Using Propensity Score Matching to Test the Community College Penalty Assumption

Eric Lichtenberger & Cecile Dietrich

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Our Mission

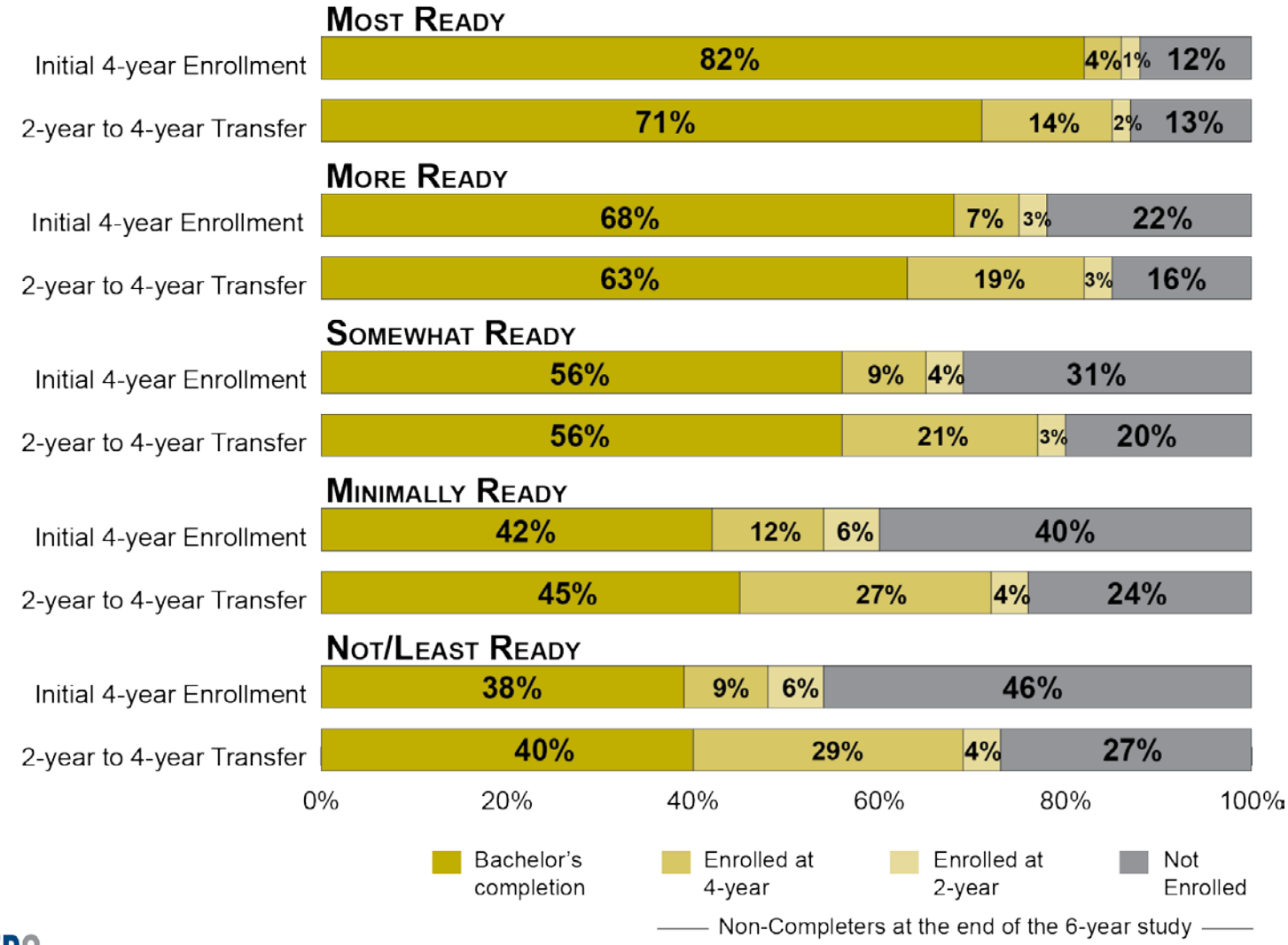
To provide objective and reliable evidence for Illinois P-20 education policy making and program development.

