PSM), which allowed us to identify a group of four-year rising juniors with a similar distribution of characteristics as the community college transfer group. The characteristics were related to one's likelihood of being a community college transfer student. PSM was used to create a balance between the treatment and comparison groups on factors that are generally associated with an increased likelihood of being a community college entrant. Then, we used a post-treatment adjustment to account for institutional differences that could potentially impact the bachelor's degree

completion (see Methods for more detail). In the end, each treatment group member was matched to a comparison group member from the same high school, with a similar likelihood of being a community college transfer student, and who attended a equally selective four-year college.

Though the goal of propensity matching method mimics experimental designs (Rosenbaum & Rubin, 1983), the approach is still quasi-experimental since the participants cannot be randomly assigned to the treatment and control groups, which is the criterion that defines a true experiment (Pedhazur & Schmelkin, 1991).

The treatment group was defined as the portion of the Illinois high school class of 2003 who enrolled full-time at a community college the fall semester following high school graduation, maintained such enrollment, and transferred to a four-year college at a point that would suggest junior-level status. The potential comparison group members enrolled full-time at a four-year college directly out of high school and maintained that enrollment without transferring to a point that would suggest junior-level status.

Our study uses a relatively recent cohort to test the community college penalty, the high school graduating class of 2003, with bachelor's completion tracked until the end of academic year 2010. This approach builds on a similar work that used an older cohort (Melguizo, Kienzl, & Alfonso, 2011).
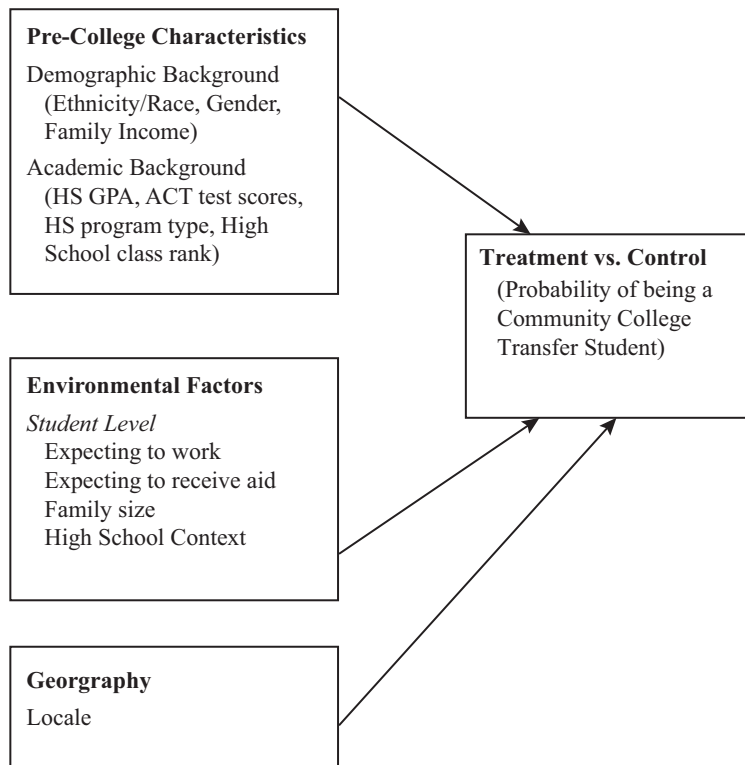
Research Questions

1. Is there a community college penalty with regard to bachelor's degree completion after achieving sufficient balance on the pre-treatment characteristics?

2. Is there a community college penalty with regard to bachelor's degree completion after achieving sufficient balance on the post-treatment control?

Propensity Score Matching Model

The conceptual framework we used for the propensity score matching model was largely based on Wang (2009) and Lichtenberger and Dietrich (2012b). Wang (2009) described the importance of pre-college characteristics and environmental characteristics in predicting postsecondary outcomes for community college transfer students. We applied that framework to postsecondary enrollment patterns specifically focusing on one's likelihood of taking the community college to four-year institution pathway. As illustrated in Figure 1, we include pre-college characteristics (gender, race, family income, high school GPA and class rank, high school program type, as well as ACT scores) in addition to the following environmental characteristics (high school context, expectation to work, expectation to receive financial aid, and family size) to help explain one's postsecondary pathways. Finally, geography has been found to impact postsecondary enrollment patterns for Illinois students (Lichtenberger & Dietrich, 2012a; Lichtenberger & Dietrich, 2012b). For this study, we assess geography with locale, which is defined as Chicago, other urban, suburban, town, or rural. For more information about the conceptual model, please see Lichtenberger and Dietrich (2012b).

Figure 1:

Conceptual Framework for Propensity Score Matching Model

| **Pre-College Characteristics** |
| Demographic Background (Ethnicity/Race, Gender, Family Income) |
| Academic Background (HS GPA, ACT test scores, HS program type, High School class rank) |

| **Treatment vs. Control** |
| (Probability of being a Community College Transfer Student) |

| **Environmental Factors** |
| *Student Level* |
| Expecting to work |
| Expecting to receive aid |
| Family size |
| High School Context |

| **Georgraphy** |
| Locale |

Methods

This unique and robust dataset along with the quasi-experimental design of the study allow us to better control for high school context as an environmental factor and college context as a post-treatment adjustment in the final match. We also control for several other observed pre-college and demographic characteristics. Through our quasi-experimental design we demonstrate how propensity score matching and later a post-treatment adjustment help create balance between our community college transfer group and the group of rising four-year college juniors. This was undertaken to better isolate the impact of receiving the treatment. Finally, we explored the likelihood of bachelor's degree completion to test the community college penalty assumption using Pearson's Chi-Square and a binary logistic regression model that included imbalanced covariates.

Data

Prior to our matching procedures, we start the study with 2,154 community college transfer students and 21,522 rising four-year college juniors from the Illinois high school graduating class of 2003 who made the postsecondary transition the fall semester following high school graduation. The data were made available to IERC researchers under shared data agreements with the Illinois Board of Higher Education and ACT. The college enrollment and degree completion information was obtained from the National Student Clearinghouse (NSC), a national collaborative, in which nearly 3,300 postsecondary institutions participate, covering 92% of postsecondary enrollments (National Student Clearinghouse, 2010).

Definitions

Community college transfer students. Members of the Illinois High School Class of 2003 who enrolled full-time at a community college the fall semester following graduation. Members of this group were required to maintain full-time enrollment in spring of 2004, fall of 2004, and spring of 2005 and to have transferred to a four-year college the fall semester of 2005. Lateral transferring among community colleges was not allowed; however, none of members of this group engaged in that mobility pattern. This group is considered the treatment group.

