Go to School? Or Go to Work?

Analysis of Two-Year and Four-Year Degree Earners

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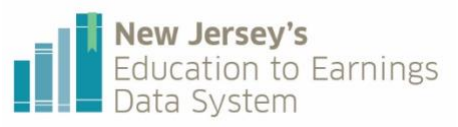

New Jersey Education to Earnings Data System
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Introduction

The motivation for our research project derived from curiosity on whether or not education pays off. And if it does pay off, how soon does it pay off and is the timeframe different for different groups of people? Education is an expensive investment, especially for young people entering college right out of high school. Therefore, it is extremely important for there to be financial transparency throughout the process. In recent years, there has been a big push toward STEM degrees, so we decided to narrow our research to students receiving degrees in these fields. We hope our research can add to transparency in the college-decision making process, particularly for STEM majors.

There are several relevant research papers that have discussed return on investment (ROI) in education, with varying results. The first paper we reviewed focused on earnings as a result of the education path an individual chooses. Reynolds (2012) used data from the National Education Longitudinal Study of 1988 to analyze earnings. The study found that students who began their college careers at two-year colleges had lower earnings. And more specifically, these lower earnings were concentrated among women. The second paper we reviewed (Xu et al., 2016) found that, at least in the short-run (8-years after starting college), the ROI of attending community colleges was not significantly different from that of attending a four-year institution. The final paper we reviewed for our research project analyzed data from North Carolina. Liu et al. (2015) found that the average increase in quarterly income of both an associate's degree and a bachelor's degree are higher for women than for men. Although there is a variety of literature regarding ROI in education, our research specifically addresses STEM majors, which is missing from current literature.

As mentioned, our research specifically explores the differences in ROI of STEM majors between 2-year and 4-year degree earners. This research is important for several stakeholders, but our main focus for this project was looking at the college-decision making process through the lens of a recent high school graduate and trying to determine which paths maximize future net earnings. However, we also think our research project could help provide guidance to the state legislature for allocating funds between two and four-year institutions. Our research also provides insight into who is graduating and working in-state, which is important for tax purposes and economic growth.

Data/Model

We used the following datasets for our project:

1. New Jersey OSHE Completions
2. New Jersey UI Wages
3. 2010, 2011, and 2012 American Community Survey 1-Year Estimates, Table ID: S2002
4. New Jersey OSHE Undergraduate In-State Full-Time Annual Tuition and Fees

In order to narrow down our dataset and arrive at our analytical sample, we applied the following filters:

- STEM Degree Earners with CIP Codes: 01-Agriculture, 03-Natural Resources & Conservation, 11- Computer & Information Sciences & Support Services, 14-Engineering, 15- Engineering Technologies/Technicians, 21-Technology

Education/Industrial Arts, 25-Library Sciences, 26-Biological & Biomedical Sciences, 27-Mathematics & Statistics, 40-Physical Sciences, 41-Science Technologies/Technicians

- 2-year degree earners under age 24, who took less than 4 years to earn their degree
- 4-year degree earners under age 26, who took less than 6 years to earn a degree
- Public university graduates only.

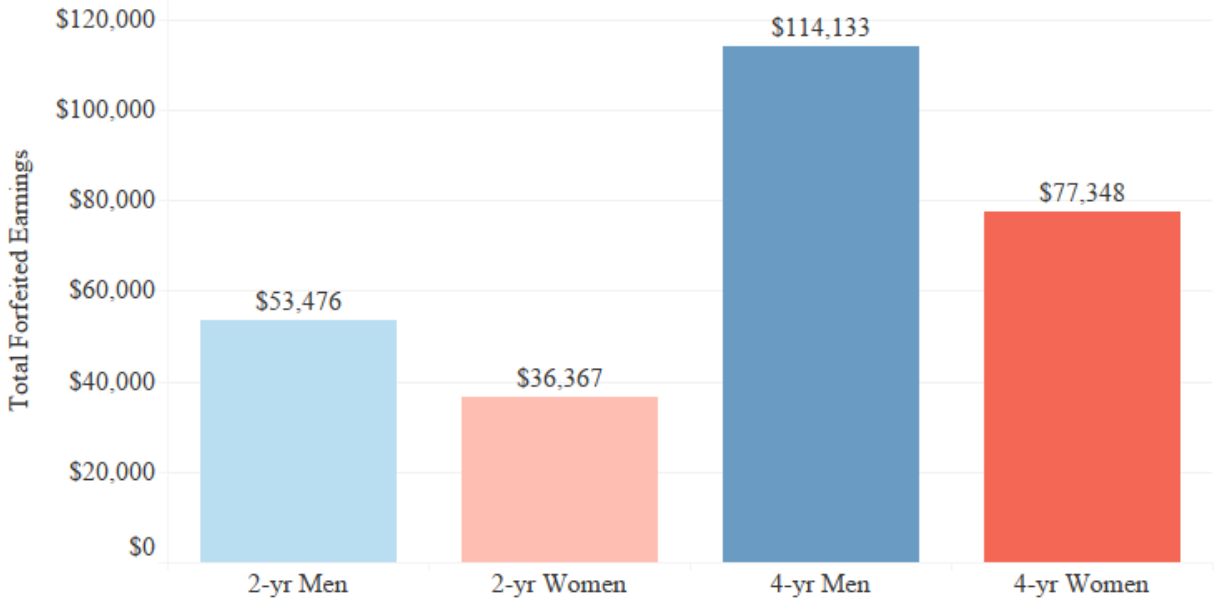
After applying the filters, our dataset represented traditional two and four-year degree earners from public universities with STEM degrees. We are cognizant that in the real-world, people attend college at different stages of life and with different sets of work experiences. This especially applies to two-year students. However, because we want the clearest possible comparison of the association between college and earnings, we restricted our dataset in the above manner to two sets of students at young ages who have very little work experience before college.

As a result, our dataset allows us to analyze the differences in cumulative net earnings between two-year and four-year STEM degree earners, which is the main focus of our project. We use a cohort analysis to track wages and calculate net cumulative earnings from 2010-2019.

Our analysis heavily relies on net cumulative earnings. In order to calculate net cumulative earnings, we first calculated forfeited earnings. To do this, we summed median earnings from men and women across all quarters they attended school. The following table summarizes the data we used:

Opportunity Cost of Forfeited Earnings				
	2-yr Women	**2-yr Men**	**4-yr Women**	**4-yr Men**
2012Q4			$6,828	$10,157
2012Q2			$6,828	$10,157
2012Q1			$6,828	$10,157
2011Q4			$6,833	$10,062
2011Q2			$6,833	$10,062
2011Q1			$6,833	$10,062
2010Q4	$6,766	$9,981	$6,766	$9,981
2010Q2	$6,766	$9,981	$6,766	$9,981
2010Q1	$6,766	$9,981	$6,766	$9,981
2009Q4	$5,357	$7,844	$5,357	$7,844
2009Q2	$5,357	$7,844	$5,357	$7,844
2010-2012 ACS 1-Year Estimates Subject Tables, Table ID: S2002				

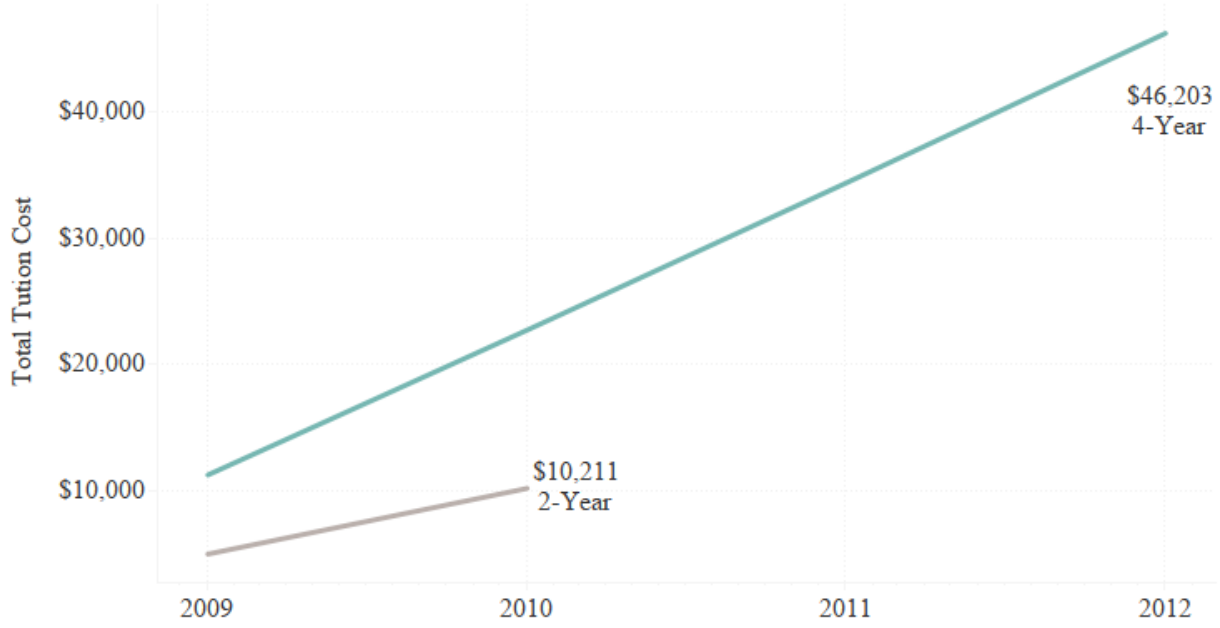
Summarizing this table, we get the following forfeited earnings by gender and degree type.