Ensuring Research-Informed Education Policy for Illinois

Community College Penalty and Bachelor's Degree Completion?

- Penalty-Community college students are less likely to earn a bachelor's degree than direct entrants to four-year colleges.
- Penalty seems to be related to the point at which the given study commences tracking outcomes
  - At initial community college enrollment
  - After vertical transfer
- Wide variation in college readiness among community college enrollees
- Observationally equivalent groups
- One cannot earn a bachelor's degree at a community college
- Parallel point of entry and time allotted for degree completion

Reason for Controlling for Point of Entry



Why Propensity Score Matching?

- Mimic experimental designs
- Conditional probability of exposure to a treatment given a particular set of observed characteristics
- Propensity score is generally created through logistic regression (predicted probability)
- Control for a large number of covariates and create balance to show the degree to which the study groups are observationally equivalent
- Make claims of causality

Decision Points in PSM

1) Need to determine your treatment and counterfactual
2) Observationally equivalent groups (treatment vs. comparison)
3) Develop a logistic regression model to predict one's likelihood of placement into the treatment group (propensity score=predicted probability)
4) Establish approach for matching
5) Matching with or without replacement
6) Nearest neighbor or radial matching
7) Number of matches to include (1 to 1, 1 to many)
8) Using a caliper (.25 standard deviation units or set difference in propensity scores, such as within 1% or 5%)
9) Determining balance with diagnostics (look at histograms of ps distribution, difference between mean propensity scores, standardized differences)

Counterfactual

- What would have happened if the treatment group (students taking the community college to four-year transfer pathway) had instead directly enrolled at a four-year college upon high school graduation?

Observationally Equivalent Groups

- **Treatment group** (*n*=2,154): those initially enrolling at a community college FT, maintaining that enrollment through their 1st and 2nd years, and then transferring to a four-year college (no lateral transfers).

- **Comparison group** (*n*=21,522): rising four-year college juniors with a similar pattern of full-time enrollment (no lateral transfers)