Rising four-year college juniors. Members of the Illinois High School Class of 2003 who enrolled full-time at a four-year college the fall semester following graduation and maintained full-time enrollment at that institution through the fall semester of their junior year. Therefore, members of this group were not allowed to laterally transfer to another four-year college leading up to their junior year. There was significantly more movement between colleges among potential members of the rising four-year college junior group. This group is considered the comparison group.

Bachelor's degree completion. Having finished a bachelor's degree prior to the end of the spring semester of 2010, or within seven years of initial postsecondary enrollment.

Institutional selectivity. This measure was created using Barron's Profiles of American Colleges (2003). This edition was used since it was available to the four-year rising juniors as they prepared to transition to postsecondary in the fall of 2003. Selectivity is based on a number of indicators of the academic quality of each institution's freshman class, such as the percentage of applicants accepted for admission and the median SAT or ACT scores (Smalley, et al. 2010). We combined the two highest selectivity categories (most/highly competitive) and the two bottom categories (less/non competitive) to create four categories for our analyses. The middle two categories are very competitive and competitive. There were some students who enrolled at colleges that did not have a Barron's ranking. We used institutional selectivity as our post-treatment adjustment.

Locale. This was based on the location of the student's high school and was categorized as: Chicago, other urban (non-Chicago), suburban, town, or rural. After identifying Chicago Public Schools, we used the National Center for Education Statistics' Common Core of Data (CCD) definition of locale.

Overview of Propensity Scores

After identifying the initial treatment group and group of potential comparison group members, we used logistic regression to create propensity scores for all potential study group members, community college transfer students and four-year rising juniors alike. The propensity score is the conditional probability of exposure to a treatment given a particular set of observed characteristics (Joffe & Rosenbaum, 1999; Rosenbaum & Rubin, 1983). For the current study, we are considering enrollment at a community college prior to transferring to a four-year institution as the treatment. Absent random assignment, the propensity score is a device for constructing matched pairs that balance numerous observed covariates (Joffe & Rosenbaum, 1999). If subjects with the same or

similar propensity scores are matched or paired, then treated and comparison subjects in these groups will have similar patterns or distributions in the covariates creating a balance between the treatment and comparison groups. This helps to isolate the impact of the treatment and control for selection bias. Rosenbaum and Rubin (1983) argued that it would be best if members of the treatment and comparison group exactly matched on all covariates; however, given the difficulty of exactly matching on the propensity score, let alone numerous covariates, it is sufficient to use the propensity score to guide the match.

Matching Methods

First we used a combination of exact matching and nearest neighbor propensity score matching to balance pre-treatment differences between the community college transfer group and the rising junior group. The matching procedure was used to decrease the distance or difference in terms of predicted probability of being a community college transfer student between community college transfer students and the rising juniors. We find support in the literature for the matching procedures (Rosenbaum & Rubin, 1985; Rubin & Thomas, 1992; Smith, 1997; Stuart, 2010). For example, Stuart (2010) describes performing an exact match on key covariates such as race or gender followed by using propensity scores to further guide the match (Stuart, 2010, p. 6). Likewise, Rosenbaum and Rubin (1985) described their approach that provided for an exact match on gender and then propensity scores to determine the closest match or nearest neighbor.

For the current study, we required an exact match on high school (Figure 2, p. 12). We include high school context because classical as well as more recent sociological studies of education have emphasized the empirical and theoretical impact of high school context on future occupational and educational aspirations. For instance, Nelson (1972) emphasized the theoretical importance of high school context with respect to future aspirations. An empirical example of the importance of high school context was later given by Alwin and Otto (1977), who noted that the college plans of high school peer groups can affect students' educational aspirations. Furthermore, Smalley et al. (2010) suggested that high school funding and school-level teacher academic capital are related to college enrollment decisions as well. Similarly, a recent study by Rowan-Kenyon, Perna, and Swan (2011) suggested that high school resource levels, as measured by school level SES and achievement, affect both educational and occupational aspirations. Given the impact of high school context on aspirations, it is reasonable to assume its effect on postsecondary enrollment pathways, such as the probability of being a community college transfer student.

We then used the propensity scores generated from the previously described logistic regression model for one-to-one nearest neighbor matching with replacement. Similar to Bryson, Dorsett, and Purdon (2002), Caliendo and Kopeinig (2008) noted that among the methods of constructing a matched group, nearest neighbor matching is " the most straightforward matching estimator" (p. 41). Furthermore, nearest neighbor matching is said to be intuitive as well as easy to implement and understand (Rubin, 1973; Stuart, 2010), which in turn, helps make this matching type easily translatable to policy makers. In one-to-one nearest neighbor matching, an individual in the control group with the smallest distance from an individual in the treatment group is selected for the match

(Austin, 2011; Stuart, 2010). Stuart (2010) mentioned that in one-to-one matching, there is the possibility of lack of power resulting from disregarding large numbers of cases. However, lack of power is not an issue for this study due to our sample size and our use of matching with replacement.

We also decided to match with replacement in part because of the drawbacks associated with matching without replacement mentioned in Dehejia and Wahba (2002) and Rosenbaum (1995). Matching without replacement prevents someone from the comparison group being matched to more than one treatment group member. Dehejia and Wahba (2002) argued that matching without replacement restricts the number of comparison group units and when there are too few comparison units similar to the treated units, matching without replacement could cause the match treated units to be quite different in terms of the propensity scores. Matching without replacement also increases the potential impact of the order in which the matches occurred (Rosenbaum, 1995) as the cases selected to be matched first are provided with the greatest number of potential matches, arguably increasing the likelihood of a better match based on matching order.

Furthermore, we used a caliper so that only matches with an absolute difference less than .25 SD units between the propensity scores of the community college transfer student and the potential matched raising junior pair were included in the analysis. This caliper approach is supported by Rosenbaum and Rubin (1985).

Finally, we refined our matching approach by including a post-treatment adjustment to control for college context (Figure 3). This was accomplished by conducting an exact match between the community college transfer students and rising four-year college juniors on the selectivity of their undergraduate college. This approach is theoretically supported by Flores and Flores-Lagunes (2009) and Frangakis and Rubin (2002). Including a post-treatment variable provides for a comparison of individuals with the exact same values in the post-treatment variable under each of the treatment arms. Frangakis and Rubin (2002) argue that the post-treatment variable is not the primary endpoint, but may have an influence on the outcome being measured. For this study, a post-treatment adjustment is necessary given the differences in bachelor's degree completion rates across colleges of varying levels of selectivity. As established in Lichtenberger and Dietrich (2012a), even after taking into consideration academic factors such as college readiness, there were large differences in bachelor's degree completion when comparing similar students across varyingly selective four-year colleges. Students who enrolled at more selective four-year colleges generally completed bachelor's degrees at higher rates than similarly ready students who enrolled at less selective colleges (Lichtenberger & Dietrich, 2012a).