Next, we calculated total tuition and expense costs for two and four-year graduates. We used NJ OSHE data to calculate these costs.

Tuition and Expenses		
	2-year	4-year
2012		$11,830
2011		$11,642
2010	$5,198	$11,457
2009	$5,013	$11,275

Total tuition and expense costs are summarized in the chart below.



We then used the following equation to calculate cumulative net earnings:

Cumulative Net Earnings = Total Earnings - Total Cost

Tution + Expenses+ Forfeited

Another metric we used in our research was attrition. We calculated attrition rates by calculating the percent of graduates missing from in-state covered earnings data after graduation.

Clustering Approach

As an extension of our analysis we wanted to understand student outcomes more holistically. What are the latent clusters or groups that exist with respect to different outcomes of interest? We also assessed how these clusters differ with respect to their composition (in terms of demographic characteristics, majors, etc.) and relevant outcomes. We selected the following four outcomes:

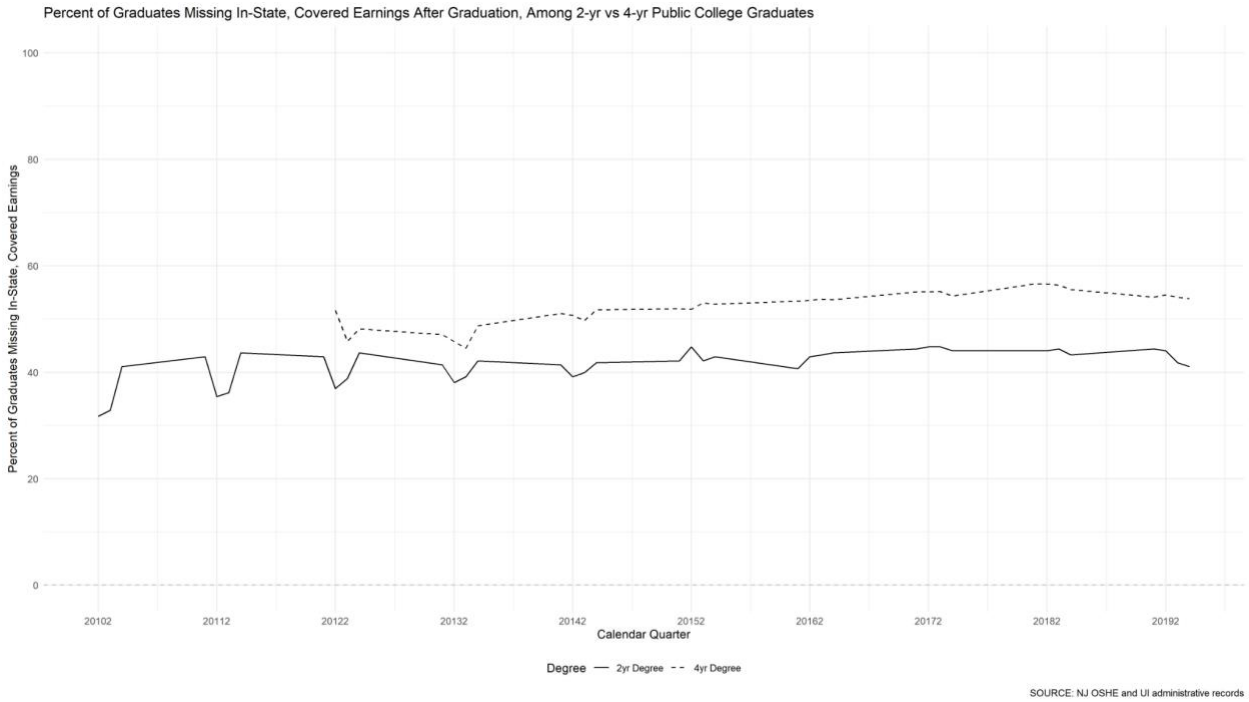
- (1) Average Quarterly Wages (excluding eligible quarters with no data)
- (2) Average Quarterly Wages (imputing zero for eligible quarters with no data)
- (3) Retention Rate (% of quarters with income)
- (4) Income Growth Rate ([final Quarter income - Q1 income]/number of eligible quarters)

Please note that in this context, “eligible quarters” varies by cohort: For the two-year degree graduates : 2010 Q3 - 2019 Q4; for the four-year degree graduates: 2012 Q3 - 2019 Q4.

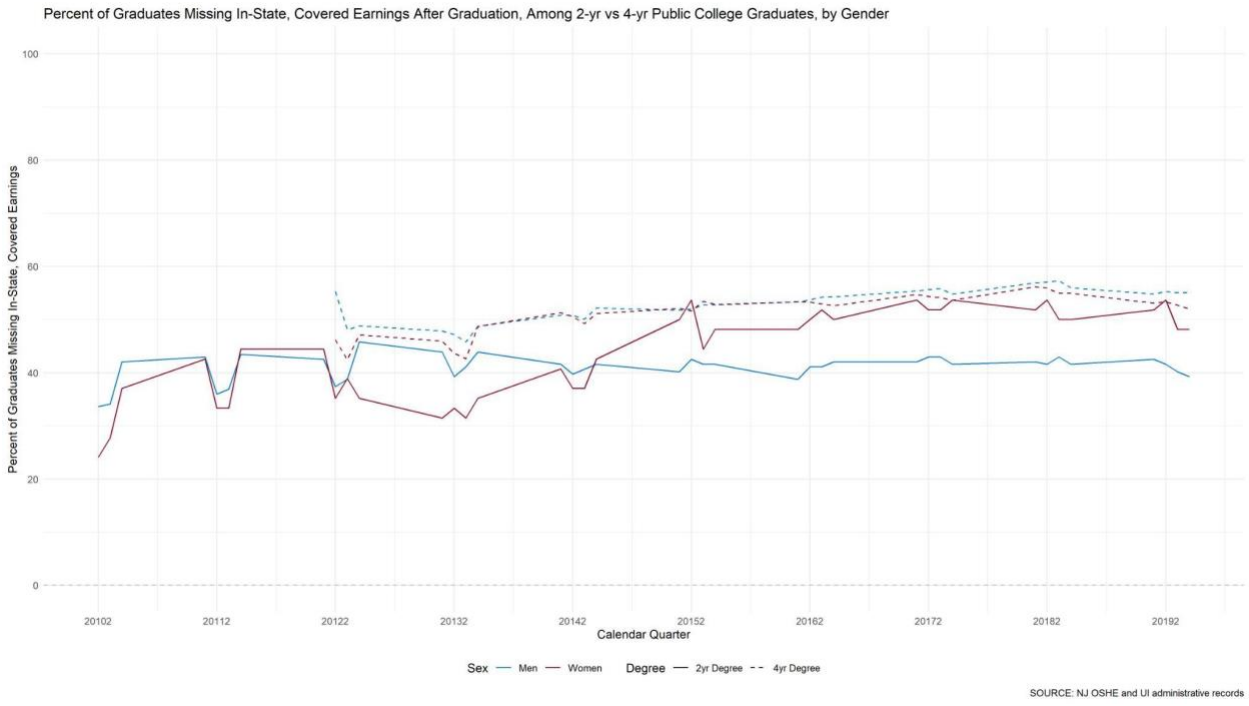
The four outcomes were coded as numeric variables. Next, we ran k-means clustering with different values of k (centers). We used an elbow plot to identify a k=5 clustering solution. We believe that this solution balances the trade-offs between creating relatively homogeneous clusters with having a reasonable number of clusters that can be interpreted.

Key Findings

Our research yielded several interesting takeaways. First, we looked at differences in attrition rates between two-year and four-year degree earners. Based on our data, four-year degree earners are more likely to be missing from in-state covered earnings after graduation. Additionally, the percentage of four-year degree earners missing from the data set increases over time whereas the attrition rate for two-year degree earners is relatively flat over time.