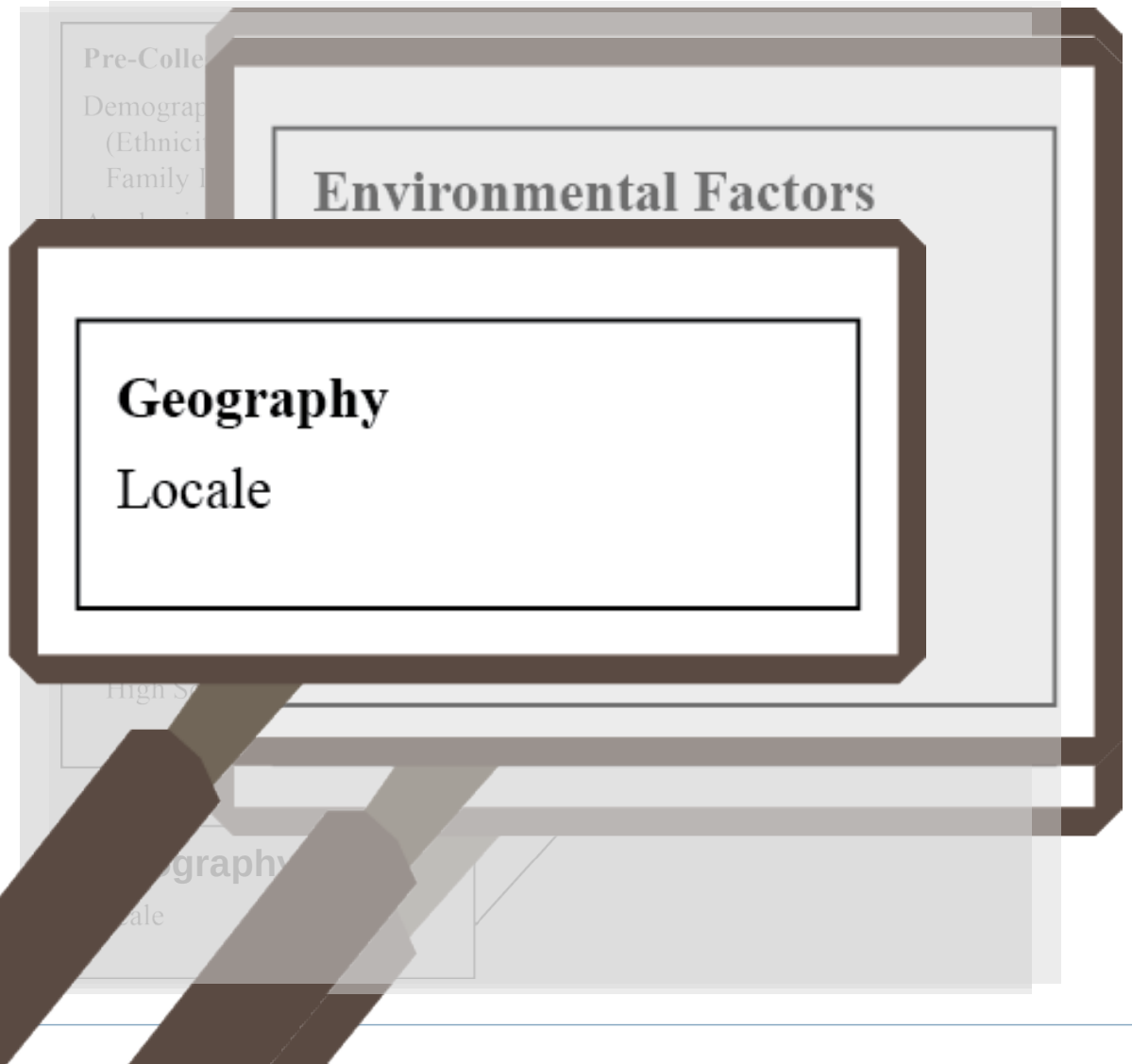
Why Full-Time Enrollment?

- Nearly all of the direct entrants to four-year colleges initially enrolled full-time
- It is the enrollment pattern most typical of direct four-year college entrants

Data Sources

- ACT HS Class of 2003
  - –ACT Scores
  - –Student Interest Profiler
- National Student Clearinghouse
  - –Enrollment
  - –Degree completion
- Illinois Interactive Report Card
- Barron’s

Propensity Score Matching Model



Matching Approach

- Exact match on high school
- Used propensity scores to find suitable matches

Type of Match

- Nearest neighbor (one-to-one)
- Caliper (.25 standard deviation units)
- Replacement (allows a comparison group member to be matched to more than one treatment group member)

Post-Treatment Adjustment

- Controlled for college context
- Exact match on the selectivity (Barron's) of their undergraduate college
  - Large differences in bachelor's completion by selectivity level even after controlling for academic preparation (Lichtenberger & Dietrich, 2012)
- This approach is theoretically supported by Flores and Flores-Lagunes (2009) and Frangakis and Rubin (2002)

Balancing Diagnostics

- Standardized differences-
  - –10% or less indicates balance
  - –20% or more indicated a large difference
- Comparisons of mean propensity scores

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 adjustment?