Figure 2

Process for Nearest Neighbor Propensity Score Matching with Replacement

1. ***Ensured an exact match on high school:*** For the first community college transfer student, find all available rising four-year college juniors who attended the same high school.

2. ***Nearest neighbor matching on the propensity score:*** For the first community college transfer student, find all available rising four-year college juniors from the subset defined in step 1. Select the rising four-year college junior with the smallest absolute values in terms of the difference between their propensity score and that of the first community college student.

3. ***Ensure the nearest neighbor is within an acceptable distance (caliper):*** Compare the propensity score of the

first community college transfer student to that of their nearest neighbor. A suitable match is made only if the difference in propensity scores is within .25 standard deviation units.

4a. If a suitable match is not found, remove the community college transfer student from the treatment group. Some treatment group members may not have a nearest neighbor within the caliper.

4b. ***Replacement:*** If a match is found, keep the matched rising four-year college junior available for other matches (matching with replacement).

5. Go to step 1 for the next community college transfer student.

Figure 3

Process for Nearest Neighbor Propensity Score Matching with Replacement and a Post-Treatment Adjustment

1. ***Ensured an exact match on high school:*** For the first community college transfer student, find all available rising four-year college juniors who attended the same high school.

2. ***Post-treatment adjustment:*** For the first community college transfer student, from the subset defined in step 1, select all rising four-year college juniors who enrolled at four-year colleges with the same Barron's selectivity rating as the community college transfer student.

3a. If suitable match is not found, remove the community college entrant from treatment group.

3b. ***Nearest neighbor matching on the propensity score:*** For the first community college transfer student, find all available rising four-year college juniors from the subset defined in both step 1 and step 2. Select the rising four-year college junior with the smallest absolute value in terms of the difference between their propensity score

and that of the first community college transfer student.

4. ***Ensure the nearest neighbor is within an acceptable distance (caliper):*** Compare the propensity score of the first community college transfer student to that of their nearest neighbor. A suitable match is made only if the difference in propensity scores is within .25 standard deviation units.

5a. If a suitable match is not found, remove the community college transfer student from the treatment group. Some treatment group members may not have a nearest neighbor within the caliper.

5b. ***Replacement:*** Keep the matched rising four-year college junior available for other matches (matching with replacement).

6. Go to step 1 for the next community college transfer student.

Missing Data

In an effort to ensure that we retained as many cases as possible for matching purposes we used a dummy variable adjustment for cases with missing data on some of the control variables (Cohen & Cohen, 1975). This approach allowed us to keep cases that would have otherwise been dropped. While dropping subjects with missing data is commonly seen in practice, this approach has the disadvantage of being potentially biased (Horton & Kleinman, 2007). The proportion of individuals with missing data on each of the categorically coded control variables in listed in Table 1 (pp. 14-15).

Results

First, we applied the model of postsecondary enrollment borrowing elements from Wang (2009) and previous IERC research (Lichtenberger & Dietrich, 2012a; Lichtenberger & Dietrich, 2012b) to predict the likelihood of taking the community college to four-year pathway. These control variables included student characteristics such as race, gender, high school program type; environmental factors such as family size, family income, whether one expected to receive financial aid to work during college; and geography, namely the locale of the student's high school. Logistic regression was used to estimate the propensity scores. Based on the pseudo R-squared, we were able to account for approximately 22% of the variance in terms of predicting the likelihood of taking the community college to four-year pathway.

Balancing Diagnostics

We ran two separate propensity score matching (PSM) diagnostics to determine how well PSM worked in creating balance between the community college transfer group and the group of rising four-year college juniors. The goal of PSM diagnostics is to assess the balance among the treatment and control groups and among the covariates involved in the PSM model (Lane, To, Shelley & Henson, 2012). The first diagnostic test involved an evaluation of the mean difference in propensity scores between the groups. A similar approach is described in Baser (2006). Before matching, the difference was 13 percentage points; after matching there was no difference, which shows a significant reduction and provides evidence of balance. After the post-treatment adjustment, the difference in mean propensity scores between the community college transfer students and four-year rising juniors remained zero.

We then used the standardized bias method for assessing balance using equation 1 for dichotomously coded variables and equation 2 for continuous variables (Austin & Mamdani, 2006).

$$d = \frac{100(\rho_{treatment} - \rho_{control})}{\sqrt{[\rho_t(1 - \rho_t) + \rho_c(1 - \rho_c)]/2}}$$

Equation 1

$$d = \frac{100(\bar{X}_{treatment} - \bar{X}_{control})}{\sqrt{[(s^2_{treatment} + s^2_{control})]/2}}$$ Equation 2

The standardized differences are included in Table 1. Standardized differences greater than 20% are considered large (Rosenbaum & Rubin, 1985). Further, citing Cohen (1977), Normand, Landrum, Guadagnoli, Ayanian, Ryan, Cleary, & McNeil (2001) stated that standardized differences less than 10% provide sufficient evidence of balance.

Table 1

Balancing Diagnostics on Pre-Treatment Variables: Pre-College Characteristics, Environmental Factors, and Geography*