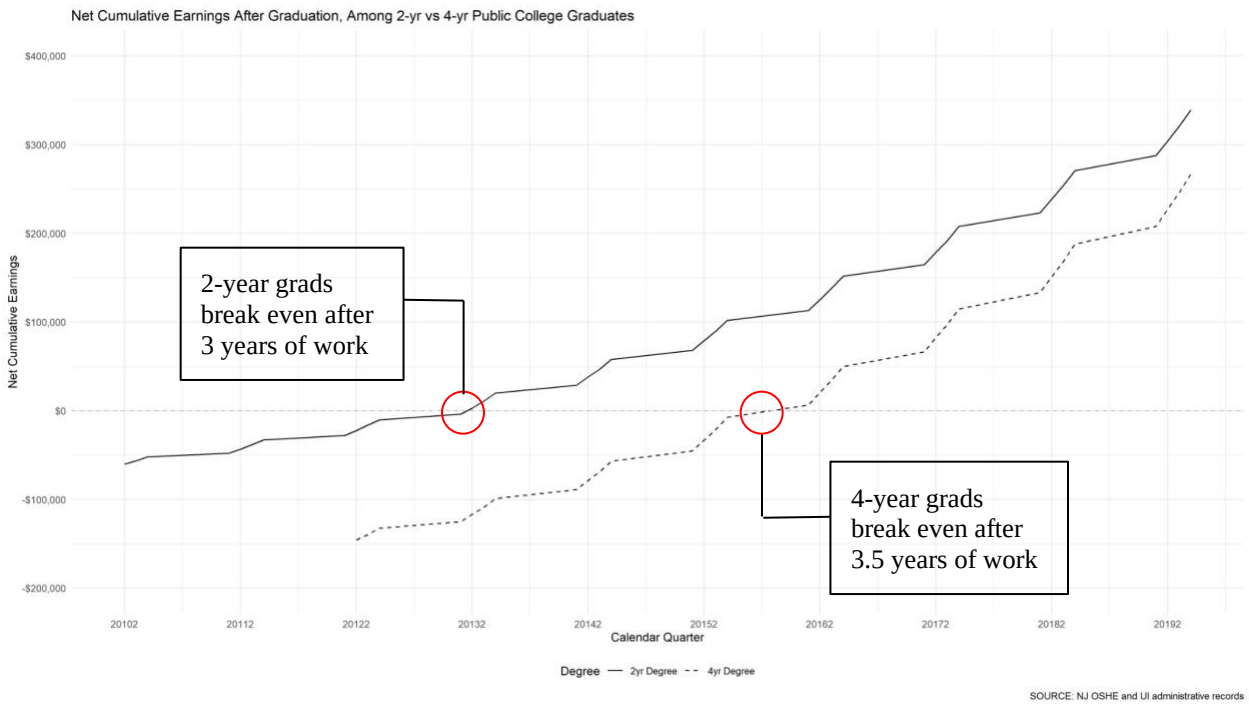


We also looked at attrition rates based on degree type and gender. From this, we found that women with two-year degrees have higher rates of missing wages than men with two-year degrees. In contrast, women and men with four-year degrees have similar rates of missing wages.

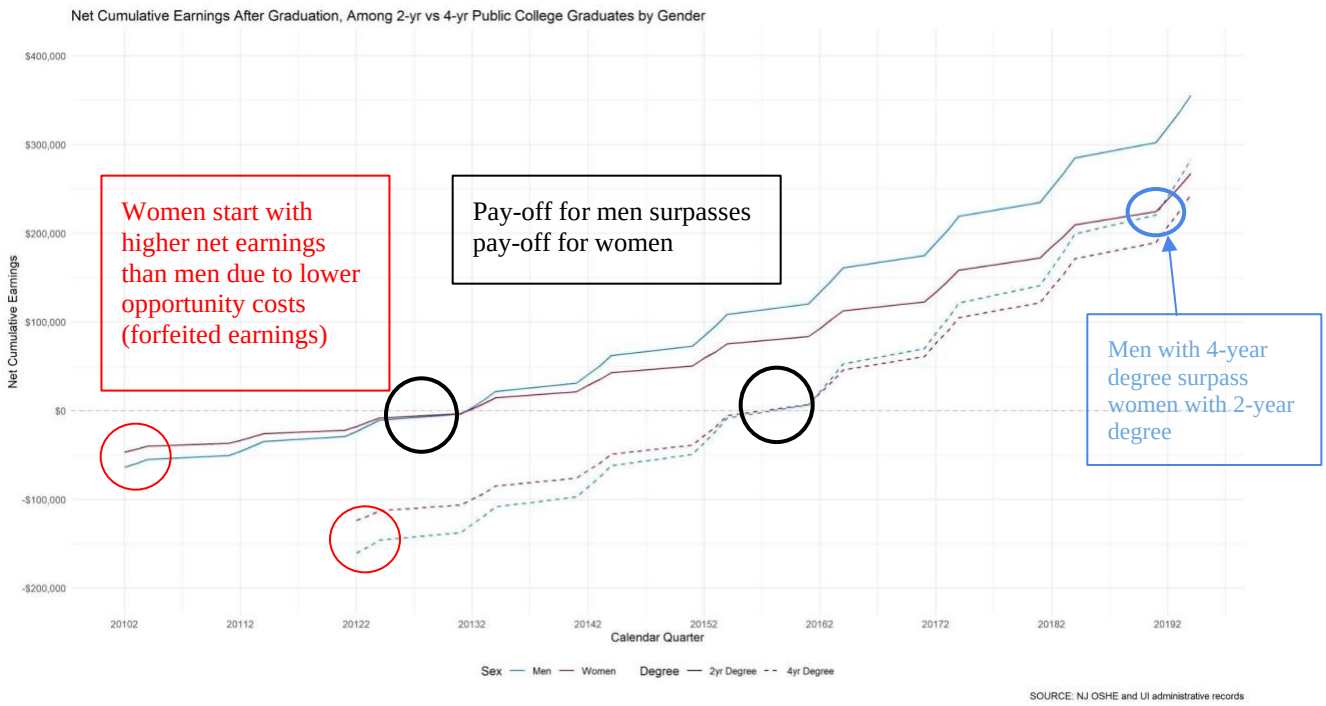


The main takeaway from our analysis on attrition rates between degree type and gender is that many graduates are either leaving the state or not participating in the workforce after graduation. This helps set the stage for our main analysis regarding cumulative net earnings.

First, we looked at the net cumulative earnings for two-year graduates vs four-year graduates over time. The data show that two-year graduates break even (net cumulative earnings of $0) after three years in the labor force. Comparatively, four-year graduates break even after 3.5 years in the workforce. Although the two-year graduates break even more earlier in their career, the four-year graduates' net earnings increase at a faster rate. Thus, net earnings between the two groups are converging as time progresses.



Next, we analyzed gender differences. We found that even though women have lower opportunity costs, and therefore start with a less negative net cumulative earnings compared to their male counterparts, women and men break even around the same time--3 years out from graduating for 2 year degree earners and 3.5 years out from graduating for 4-year degree earners. Net earnings for men with two-year degrees surpass net earnings for women with two-year degrees before the break-even point. Net earnings for men with four-year degrees surpass net earnings for women with four-year degrees right around the break-even point. For both degree types, men's net cumulative earnings increase at a faster rate than women's. After 7 years in the labor force, net earnings for men with four-year degrees surpass net earnings for women with two-year degrees, even though these women have 2 extra years of earnings.