Differences in Demographics

Control	Prior to Matching Standardized Difference
Race: White	26.32
Race: Latino	-5.43
Race: Asian	-18.16
Race: African American	-21.65
Race: Other	3.27
Gender: Male	8.19
Family Income: High $80k+	-32.37
Family Income: Mid High $50k-<$80k	9.95
Family Income: Mid Low $30k-<$50k	16.27
Family Income: Low $<30k	6.70
Family Income: Missing	0.00

* Cells are shaded according to their difference from zero

Difference favoring 4-year group

Difference favoring community college group

Differences in Academic Factors

Control	Prior to Matching Standardized Difference
HS GPA: 3.5+	-37.07
HS GPA: 3.0-3.4	11.99
HS GPA: 2.5-2.9	19.51
HS GPA: <2.5	22.23
HS GPA: Missing	4.71
ACT Math	-80.05
ACT English	-80.11
ACT Reading	-62.94
ACT Science	-67.67
ACT Composite	-84.18
HS Program: College Prep	-27.99
HS Program: CTE	19.25
HS Program: General	21.35
HS Program: Missing	4.65
HS Class Rank: Top 25%	-33.93
HS Class Rank: Second 25%	26.22
HS Class Rank: Third 25%	22.49
HS Class Rank: Bottom 25%	0.00
HS Class Rank: Missing	4.71

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Difference favoring 4-year group

Difference favoring community college group

Differences in Environmental Factors

Control	Prior to Matching Standardized Difference
Work Expectation: Yes	4.05
Work Expectation: No	-9.12
Work Expectation: Missing	4.86
Aid Expectation: Yes	-2.06
Aid Expectation: No	-2.83
Aid Expectation: Missing	2.44
Number of Siblings	-3.57
Locale: Chicago	-27.11
Locale: Other Urban	0.00
Locale: Suburban	-29.63
Locale: Town	32.90
Locale: Rural	35.65

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Difference favoring 4-year group

Difference favoring community college group

Differences in Institutional Selectivity

Barron's Institutional Selectivity	Prior to Matching Standardized Difference
Barron's: Most/Highly Competitive	-49.15
Barron's: Very Competitive	-34.98
Barron's: Competitive	60.94
Barron's: Less/Non Competitive	21.32
Barron's: Other	14.36

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Difference favoring 4-year group

Difference favoring community college group

- Rising four-year juniors were more likely to be at more competitive institutions.
- Community college transfer were more likely to be at less competitive institutions.

Differences in Demographics after PSM

Control	Prior to Matching Standardized Difference	After Propensity Score Matching Standardized Difference
Race: White	26.32	-3.41
Race: Latino	-5.43	0.00
Race: Asian	-18.16	8.29
Race: African American	-21.65	7.22
Race: Other	3.27	0.00
Gender: Male	8.19	0.00
Family Income: High $80k+	-32.37	11.29
Family Income: Mid High $50k-<$80k	9.95	-3.41
Family Income: Mid Low $30k-<$50k	16.27	-3.60
Family Income: Low $<30k	6.70	4.52
Family Income: Missing	0.00	-6.12

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Difference favoring community college group

Differences in Academic Factors after PSM

Control	Prior to Matching Standardized Difference	After Propensity Score Matching Standardized Difference
HS GPA: 3.5+	-37.07	3.12
HS GPA: 3.0-3.4	11.99	3.22
HS GPA: 2.5-2.9	19.51	8.41
HS GPA: <2.5	22.23	0.00
HS GPA: Missing	4.71	-12.90
ACT Math	-80.05	-5.61
ACT English	-80.11	-2.77
ACT Reading	-62.94	-3.03
ACT Science	-67.67	-3.63
ACT Composite	-84.18	-4.24
HS Program: College Prep	-27.99	0.00
HS Program: CTE	19.25	-5.21
HS Program: General	21.35	10.61
HS Program: Missing	4.65	-9.56
HS Class Rank: Top 25%	-33.93	0.00
HS Class Rank: Second 25%	26.22	6.23
HS Class Rank: Third 25%	22.49	4.94
HS Class Rank: Bottom 25%	0.00	0.00
HS Class Rank: Missing	4.71	-12.90

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Difference favoring 4-year group