	Prior to Matching			After Propensity Score Matching		
Control	Community College Transfer (N=2,154)	4-Year Rising Junior (N=21,522)	Standardized Difference	Community College Transfer (N=1646)	4-Year Rising Junior (N=1646)	Standardized Difference
Race: White	81%	71%	26.32	78%	79%	-3.41
Race: Latino	3%	4%	-5.43	3%	3%	0.00
Race: Asian	3%	7%	-18.16	3%	2%	8.29
Race: African American	3%	8%	-21.65	4%	3%	7.22
Race: Other	11%	10%	3.27	12%	12%	0.00
Gender: Male	47%	43%	8.19	45%	45%	0.00
Family Income: High $80k+	15%	29%	-32.37	17%	14%	11.29
Family Income: Mid High $50k-<$80k	23%	19%	9.95	22%	23%	-3.41
Family Income: Mid Low $30k-<$50k	20%	14%	16.27	19%	20%	-3.60
Family Income: Low $<30k	11%	9%	6.70	11%	10%	4.52
Family Income: Missing	30%	30%	0.00	31%	33%	-6.12
HS GPA: 3.5+	26%	45%	-37.07	29%	28%	3.12
HS GPA: 3.0-3.4	26%	21%	11.99	26%	25%	3.22
HS GPA: 2.5-2.9	14%	8%	19.51	13%	11%	8.41
HS GPA: <2.5	8%	3%	22.23	6%	6%	0.00
HS GPA: Missing	25%	23%	4.71	26%	30%	-12.90
ACT Math	21.05	24.90	-80.05	21.82	22.06	-5.61
ACT English	20.67	24.58	-80.11	21.55	21.67	-2.77
ACT Reading	21.34	24.67	-62.94	22.06	22.21	-3.03
ACT Science	21.20	23.97	-67.67	21.74	21.87	-3.63
ACT Composite	21.20	24.66	-84.18	21.93	22.08	-4.24
HS Program: College Prep	42%	57%	-27.99	45%	45%	0.00
HS Program: CTE	10%	5%	19.25	8%	9%	-5.21
HS Program: General	22%	14%	21.35	20%	17%	10.61
HS Program: Missing	26%	24%	4.65	27%	30%	-9.56
HS Class Rank: Top 25%	33%	51%	-33.93	35%	35%	0.00
HS Class Rank: Second 25%	31%	20%	26.22	29%	27%	6.23
HS Class Rank: Third 25%	11%	5%	22.49	9%	8%	4.94
HS Class Rank: Bottom 25%	1%	1%	0.00	1%	1%	0.00
HS Class Rank: Missing	25%	23%	4.71	26%	30%	-12.90
Work Expectation: Yes	54%	52%	4.05	54%	52%	5.68
Work Expectation: No	23%	27%	-9.12	23%	22%	3.36
Work Expectation: Missing	23%	21%	4.86	23%	26%	-10.08
Aid Expectation: Yes	63%	64%	-2.06	63%	61%	5.86
Aid Expectation: No	14%	15%	-2.83	14%	13%	4.08
Aid Expectation: Missing	22%	21%	2.44	23%	26%	-10.08
Number of Siblings	1.30	1.34	-3.57	1.34	1.38	-3.48
Locale: Chicago	2%	8%	-27.11	2%	2%	0.00
Locale: Other Urban	13%	13%	0.00	15%	15%	0.00
Locale: Suburban	45%	61%	-29.63	53%	53%	0.00
Locale: Town	16%	6%	32.90	13%	13%	0.00
Locale: Rural	24%	11%	35.65	17%	17%	0.00

* Cells are shaded according to their difference from zero

Difference favoring 4-year group

Difference favoring community college group

	After Post-Treatment Adjustment	
Community College Transfer (N=1,322)	4-Year Rising Junior (N=1,322)	Standardized Difference
78%	80%	-4.91
3%	3%	0.00
4%	3%	5.44
4%	4%	0.00
11%	11%	0.00
45%	43%	4.03
18%	17%	2.63
24%	21%	7.19
17%	17%	0.00
10%	10%	0.00
31%	35%	-8.51
28%	27%	2.24
26%	26%	0.00
14%	11%	9.08
6%	6%	0.00
26%	29%	-6.72
22.03	22.16	-3.04
21.77	21.87	-2.30
22.12	22.14	-0.40
21.87	21.88	-0.29
22.09	22.13	-1.14
45%	45%	0.00
8%	8%	0.00
21%	17%	10.21
26%	30%	-8.92
34%	34%	0.00
29%	28%	2.22
9%	8%	3.59
1%	1%	0.00
26%	30%	-8.92
54%	48%	12.02
22%	25%	-7.08
24%	27%	-6.89
63%	60%	6.17
14%	13%	2.93
24%	27%	-6.89
1.36	1.34	1.79
2%	2%	0.00
16%	16%	0.00
57%	57%	0.00
11%	11%	0.00
14%	14%	0.00

Group Balance prior to Propensity Score Matching

As shown in Table 1, several of the standardized differences between the community college transfer students and the rising four-year college juniors were well over the threshold for being considered large, i.e., 20%.

Most of the large differences suggested that as a group, the community college transfer students might have a lower likelihood of completing a bachelor's degree. For example, the standardized differences in terms of performance on ACT Math and ACT English were slightly over 80%, with the community college transfer group having significantly lower scores, as depicted by the black shading. Additionally, the community college transfer group had relatively fewer students falling within the high family income category, participating in a college preparatory program during high school, having a 3.5 or higher high school grade point average, and being in the top 25% of their high school graduating class. Relative to the four-year rising juniors, substantially more of the community college transfer students were white and fewer were African American and Asian American. In relative terms, substantially more of the community college transfer students were from towns and rural locales and fewer were from Chicago and suburban locales

Diagnostics after Propensity Score Matching

More than three-quarters of the community college transfer students (76.4%) were matched to a four-year rising junior who attended the same high school reducing our treatment group sample from 2,154 to 1,646. Each set of matched pairs had propensity scores within the caliper mentioned in the methods (.25 of one standard deviation). Using this approach we established substantially better balance between the community college transfer group and the rising four-year college juniors relative to the non-matched comparison mentioned above. The improvement in the balance is visually depicted by fewer shaded cells in the standardized difference column and the fact that all of the shaded cells are shaded with light colors. In fact, regarding the factors used to develop the propensity scores, none of the standardized differences were greater than 20% and nearly all of them fell under the 10% threshold. This suggested a move towards an adequate balance between the community college transfer group and the rising four-year college juniors on the pre-treatment factors.

Some slight imbalances remained between the groups on a few of the control variables, most of which indicated that higher proportions of the four-year rising juniors had missing information. The comparison group had higher proportions with missing data in the following categorical control variables: financial aid expectation, expectation to work, high school class rank, and high school GPA. Beyond the slight imbalances regarding missing data mentioned above, there were two

additional control variables just above the 10% threshold. From the perspective of the treatment group, one was arguably related to a decreased likelihood of bachelor's degree completion and the other associated with an increased likelihood. As shown on Table 1, slightly more community college transfer students participated in a general high school curriculum program relative to rising four-year college juniors, which may be associated with a decreased likelihood of bachelor's degree completion. However, slightly more community college transfer students fell into the high family income category and this has been shown to increase one's odds of bachelor's degree completion.

Institutional Selectivity

As previously mentioned, we also explored differences between the community college transfer group and the rising four-year college juniors regarding the selectivity of their four-year colleges. Because such enrollment took place after the treatment or community college enrollment, we did not include it in the logistic regression model that was used to predict the likelihood of taking the community college to four-year pathway.

As shown in Table 2, prior to matching, there were substantially large differences between the community college transfer students and the rising four-year college juniors in all but one of the institutional selectivity categories (Other) and all of the differences indicated imbalance. Generally, more four-year rising juniors were enrolled at highly and very selective institutions, while more of the community college transfer students were enrolled at less selective institutions, as well as those lacking a selectivity rating.

After propensity score matching there was a significant decrease in the standardized differences, however, there was still imbalance in all but one of the selectivity categories (less/non competitive). Since our logistic regression model only controlled for pre-treatment characteristics, the imbalance in institutional selectivity was not surprising. Once again, more community college transfer students enrolled at less selective institutions and more four-year rising juniors enrolled at highly selective institutions. These findings suggest that the treatment group may be less likely to complete a bachelor's degree relative to the four-year rising juniors.