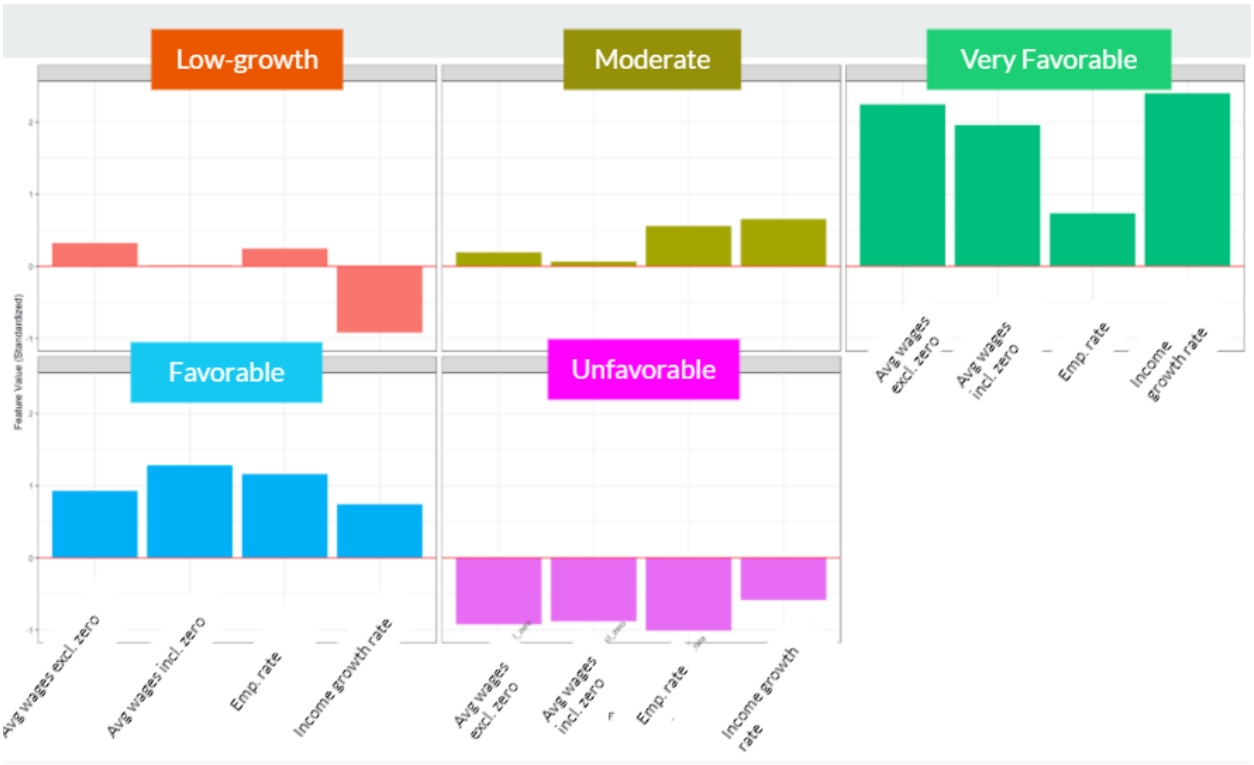
Our findings suggest the students in the STEM fields should pursue a four-year degree in order to maximize net cumulative earnings in the long-run. Even though four-year degree earners face higher initial costs, their higher earnings help increase net cumulative earnings at a faster rate compared to two-year degree earners. Based on the trends in our data, cumulative net earnings for four-year degree earners would surpass two-year degree earners sometime shortly after 2019Q2 (most recent data available at time of analysis). Education is even more important for women earning STEM degrees. Cumulative net earnings for women with four-year degrees almost match that of women with two-year degrees in 2019Q2, whereas there is a much larger gap between men with four-year degrees and men with two-year degrees.

Regarding our findings on net cumulative earnings, we would recommend that funding should be directed to four-year STEM programs over two-year STEM programs because they provide higher earnings. However, four-year earners have higher rates of missing data, so there is also an argument to fund two-year STEM programs because those students are more likely to contribute to New Jersey's workforce.

Clustering Results

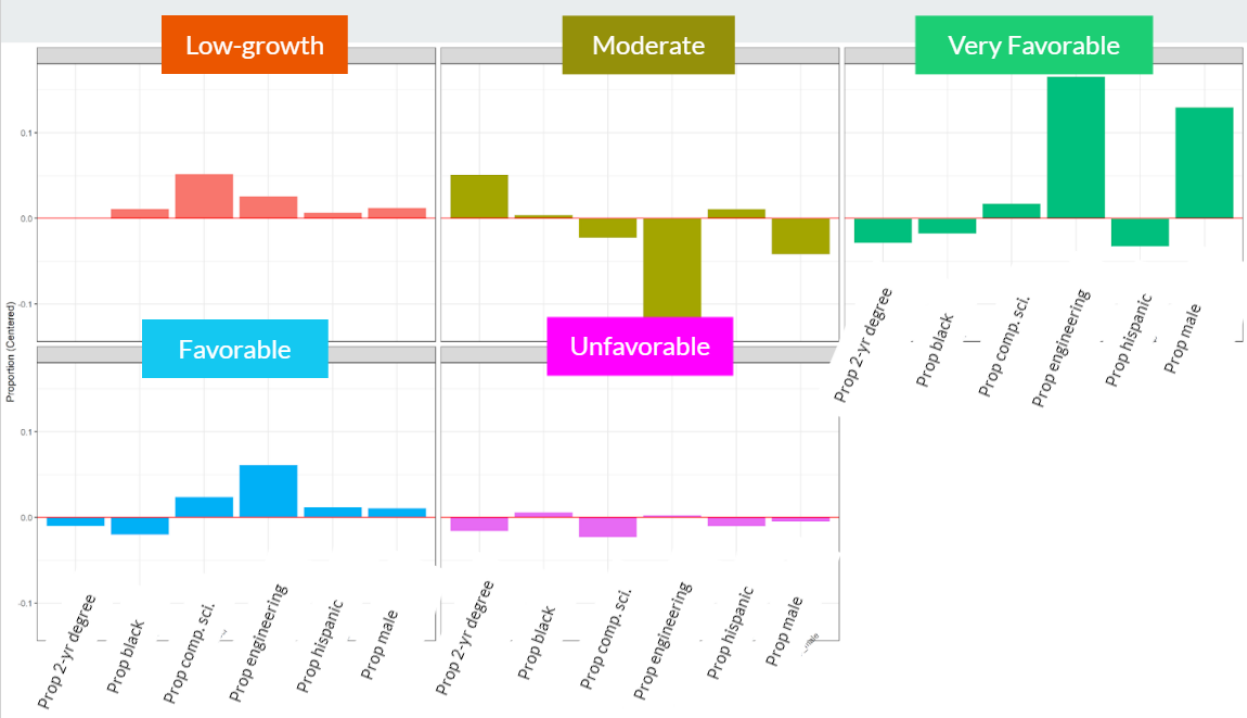
The k-means clustering procedure identified five key clusters with respect to the four outcomes. These results are displayed in the plot below. The columns represent Average Quarterly Wages (excluding zero), Average Quarterly Wages (including zero), Retention Rate, and Income Growth Rate. Higher outcome values indicate more favorable outcomes for the cluster relative to

the mean. The labels of the clusters summarize the values across all four outcomes: (1) Low growth, (2) Moderate, (3) Favorable, (4) Very Favorable, and (5) Unfavorable.



Next, we identified characteristics of graduates in each cluster. In the plot below, each cluster is analyzed for the relative representation of demographic characteristics and field of study. For example, a high relative proportion majoring in engineering means that the cluster contains relatively more engineering majors compared to the overall sample.

What groups of graduates are in these clusters? Both clusters with favorable outcomes show a relatively high rate of engineering majors. Noticeable relative differences occurred in the distributions of gender, degree type, and race/ethnicity. Together, the results show that favorable outcomes seem to mostly be affected by field of study, gender, and degree type. We acknowledge that field of study may be related to certain demographic and social characteristics.



Caveats

The scope of our analysis is limited to a specific subpopulation of graduates and workers. Additionally, inference from our data should always consider certain limitations and caveats in the data selection process. For example, we did not control for re-enrollments of degree earners into graduate school. People who earned a 4-year degree may have gone back to get their master's degree. Another caveat is the imbalance between group sizes in our analysis. Notably fewer 2-year degree than 4-year degree earners were included in our sample. This may stem from the fact that 2-year degree earners are usually less "traditional" students that fit certain age criteria. Many associate degrees are completed by students who re-enroll later in life to finish a degree or as a means to get a higher paying job. For the interpretation of missing wages, underlying reasons are hard to pinpoint. Besides leaving the state of New Jersey for work, missing wages can result from unemployment, self-employment or childbearing for women. When considering return on investment, net earnings would need to be adjusted for inflation and individual financial differences such as scholarships or student loans.

Possible Extensions

Future extensions of this project should include a longer follow-up period. The timeframe of our analysis does not capture the predicted cross-over point of wages between 2-year and 4-year degree earners. A wider time window would capture where the total earnings of the two cohorts intersect. We suggest two other possible extensions of this work: (1) considering the data from other regions and states, which may

yield different results; (2) and considering other majors and fields of studies, to assess whether the returns to education may vary by gender.

References

Liu, Vivian Y.T., Clive R. Belfield, and Madeline J. Trimble. 2015. "The Medium-Term Labor Market Returns to Community College Awards: Evidence from North Carolina." *Economics of Education Review* 44 (February): 42–55. https://doi.org/10.1016/j.econedurev.2014.10.009.

Reynolds, C. Lockwood. 2012. "Where to Attend? Estimating the Effects of Beginning College at a Two-Year Institution." *Economics of Education Review* 31 (4): 345–62. https://doi.org/10.1016/j.econedurev.2011.12.001.

Xu, Di, Shanna Smith Jaggars, and Jeffrey Fletcher. 2016. "How and Why Does Two-Year College Entry Influence Baccalaureate Aspirants' Academic and Labor Market Outcomes?" Community College Research Center, Teachers College, Columbia University.

Go to school? Or go to work?