Difference favoring community college group

Differences in Environmental Factors after PSM

Control	Prior to Matching Standardized Difference	After Propensity Score Matching Standardized Difference
Work Expectation: Yes	4.05	5.68
Work Expectation: No	-9.12	3.36
Work Expectation: Missing	4.86	-10.08
Aid Expectation: Yes	-2.06	5.86
Aid Expectation: No	-2.83	4.08
Aid Expectation: Missing	2.44	-10.08
Number of Siblings	-3.57	-3.48
Locale: Chicago	-27.11	0.00
Locale: Other Urban	0.00	0.00
Locale: Suburban	-29.63	0.00
Locale: Town	32.90	0.00
Locale: Rural	35.65	0.00

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Difference favoring 4-year group

Difference favoring community college group

Differences in Institutional Selectivity after PSM

Barron's Institutional Selectivity	Prior to Matching Standardized Difference	After Propensity Score Matching Standardized Difference
Barron's: Most/Highly Competitive	-49.15	-14.82
Barron's: Very Competitive	-34.98	-21.03
Barron's: Competitive	60.94	11.72
Barron's: Less/Non Competitive	21.32	8.70
Barron's: Other	14.36	10.10

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Difference favoring 4-year group

Difference favoring community college group

- Rising four-year juniors were more likely to be at more competitive institutions.
- Community college transfer were more likely to be at less competitive institutions.

Differences in Demographics

Control	Prior to Matching Standardized Difference	After Propensity Score Matching Standardized Difference	After Post-Treatment Adjustment Standardized Difference
Race: White	26.32	-3.41	-4.91
Race: Latino	-5.43	0.00	0.00
Race: Asian	-18.16	8.29	5.44
Race: African American	-21.65	7.22	0.00
Race: Other	3.27	0.00	0.00
Gender: Male	8.19	0.00	4.03
Family Income: High $80k+	-32.37	11.29	2.63
Family Income: Mid High $50k-<$80k	9.95	-3.41	7.19
Family Income: Mid Low $30k-<$50k	16.27	-3.60	0.00
Family Income: Low $<30k	6.70	4.52	0.00
Family Income: Missing	0.00	-6.12	-8.51

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Difference favoring 4-year group

Difference favoring community college group

Differences in Academic Factors

Control	Prior to Matching Standardized Difference	After Propensity Score Matching Standardized Difference	After Post-Treatment Adjustment Standardized Difference
HS GPA: 3.5+	-37.07	3.12	2.24
HS GPA: 3.0-3.4	11.99	3.22	0.00
HS GPA: 2.5-2.9	19.51	8.41	9.08
HS GPA: <2.5	22.23	0.00	0.00
HS GPA: Missing	4.71	-12.90	-6.72
ACT Math	-80.05	-5.61	-3.04
ACT English	-80.11	-2.77	-2.30
ACT Reading	-62.94	-3.03	-0.40
ACT Science	-67.67	-3.63	-0.29
ACT Composite	-84.18	-4.24	-1.14
HS Program: College Prep	-27.99	0.00	0.00
HS Program: CTE	19.25	-5.21	0.00
HS Program: General	21.35	10.61	10.21
HS Program: Missing	4.65	-9.56	-8.92
HS Class Rank: Top 25%	-33.93	0.00	0.00
HS Class Rank: Second 25%	26.22	6.23	2.22
HS Class Rank: Third 25%	22.49	4.94	3.59
HS Class Rank: Bottom 25%	0.00	0.00	0.00
HS Class Rank: Missing	4.71	-12.90	-8.92

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Difference favoring 4-year group

Difference favoring community college group

Differences in Environmental Factors

Control	Prior to Matching Standardized Difference	After Propensity Score Matching Standardized Difference	After Post-Treatment Adjustment Standardized Difference
Work Expectation: Yes	4.05	5.68	12.02
Work Expectation: No	-9.12	3.36	-7.08
Work Expectation: Missing	4.86	-10.08	-6.89
Aid Expectation: Yes	-2.06	5.86	6.17
Aid Expectation: No	-2.83	4.08	2.93
Aid Expectation: Missing	2.44	-10.08	-6.89
Number of Siblings	-3.57	-3.48	1.79
Locale: Chicago	-27.11	0.00	0.00
Locale: Other Urban	0.00	0.00	0.00
Locale: Suburban	-29.63	0.00	0.00
Locale: Town	32.90	0.00	0.00
Locale: Rural	35.65	0.00	0.00