Table 2

*Balancing Diagnostics on Institutional Selectivity**

	Prior to Matching			After Propensity Score Matching			After Post-Treatment Adjustment		
Barron's Institutional Selectivity	Community College Transfer (N=2,154)	4-Year Rising Junior (N=21,522)	Standardized Difference	Community College Transfer (N=1646)	4-Year Rising Junior (N=1646)	Standardized Difference	Community College Transfer (N=1,322)	4-Year Rising Junior (N=1,322)	Standardized Difference
Barron's: Most/Highly Competitive	8%	28%	-49.15	9%	12%	-14.82	8%	8%	0.00
Barron's: Very Competitive	11%	25%	-34.98	13%	18%	-21.03	13%	13%	0.00
Barron's: Competitive	65%	39%	60.94	63%	59%	11.72	71%	71%	0.00
Barron's: Less/Non Competitive	12%	6%	21.32	12%	10%	8.70	7%	7%	0.00
Barron's: Other	3%	1%	14.36	2%	1%	10.10	1%	1%	0.00

* Cells are shaded according to their difference from zero   Difference favoring 4-year group   Difference favoring community college group

Diagnostics after the Post-treatment Adjustment

As described in the methods section, we used a post-treatment adjustment to better control for contextual differences in terms of the four-year colleges. We felt that bachelor's

degree completion could potentially be impacted by institutional characteristics of the four-year colleges. One way to control for college context is to have matched pairs who enroll at institutions that are equally selective. After the post-treatment adjustment, matched pairs were required to have graduated from the same high school, to have a similar likelihood of enrolling at a community college as a result of PSM, and to have enrolled at a similarly selective four-year college. We were able to find a suitable match for over 61% of the initial group of community college transfer students. Further, four out of every five community college transfer students who had a matched pair after PSM, also had a matched pair at a similarly selective four-year college. We initially considered conducting an exact match on the four-year institution as the post-treatment adjustment, but that requirement eliminated substantially more potential matches.

As previously shown in Table 1 (p. 15), the post-treatment adjustment provides an improvement from the matched comparison in terms of balance on the pre-treatment characteristics. Only two of the controls remained slightly imbalanced: the percentage within each group from a general high school curriculum and the percentage within each group indicating a need to work during college. The slight imbalance on both of these controls suggested that the community college transfer group would be at a slight relative disadvantage in terms of the likelihood of degree completion.

Next we explored bachelor's degree completion. We ran both Pearson Chi Squares and a binary logistic regression model including control variables that were lacking balance (over the 10% standardized difference threshold) after our post-treatment adjustment.
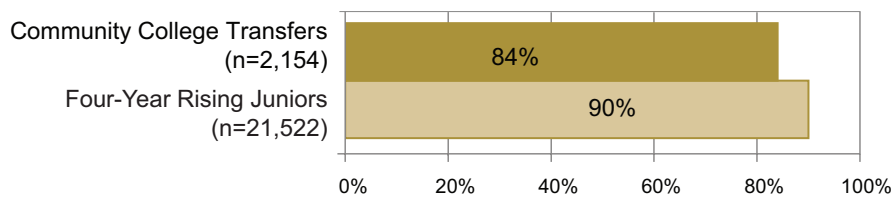
Bachelor's Degree Completion

Prior to PSM

Prior to PSM, the community college transfer students had a significantly lower rate of bachelor's degree completion relative to rising four-year rising juniors as measured inferentially (Pearson's Chi-Square). As shown in Figure 4, the six percentage point difference favoring four-year rising juniors, equated to a standardized difference of roughly 16%. This was not surprising given the large standardized differences on key factors that generally suggested the four-year rising juniors would have a higher likelihood of completing a bachelor's degree. That is, overall, the rising four-year juniors had a stronger profile in terms of academic preparation.

Figure 4

*Bachelor's Completion Rates Prior to PSM**

Community College Transfers (n=2,154) — 84%
Four-Year Rising Juniors (n=21,522) — 90%

* Statistically significant based on Pearson's Chi Square

After PSM

Despite the slight imbalances that existed between the community college group and the four-year rising juniors after propensity score matching, only one percentage point separated the groups in terms of the rate of bachelor's degree completion (Figure 5). Further, inferential statistics (Pearson's Chi Square) indicated no community college penalty was evident. That is, after controlling for academic preparation and environmental factors, community college transfer students were just as likely to complete a bachelor's degree as four-year rising juniors.

Figure 5
Bachelor's Completion Rates After PSM*

Community College Transfers (n=1,646)	85%
Four-Year Rising Juniors (n=1,646)	86%

0%   20%   40%   60%   80%   100%

*Pearson's Chi Square not significant
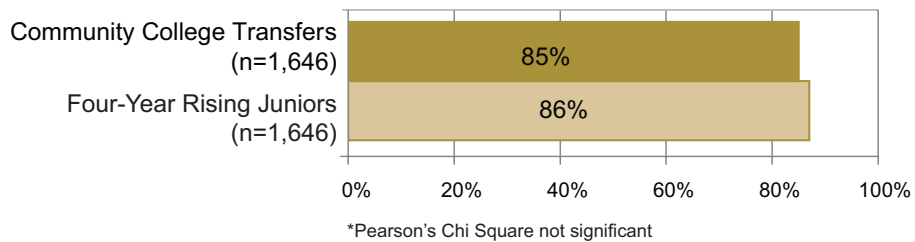
After post-treatment adjustment

To better control for college context, we also matched on institutional selectivity, which substantially improved the balance between the two groups. As shown in Figure 6, the rate of bachelor's degree completion was the same prior to the post-treatment adjustment with 85% of community college transfer students earnings a bachelor's degree relative to 86% of four-year rising juniors. The one percentage point advantage favoring rising four-year juniors lacked statistical significance (Pearson's Chi Square). Once again, this indicated that no community college penalty was evident.