Analysis of Two-Year and Four-Year Degree Earners

Group 2: Hannah Elder, John Lee, Juliane Vega, Kylee Teague, and Sarah Madigan

1

Motivation: Does education pay off?

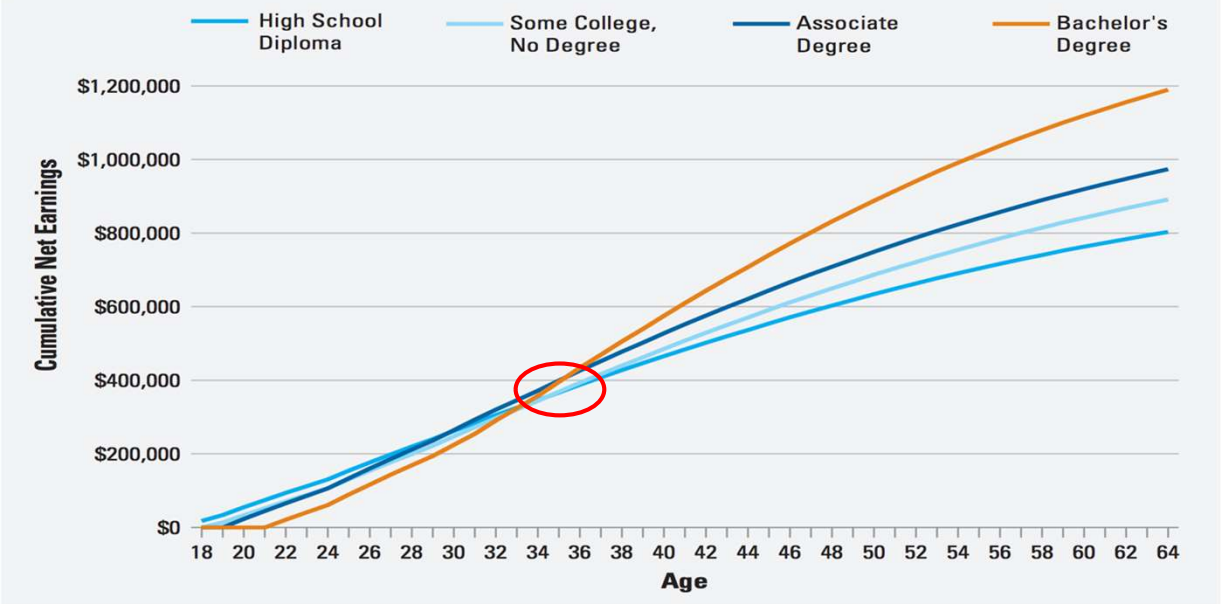


Figure: Estimated cumulative full-time earnings (in 2014 dollars) net of forgone earnings and payment for tuition and fees and books and supplies, by education level

Source Article: Investment in a college degree pays off by age 34 - Utah System of Higher Education (ushe.edu)

2

We used data spanning from 2010-2019 to analyze net cumulative earnings

- 2-year graduates begin earning in the first quarter of our data set
- 4-year graduates were still in school and don't show up in our data until 2012

3

What are Cumulative Net Earnings?

Total Cost:
Direct costs: tuition + expenses
+
Opportunity costs: forfeited earnings

Total Earnings

Cumulative Net Earnings = Total Earnings - Total Cost

4

Understanding return on investment in education has important policy implications

- **For students:** Given opportunity costs, how should I allocate my time and tuition?
- **For state legislature:** How should public funding for education be allocated between: 4-year institutions vs. 2-year institutions?

5

Relevant research has conflicting results

- Students who begin their college careers at 2-year colleges have lower earnings
  (Reynolds, 1988)
- In the short-run, the return on investment for attending community college is not significantly different from that of attending a 4-year institution
  (Xu et al., 2016)

6

Subsetting our dataset

OSHE Completion Data

STEM Degree CIP Codes:

- 01-Agriculture
- 03-Natural Resources & Conservation
- 11-Computer & Information Sciences & Support Services
- 14-Engineering
- 15-Engineering Technologies/Technicians
- 21-Technology Education/Industrial Arts
- 25-Library Sciences
- 26-Biological & Biomedical Sciences
- 27-Mathematics & Statistics
- 40-Physical Sciences
- 41-Science Technologies/Technicians

2-Year Degree Earners

- under age 24
- Less than 4 years to earn degree

4-Year Degree Earners

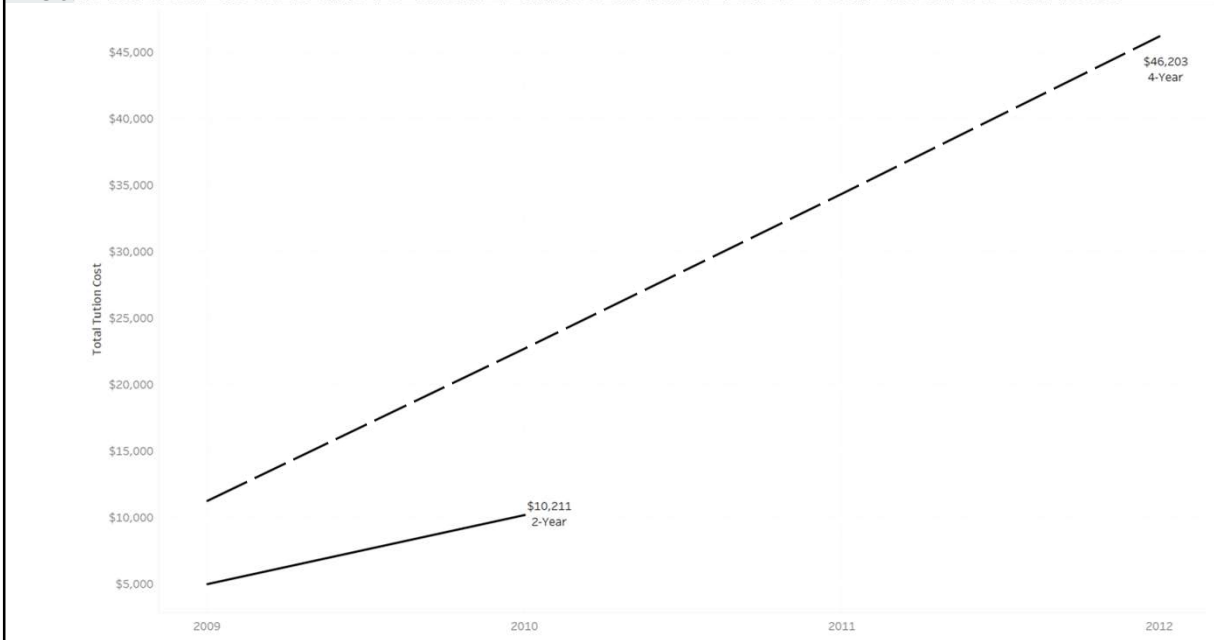
- under age 26
- Less than 6 years to earn degree

Public Universities only

Traditional 2 & 4-year degree earners from public universities with STEM degrees

7

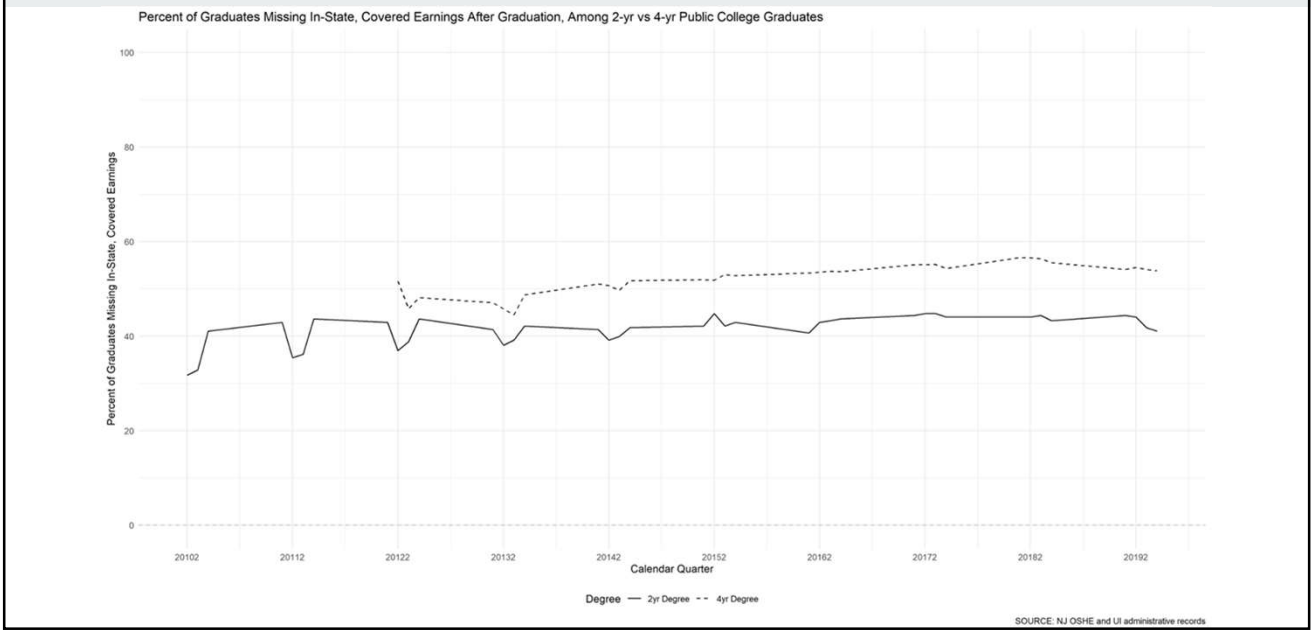
Total tuition cost is more than 4 times higher for 4-year degree earners