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Difference favoring 4-year group

Difference favoring community college group

Differences in Institutional Selectivity

Barron's Institutional Selectivity	Prior to Matching **Standardized Difference**	After Propensity Score Matching **Standardized Difference**	After Post-Treatment Adjustment **Standardized Difference**
Barron's: Most/Highly Competitive	**-49.15**	-14.82	0.00
Barron's: Very Competitive	-34.98	-21.03	0.00
Barron's: Competitive	60.94	11.72	0.00
Barron's: Less/Non Competitive	21.32	8.70	0.00
Barron's: Other	14.36	10.10	0.00

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Difference favoring 4-year group

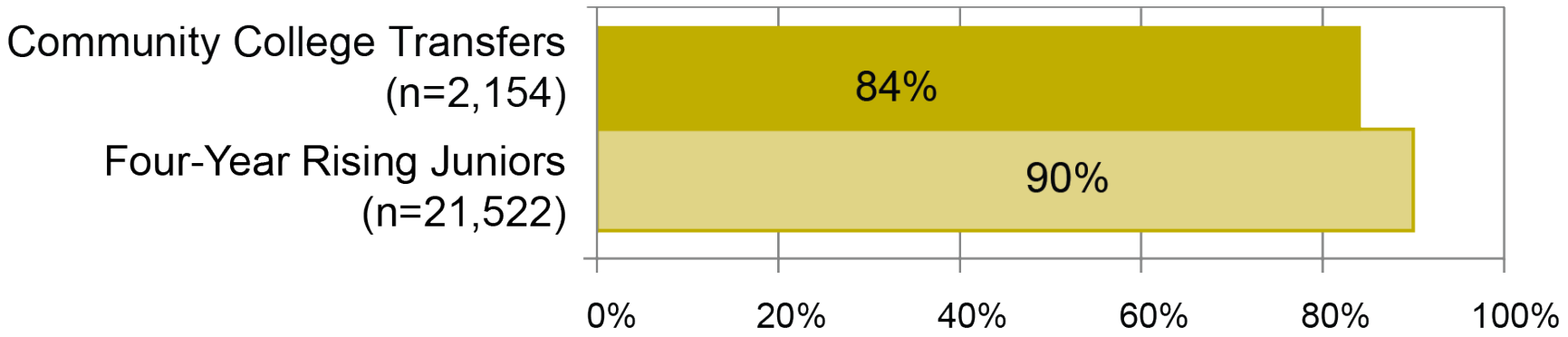
Difference favoring community college group

- After the Post-Treatment Adjustment- perfect balance on institutional selectivity.

Difference in Mean Propensity Scores

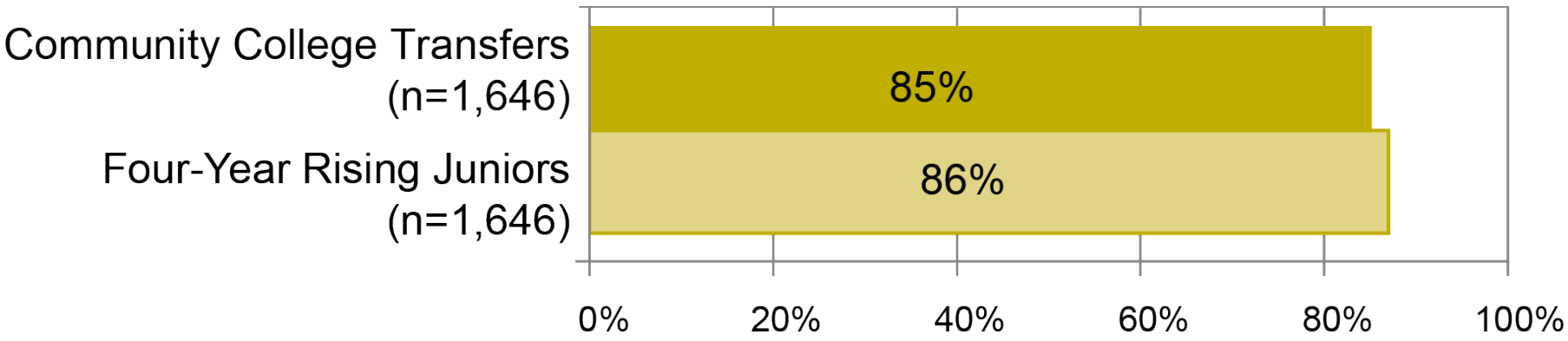
- Prior to Matching- 13 percentage point difference favoring the community college group.
- After Matching- no difference
- After Post-treatment Adjustment-no difference