Figure 6
Bachelor's Completion Rates After Post-Treatment Adjustment*

Community College Transfers (n=1,322)	85%
Four-Year Rising Juniors (n=1,322)	86%

0%   20%   40%   60%   80%   100%

*Pearson's Chi Square not significant
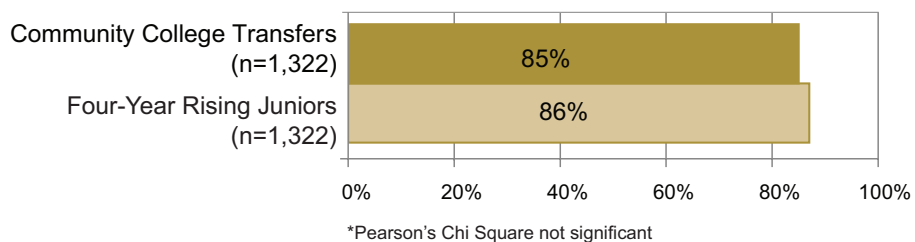
Given this balance in the propensity scores and in nearly all of the covariates between the groups, logistic regression was used to assess whether community college transfer status affects the likelihood of bachelor's degree completion above and beyond the slightly imbalanced factors that remained after PSM and the post-treatment adjustment. Therefore, we controlled for high school program type, due to the slight imbalance on the percentage of community college transfer students and rising four-year juniors having been from a general curriculum program in high school. In addition, we controlled for differences in maintaining the expectation to work during college due to the slight

imbalance in the percentage responding that they expected to work during college. In the end, there was no statistically significant difference in the likelihood of bachelor's degree completion based on community college transfer status. In other words, even after further adjustments to ensure proper balance between the community college transfer students and the rising four-year juniors, no community college penalty was evident.

Further, based on the binary logistic regression model, the predicted probabilities of bachelor's degree completion were the same as the actual rates—85% for community college transfer students and 86% for four-year rising juniors. While this model explained less than one percent of the variance (based on the pseudo R-squared) and the model fit was fairly poor, the purpose of this model was not to determine the factors related to an increased likelihood of bachelor's degree completion. Instead, the purpose of the model was to control for the remaining imbalance between the community college transfer students and the four-year rising juniors on the expectation to work and high school program type. In the end, the treatment variable (taking the community college to four-year pathway) lacked statistical significance (p-value of .419). Thus, we can again conclude that no significant community college penalty was evident.

Discussion

Community College Penalty?

Controlling for other factors, enrolling full-time at a community college directly out of high school, maintaining full-time enrollment, and transferring to a four-year institution provides for a similar rate of bachelor's degree completion relative to directly enrolling at a four-year college and maintaining a parallel enrollment pattern.

While our study was fairly specific and the results cannot be applied to all community college transfer students, let alone all community college students, we found no significant evidence of a community college penalty. We therefore conclude that community college transfer students were just as likely to earn a bachelor's degree as rising four-year juniors. This does not equate to a universal benefit for all community college students, rather *a lack of penalty for full-time community college students who choose to make the transition to a four-year college.*

Further, these results help validate the findings of previous studies that have demonstrated no community college penalty for community college transfer students (Glass & Harrington, 2002; Lee, Mackie-Lewis & Marks, 1993; Melguizo, Kienzl & Alfonso, 2011; Melguizo & Dowd, 2009). In other words, our study provides additional evidence that the community college to four-year pathway is a viable option for Illinois high school graduates.

Institutional Selectivity as a Post-Treatment Adjustment

Other education policy researchers employing quasi-experimental research designs that use propensity scores to match on pre-treatment factors should consider using a post-treatment adjustment as a way to control for college context, particularly when exploring bachelor's degree completion. We found substantially better balance between our treatment and comparison groups after making sure the matched pairs were from the same high school (pre-treatment factor) and eventually enrolled at similarly selective colleges (post-treatment adjustment). Further, after matching on institutional selectivity, the mean predicted probability of being a community college transfer student for both the treatment and comparison groups only decreased by one percentage point. In other words, the post-treatment adjustment did not substantially change the group composition in terms of their likelihood of being a community college transfer student.

Further Investigation

We propose two methodological enhancements to future studies examining the effect of being a community college transfer on bachelor's degree completion. First, we recommend exploring the use of multiple imputations to deal with missing data rather than relying on dummy variable adjustments. Secondly, it would be beneficial to further explore bachelor's degree completion using survival analysis. We found no evidence of a community college penalty on bachelor's degree completion when the outcome is measured dichotomously (yes/no) at the end of the study; however, the current outcome measure does not consider how many semesters it takes to earn such a degree. Relatedly, this could also allow for an estimation of the total relative cost associated with earning a bachelor's degree for community college transfer students as compared with four-year rising juniors.

We also suggest exploring differences in majors between community college transfer students and similar direct four-year college entrants. A penalty or potential benefit may exist in the proportion of community college transfer students majoring in select fields that have been incentivized by higher education performance-based funding in Illinois. For example, colleges are being rewarded for bachelor's degrees conferred in Science, Technology, Engineering, Mathematics, and key health fields such as nursing. It would be interesting to determine if community college transfer students are more or less likely to major in such areas relative to similar direct four-year college entrants.

The composition of the treatment group, community college students who enrolled full-time prior to transferring, combined with their relatively high rate of bachelor's degree completion (85%) suggest the importance of enrollment intensity for community college students as it relates to postsecondary success. Because of this we feel it would be beneficial to explore the relationship between initial community college enrollment intensity and subsequent postsecondary outcomes controlling for other pre-college and environmental factors.

We also propose exploring if the treatment effect related to taking the community college to four-year pathway is different for various subgroups of students. For example, does the treatment effect in terms of bachelor's degree completion differ among high and low income students, or those who enroll at a community college ready for college-level work compared to those requiring remediation.

Finally, to better align future studies with the current completion agenda (Illinois Board of Higher Education, 2008; Obama, 2009; Illinois P-20 Council, 2011), we recommend including associate degree attainment and certificate completion as additional measures of college outcomes for all students, particularly if a bachelor's degree is not attained.

Policy Implications

As the state of Illinois develops strategies to increase the proportion of postsecondary degree holders, it should consider ways to enhance the community college to four-year pathway given sufficient evidence from this cohort of Illinois students that shows a lack of community college penalty.

We feel that policymakers should continue to:

1. Develop baseline information about statewide transfer performance in terms of both persistence and bachelor's degree completion (Wellman, 2002) as the state's longitudinal data system is fully implemented;

2. Set goals and measures for performance related to community college to four-year transfer (Wellman, 2002). Such measures could be integrated into the state's higher education performance based funding formula;

3. Help community college transfer students face their financial aid future by developing information and incentives—such as the state's Monetary Assistance Program (MAP) 2+2 Pilot Program— that fully span their undergraduate enrollment from community college to a four-year institution (Wellman, 2002; Handel, 2011).

References

Adelman, C. (2006) *Toolbox revisited. Paths to degree completion from high school through college.* Retrieved from: http://www2.ed.gov/rschstat/research/pubs/toolboxrevisit/toolbox.pdf

Alfonso, M. (2006). The impact of community college attendance on baccalaureate attainment. *Research in Higher Education, 47*(8), 873-903.

Alwin, D. F. & Otto, L. B. (1977). High school context effects on aspirations. *Sociology of Education, 50*, 259-273.