Source: https://www.state.nj.us/highereducation/dashboard-tution.shtml

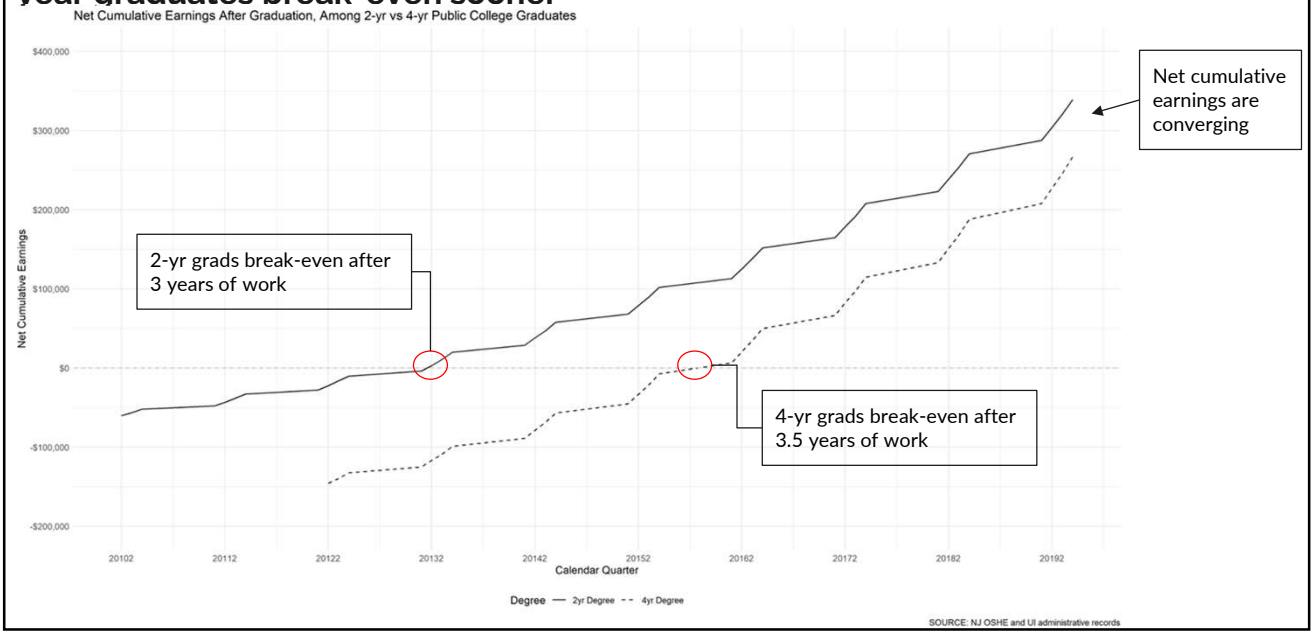
8

Graduates with 4-year degrees are more likely to leave NJ after graduation



9

Net cumulative earnings for 4-year graduates increased at a faster rate, but 2-year graduates break-even sooner



10

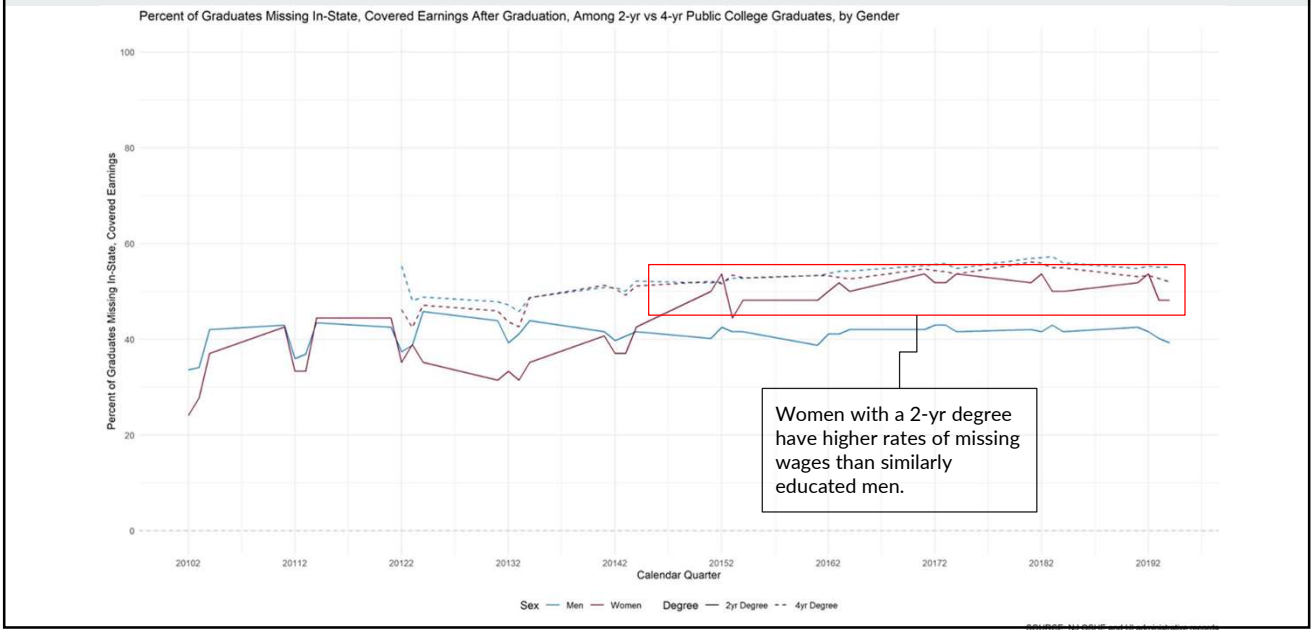
Taking it a step further, we decided to look at gender differences within our cohorts

*"Another notable gender difference is that the **relative return from education in the 20s is substantially large for women**, whereas it is statistically zero for men, mainly because **the earnings of less-educated young women are much lower than correspondingly less-educated men.** The latter is likely driven, in part, by childbearing and the weak labor force attachment of less-educated women in their 20s. This pattern may, in turn, **lower the perceived opportunity cost** for women in going to college."*

Source: Tamborini, Christopher R., ChangHwan Kim, and Arthur Sakamoto. 2015. "Education and Lifetime Earnings in the United States." *Demography* 52: 1383–1407.

11

Sex differences for missing in-state covered earnings only show in 2-yr graduates



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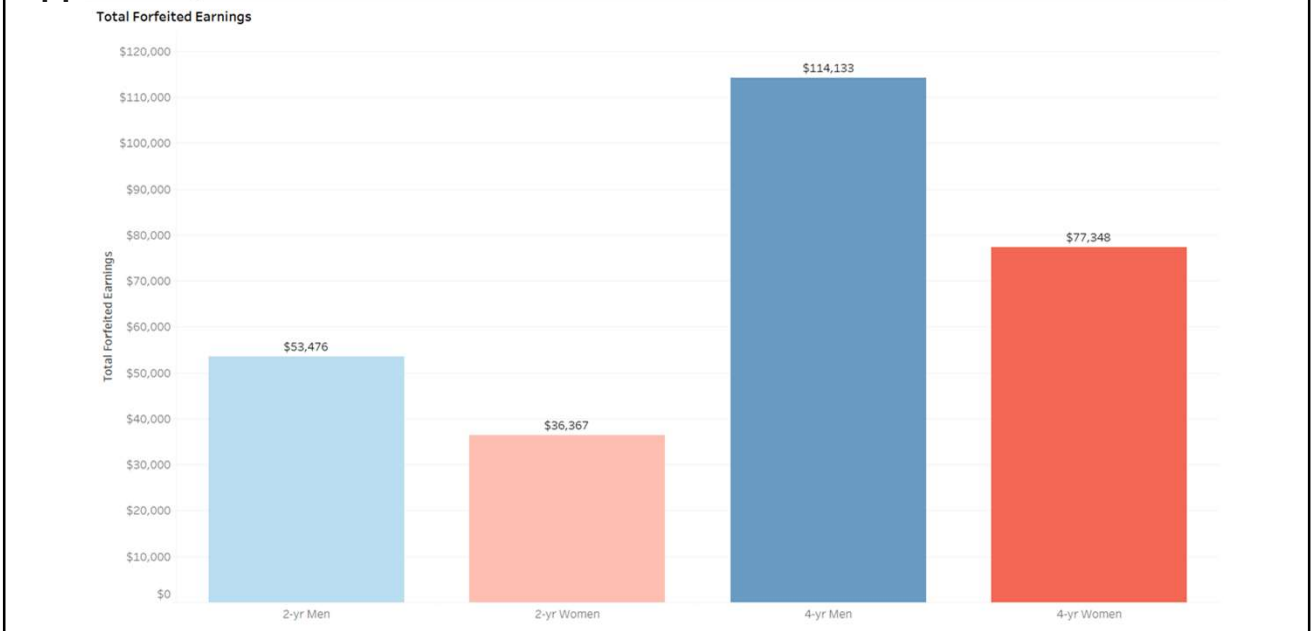
1