Bachelor's Completion Rates Prior to Matching



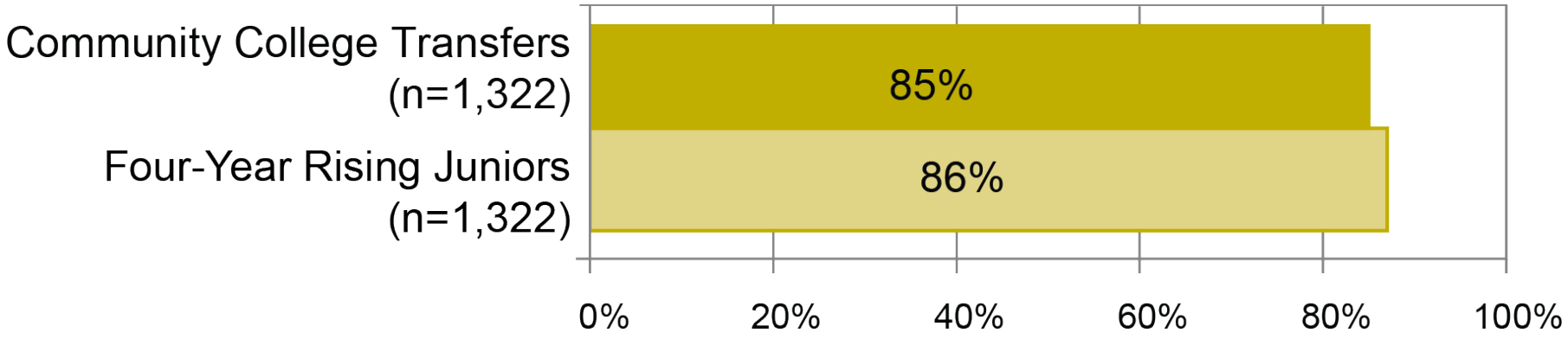
* Statistically significant based on Pearson's Chi Square

Bachelor's Completion Rates after PSM



*Pearson's Chi Square not significant

Bachelor's Completion Rates after Post-Treatment Adjustment



*Pearson's Chi Square not significant

Summary

- The profile of CC transfers was significantly different than that of the rising four-year college juniors prior to matching.
- 84% of the CC transfers had earned a bachelor's degree within 5 academic years of transitioning to a four-year college.
- After matching on key factors, *no community college penalty was evident.*

Policy Implications

- Continue to develop baseline information about statewide transfer performance.
- Set goals for institutional performance related to vertical transfer.
  - Community colleges and four-year institutions
- Help students face their financial aid future by developing information and incentives spanning undergraduate enrollment.
- Full-time enrollment

Further Investigation

- Survival analysis (time to degree completion)
- Differences in terms of majors
- Variation of the treatment effect by sub-group
- A more global view of degree completion

Resources

- http://www.unc.edu/~painter/SPSSsyntax/propen.txt
- 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.
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- 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.

Illinois Education Research Council

Southern Illinois University Edwardsville

Eric J. Lichtenberger

elichte@siue.edu

866-799-IERC (4372)

http://www.siue.edu/ierc/