Austin, P.C. & Mamdani, M.M. (2006). A comparison of propensity score methods: A case-study illustrating the effectiveness of post-AMI statin use. *Statistics in Medicine, 25*, 2084-2106.

Austin, P. C. (2011). An introduction to propensity score methods for reducing the effects of confounding in observational studies. *Multivariate Behavioral Research, 46*(3), 399-424.

Barron's. (2003). *Profiles of American Colleges.* Woodbury, NY: Barron's Education Series, Inc.

Baser, O. (2006). Too much ado about propensity score models? Comparing methods of propensity score matching. *Value in Health, 9*(6), 377-385.

Bryson, A., Dorsett, R., & Purdon, S. (2002). *The use of propensity score matching in the evaluation of active labour market policies.* London: Policy Studies Institute and National Centre for Social Research. Retrieved from: http://eprints.lse.ac.uk/4993/1/The_use_of_propensity_score_matching_in_the_evaluation_of_active_labour_market_policies.pdf

Caliendo, M. & Kopeinig, S. (2008). Some practical guidance for the implementation of propensity score matching. *Journal of Economic Surveys, 22*(1), 31-72.

Cohen, J. (1977). S*tatistical power analysis for the behavioral sciences.* Toronto: Academic Press.

Cohen, J. & Cohen, P. (1975). *Applied multiple regression correlation analysis for the behavioral sciences.* New York: Wiley.

Dehejia, R. H. & Wahba, S. (2002). Propensity score-matching methods for nonexperimental causal studies. *Review of Economics and Statistics, 84*(1), 151-161.

Doyle, W. R. (2009). The effect of community college enrollment on bachelor's degree completion. *Economics of Education Review, 28*(2), 199-206.

Epstude, K. & Roese, N. J. (2008). The functional theory of counterfactual thinking. *Personality and Social Psychology Review, 12*(2), 168-192.

Flores, C. A. & Flores-Lagunes, A. (2009). *Identification and Estimation of Causal Mechanisms and Net Effects of a Treatment.*

Frangakis, C. E. & Rubin, D. B. (2004). Principal stratification in causal inference. *Biometrics, 58*(1), 21-29.

Glass, J. C. & Harrington, A. R. (2002). Academic performance of community college transfer students and "native" students at a large state university. *Community College Journal of Research and Practice, 26*(5), 415-430.

Handel, S. J. (2011). Improving student transfer from community colleges to four-year institutions: The perspectives of leaders from baccalaureate-granting institutions. *College Board.*

Horton, N. J. & Kleinman, K. P. (2007). Much ado about nothing: A comparison of missing data methods and software to fit incomplete data regression models *The American Statistician, 61*(1).

Illinois Board of Higher Education (2008). *The Illinois public agenda for college and career success.* Springfield, IL: IBHE.

Illinois P-20 Council (2011). *Education for our future: First report and recommendations of the Illinois P-20 Council to the Governor, the General Assembly, and the people of Illinois*. Chicago, IL. Chicago Community Trust.

Joffe, M. M. & Rosenbaum, P. R. (1999). Invited commentary: propensity scores. *American Journal of Epidemiology, 150*(4), 327-333.

Lane, F. C., To, Y. M., Shelley, K., & Henson, R. K. (2012). An Illustrative Example of Propensity Score Matching with Education Research. *Career and Technical Education Research, 37*(3), 187-212.

Lee, V. E., Mackie-Lewis, C., & Marks, H. M. (1993). Persistence to the baccalaureate degree for students who transfer from community college. *American Journal of Education*, 80-114.

Lichtenberger, E. J. & Dietrich, C. (2012a). *College readiness and the postsecondary outcomes of Illinois high school students* (Policy Research: IERC 2012-1). Edwardsville, IL: Illinois Educational Research Council.

Lichtenberger, E.J. & Dietrich, C. (2012b). *College readiness and the potentially overlapping outcomes of community college entrants* (Policy Research: IERC 2012-3). Edwardsville, IL: Illinois Educational Research Council.

Long, B. T. & Kurlaender, M. (2009). Do community colleges provide a viable pathway to a baccalaureate degree? *Educational Evaluation and Policy Analysis, 31*(1), 30-53.

Melguizo, T. & Dowd, A. C. (2009). Baccalaureate success of transfers and rising 4-year college juniors. *The Teachers College Record, 111*(1), 55-89.

Melguizo, T., Kienzl, G. S., & Alfonso, M. (2011). Comparing the educational attainment of community college transfer students and four-year college rising juniors using propensity score matching methods. T*he Journal of Higher Education, 82*(3), 265-291.

National Student Clearinghouse (2010). *Frequently asked questions.* Retrieved from http://www.studentclearinghouse. org/highschools/hs/faqs.htm

Nelson, J. I. (1972). High school context and college plans: The impact of social structure on aspirations. *American Sociological Review, 37*, 143-148.

Normand, S. L. T., Landrum, M. B., Guadagnoli, E., Ayanian, J. Z., Ryan, T. J., Cleary, P. D., & McNeil, B. J. (2001). Validating recommendations for coronary angiography following acute myocardial infarction in the elderly: a matched analysis using propensity scores. *Journal of Clinical Epidemiology, 54*(4), 387-398.

Obama, B. (2009). *Remarks by the President on the American graduation initiative*. The White House Office of the Press Secretary.

Pedhazur, E. J. & Schmelkin, LP (1991). *Measurement, design, and analysis: An integrated approach.* Hillsdale, New Jersey: Lawrence Erlbaum.

Rosenbaum, P. R. (1995). *Observational studies.* New York: Springer-Verlag.

Rosenbaum, P. R., & Rubin, D. B. (1983). The central role of the propensity score in observational studies for causal effects. Biometrika, 70(1), 41-55.

Rosenbaum, P. R. & Rubin, D. B. (1985). Constructing a control group using multivariate matched sampling methods that incorporate the propensity score. *The American Statistician, 39*(1), 33-38.

Rowan-Kenyon, H. T., Perna, L. W., & Swan, A. K. (2011). Structuring opportunity: The role of school context in shaping high school students' occupational aspirations. *The Career Development Quarterly, 59*(4), 330-344.

Rubin, D. (1973). Matching to remove bias in observational studies. *Biometrics, 29*, 159–184.

Rubin, D. B. & Thomas, N. (1992). Characterizing the effect of matching using linear propensity score methods with normal distributions. *Biometrika, 79*(4), 797-809.

Sandy, J., Gonzalez, A., & Hilmer, M. J. (2006). Alternative paths to college completion: Effect of attending a 2-year school on the probability of completing a 4-year degree. *Economics of Education Review, 25*(5), 463-471.

Smalley, D., Lichtenberger, E., & Brown, K.S. (2010). *A longitudinal study of the Illinois high school class of 2002: A six year analysis of postsecondary enrollment and completion.* (2010-3). Edwardsville, IL: Illinois Education Research Council.