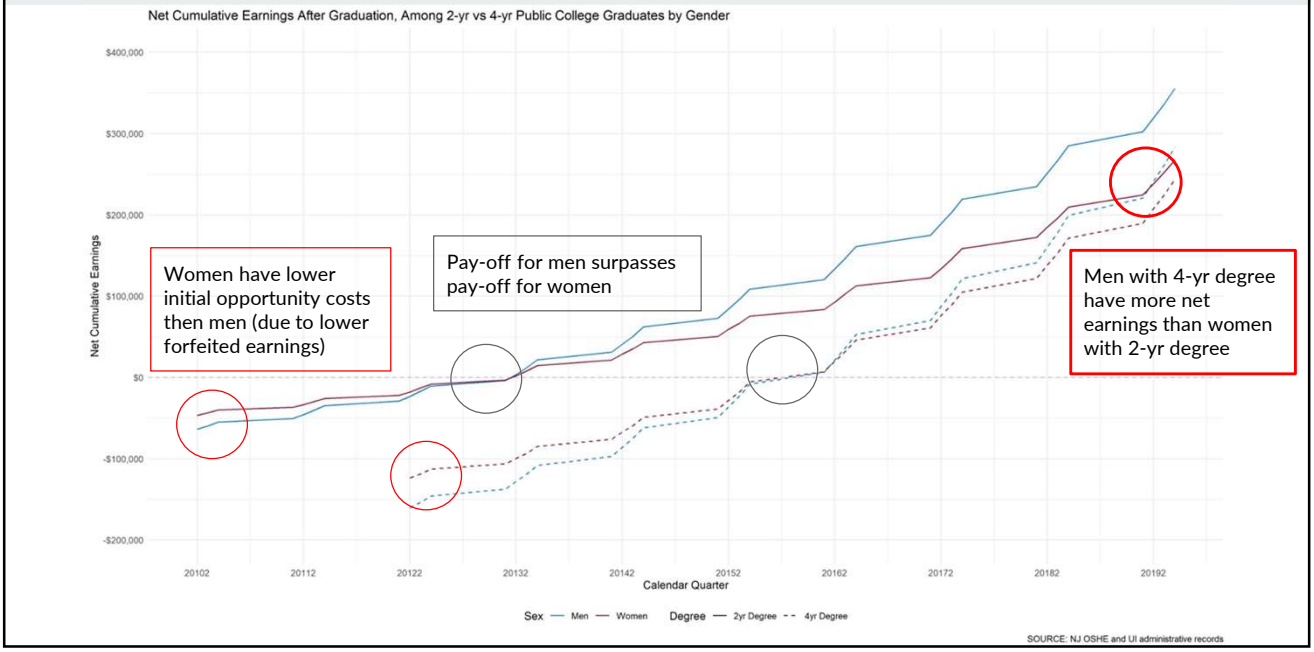
Opportunity costs are lower for women



Source: ACS 1-Year Estimates Subject Tables, TableID: S2002

13

Men have higher gains from more education



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Slide 13

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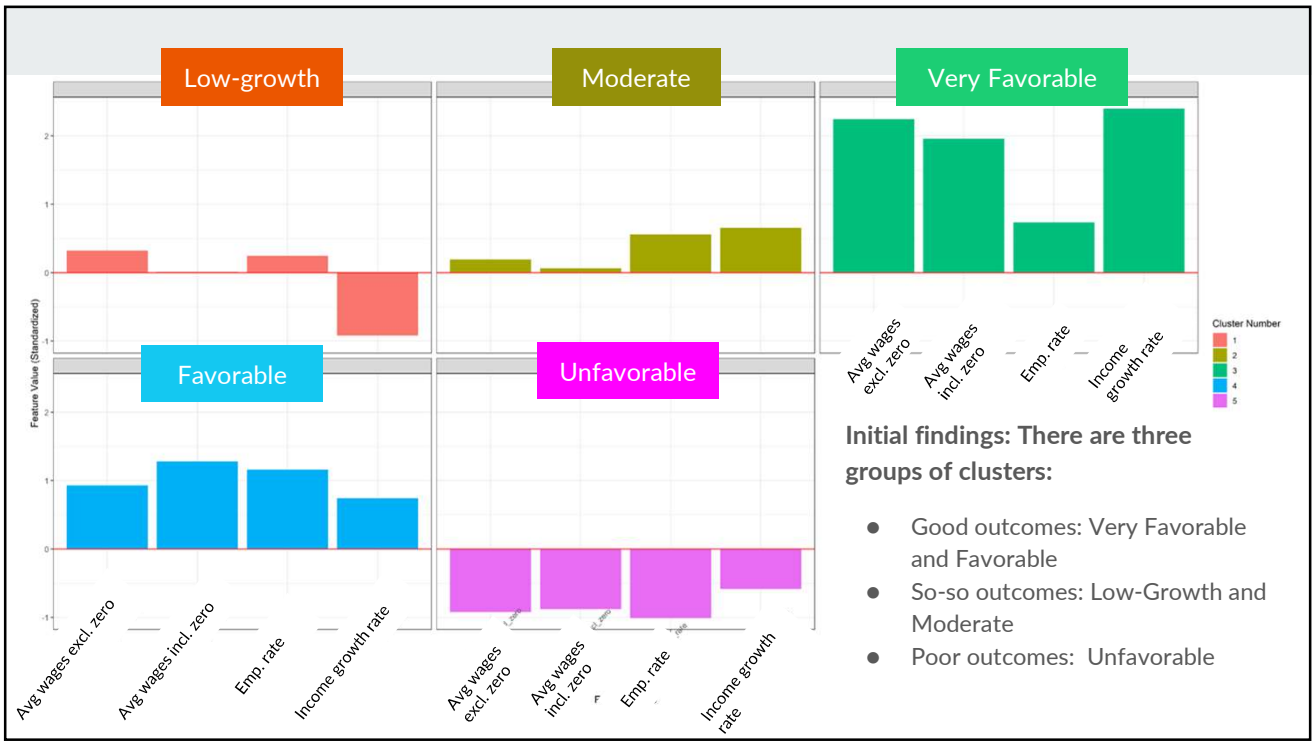
1 This summarizes a lot of info- but part of me wonders if it's "too much" for J. She likes one idea per slide. I wonder if the bottom panel might be enough. Others?
David Seith, 7/20/2021