Smith, H. L. (1997). Matching with multiple controls to estimate treatment effects in observational studies. *Sociological Methodology, 27*(1), 325-353.

Stuart, E.A. (2010). Matching methods for causal inference: A review and a look forward. *Statistical Science, 25*(1), 1-21. doi: 10.1214/09-STS313

Wang, X. (2009). Baccalaureate attainment and college persistence of community college transfer students at four-year institutions. *Research in Higher Education, 50*, 570–588. doi: 10.1007/s11162-009-9133-z

Wellman, J. V. (2002). S*tate policy and community college-baccalaureate transfer.* San Jose: National Center for Public Policy and Higher Education.

Appendix

Study	Alfonso (2006)
Summary	Community colleges significantly reduce the probability of bachelor's degree completion
Data	National Educational Longitudinal Study (NELS)
Design and Statistical Analysis	Design: Observational design Statistical analysis: *Structural equation modeling*
Independent Variables	Instrumental (exogenous) variables: state per capita income, unemployment rate, tuition at two- and four-year colleges, geographic accessibility of two- and four-year colleges Control variables: gender, race, educational expectations, SES, language spoken at home, religion, ability, high school track, high school characteristics, patterns of college enrollment, field of study
Comparison	Initial community college enrollees versus initial four-year enrollees
Community College Penalty	Yes
Study	Doyle (2009)
Summary	Community college attendance is related to a lower probability of completing a bachelor's degree
Data	National Center for Educational Statistics (NCES) Beginning Postsecondary Student Study
Design and Statistical Analysis	Design: Quasi-experimental Statistical analysis: *Propensity Score Matching (PSM)* to create matched control and treatment groups PSM model controlled for family characteristics, high school characteristics, student information, attitudinal data, financial aid and cost data *Cox proportional hazards model* used to estimate penalty
Independent Variables	Independent variables: beginning at a community college/not beginning at a community college Controls: Age, dependent status, hours worked per week, full-time status, on campus versus off campus student
Comparison	Initial community college enrollees versus initial four-year enrollees
Community College Penalty	Yes
Study	Glass & Harrington (2002)
Summary	In general, transfers do as well or better than native students with respect to GPA, retention, and graduation rates
Data	Sample from the North Carolina Community College System who transferred to one four-year university and native students from that university
Design and Statistical Analysis	Design: Observational Statistical analysis: *T-tests* for GPA comparisons, chi square for graduation rate comparisons between transfers and natives
Independent Variables	n/a
Comparison	Community college transfer students versus native students
Community College Penalty	No
Study	Lee, Mackie-Lewis & Marks (1993)
Summary	African-American students less likely to graduate High GPA and full time status are significantly related to bachelor's completion Sector (private versus public) is not significant along with selectivity, location, size of college Whether a college awards professional degrees affects persistence to the bachelor's degree College composition: Mostly white colleges or high minority composition institutions have a positive effect on bachelor's completion Significant interaction term: former community college students who transferred into four-year colleges that enrolled more than 30% minority students were less likely to graduate
Data	High School and Beyond
Design and Statistical Analysis	Design: Observational Statistical analysis: *Logistic regression*
Independent Variables	Background Measures: SES, gender, race, ethnicity Transfer measure: transfer versus native student Student behaviors: Living at college, full time student status, academic satisfaction, social satisfaction
Comparison	Community college transfer students versus native students
Community College Penalty	No

Study	Long & Kurlaender (2009)
Summary	Students beginning postsecondary education at community colleges are less likely to earn a bachelor's degree than native students by 14.5 percentage points
Data	Data are from the Ohio public higher education system
Design and Statistical Analysis	Design: Quasi-experimental Statistical analysis: *Propensity Score Matching* to create matched control and treatment groups PSM model controlled for gender, race, age, parental income, high school GPA, years of high school math, years of high school English, high school math grades, high school English grades, ACT percentile, high school type (private versus public) *Probit modeling* used to estimate penalty
Independent Variables	Distance to closest two-year college, distance to closest nonselective four-year university, gender, race, age, parental income, ACT math score, ACT English score
Comparison	Initial community college enrollees versus initial four-year enrollees
Community College Penalty	Yes
Study	Melguizo, Kienzl, & Alfonso (2011)
Summary	There are no differences between natives and transfers with respect to completion of a bachelor's degree within eight years of high school graduation
Data	National Educational Longitudinal Study (NELS)
Design and Statistical Analysis	Design: Quasi-experimental Statistical analysis: *Ordinary Least Squares Regression and Propensity Score Matching*
Independent Variables	Gender, race,ethnicity,12th grade test scores, academic program in high school, participation in honors program, participation in school government, having a child by 1992, being married by 1992, educational expectations, receipt of grants/loans, participation in study-related activities, SES (parental income, education, occupation)
Comparison	Community college transfer students versus native students
Community College Penalty	No
Study	Melguizo & Dowd (2009)
Summary	Transfers are as likely to earn a bachelor's degree as native students (rising juniors) after controlling for SES Transfers who are in the lowest SES group are slightly more likely to obtain a degree than their low SES rising junior counterparts
Data	National Educational Longitudinal Study (NELS)
Design and Statistical Analysis	Design: Observational Statistical Method: *Logistic regression*
Independent Variables	SES, financial aid, gender, received grant, received loan, combined math and verbal 12th grade test scores, high school program type, selectivity, sector, honors program participation, student governance participation, transfer by SES (Interaction term)
Comparison	Community college transfer students versus native students
Community College Penalty	No
Study	Sandy, Gonzales, & Himler (2006)
Summary	Beginning at a two-year college is negatively associated with college completion Lower student quality (i.e., readiness) explains most of the variability in bachelor's degree completion Quality is measured by SAT scores and high school grades
Data	National Educational Longitudinal Study (NELS), High School and Beyond, Beginning Postsecondary Students Study
Design and Statistical Analysis	Design: observational Statistical analysis: *Oaxaca decomposition* with two separate equations for two-year and four-year students
Independent Variables	Gender, race, parental education, SAT scores, grades, hours worked, beginning at a community college
Comparison	Initial community college enrollees versus initial four-year enrollees
Community College Penalty	Yes

The Illinois Education Research Council at Southern Illinois University Edwardsville was established in 2000 to provide Illinois with education research to support Illinois P-20 education policy making and program development. The IERC undertakes independent research and policy analysis, often in collaboration with other researchers, that informs and strengthens Illinois' commitment to providing a seamless system of educational opportunities for its citizens. Through publications, presentations, participation on committees, and a research symposium, the IERC brings objective and reliable evidence to the work of state policymakers and practitioners.