We applied k-means clustering to better understand the outcomes

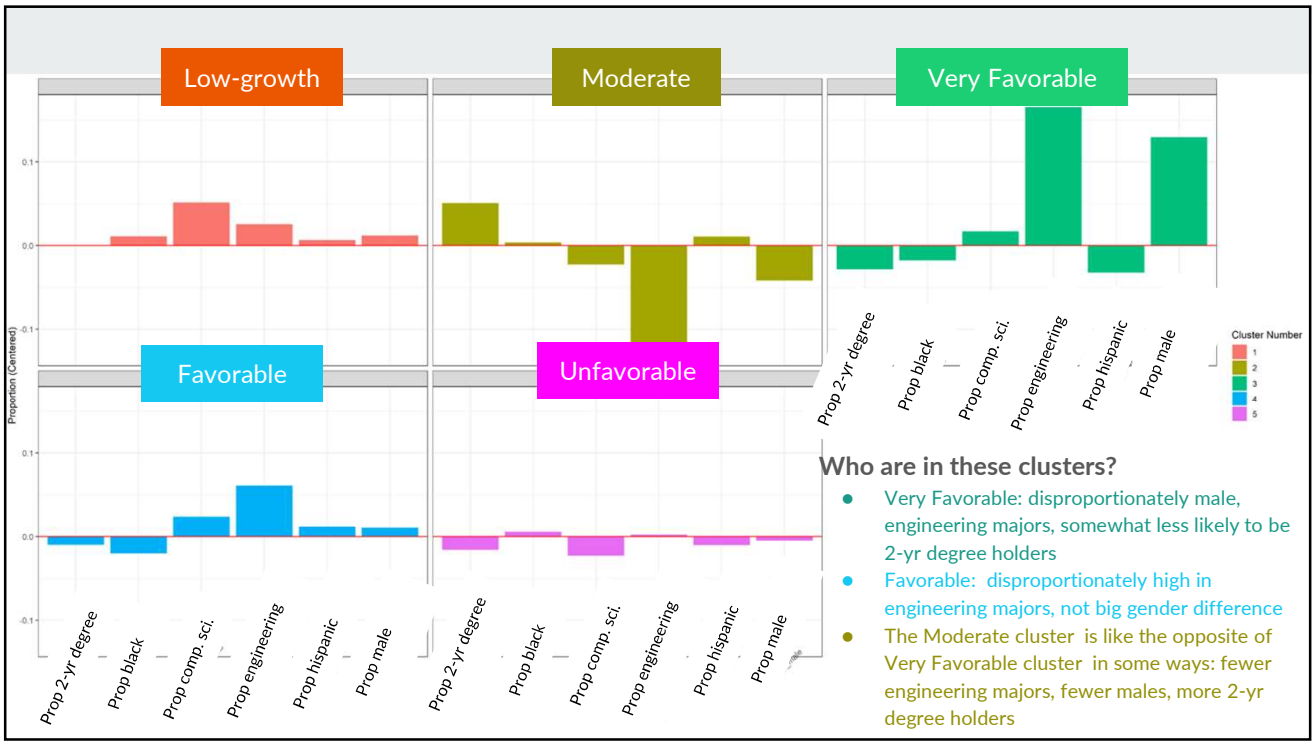
- **Motivation:**
  - To perform an exploratory analysis of the kinds of clusters (of outcomes) that exist
- **Policy Relevance:**
  - To understand which groups tend to achieve more favorable outcomes
- **Approach:**
  - Select four numeric features (outcomes), run k-means w/ different values of k (centers)
  - Use an elbow plot to identify a good clustering solution (w/ diminishing returns to k)
  - Compare the clusters using facet wrap in ggplot (conditional means/proportions by cluster)

Clustering on the Basis of Four KPIs

- **Numeric Features (Four Outcomes):**
  - (1) Average Quarterly Wages
    - (excluding eligible quarters w/ no data)
  - (2) Average Quarterly Wages
    - (imputing zero for eligible quarters w/ no data)
  - (3) Retention Rate
    - (% of quarters w/ income)
  - (4) Income Growth Rate
    - ([final Q income - Q1 income]/number of eligible quarters)


Low-growth
Moderate
Very Favorable
Favorable
Unfavorable
Feature Value (Standardized)
Avg wages excl. zero
Avg wages incl. zero
Emp. rate
Income growth rate
Cluster Number
1
2
3
4
5
Initial findings: There are three groups of clusters:
Good outcomes: Very Favorable and Favorable
So-so outcomes: Low-Growth and Moderate
Poor outcomes: Unfavorable

17


Low-growth
Moderate
Very Favorable
Favorable
Unfavorable
Proportion (Centered)
Prop 2-yr degree
Prop black
Prop comp. sci.
Prop engineering
Prop hispanic
Prop male
Cluster Number
1
2
3
4
5
Who are in these clusters?
Very Favorable: disproportionately male, engineering majors, somewhat less likely to be 2-yr degree holders
Favorable: disproportionately high in engineering majors, not big gender difference
The Moderate cluster is like the opposite of Very Favorable cluster in some ways: fewer engineering majors, fewer males, more 2-yr degree holders

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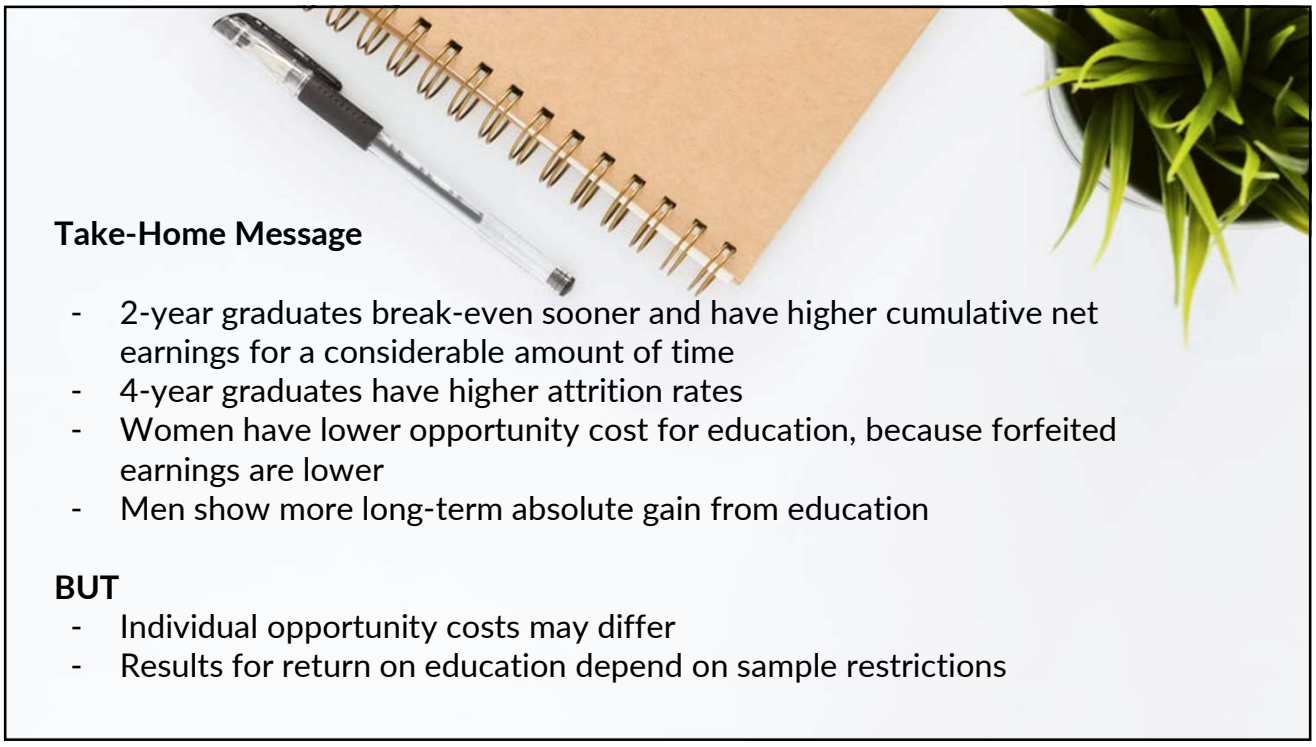
Caveats

- We did not check for re-enrollments
  - Ex: People with 4-yr degrees might go back to get their master's degree
- Imbalance between group sizes
  - Less "traditional" 2-yr degree graduates that graduate in Q2 and fit certain age criteria: Is the restriction too selective?
- Missing wages have different underlying reasons
  - Leaving state
  - Unemployed, self- employed
  - Child bearing
- Net earnings could be very different across the board (scholarships, loans, etc.)
- We did not adjust for inflation

Outlook for further analysis

- Longer follow-up period
- Where do total earnings intersect between the two cohorts?



Take-Home Message

- 2-year graduates break-even sooner and have higher cumulative net earnings for a considerable amount of time
- 4-year graduates have higher attrition rates
- Women have lower opportunity cost for education, because forfeited earnings are lower
- Men show more long-term absolute gain from education

BUT

- Individual opportunity costs may differ
- Results for return on education depend on sample restrictions

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References

Liu, Vivian Y.T., Clive R. Belfield, and Madeline J. Trimble. 2015. "The Medium-Term Labor Market Returns to Community College Awards: Evidence from North Carolina." *Economics of Education Review* 44 (February): 42–55. https://doi.org/10.1016/j.econedurev.2014.10.009.

Reynolds, C. Lockwood. 2012. "Where to Attend? Estimating the Effects of Beginning College at a Two-Year Institution." *Economics of Education Review* 31 (4): 345–62. https://doi.org/10.1016/j.econedurev.2011.12.001.

Xu, Di, Shanna Smith Jaggars, and Jeffrey Fletcher. 2016. "How and Why Does Two-Year College Entry Influence Baccalaureate Aspirants' Academic and Labor Market Outcomes?" Community College Research Center, Teachers College, Columbia University.

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