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Competition amongst Same-state Post-Secondary Institutions: Student Pool Dynamics and Specialization through Fields

Helena Jin
helenajin888@gmail.com

ABSTRACT

Post-secondary institutions have historically been recognized to have a heavy connection with the strength of a country's industries and economic well-being. Within the United States, the competitive environment of the higher education industry, which has had more than 3,900 institutions since 2019, has led many to recognize it through the lens of a market model. While various researchers have conducted studies surrounding the importance and value of the post-secondary education system, how institutions of different sectors and institutional types within the same state compete against one another remains underexamined.

Thus, this paper, through empirical analysis of 2006-2024 enrollment and completion data from the Integrated Postsecondary Education Data System (IPEDS), investigates whether public and private institutions as well as non-liberal arts and liberal arts institutions in the same state compete for students in the same student pool and whether such institutions attempt to gain a comparative advantage by specializing in specific fields.

The findings demonstrate that differences in sector and institutional type are linked to limited competition for the same student pool and that institutions do not specialize in a field of study through increasing the number of graduates of that field. Instead, the results reveal a decreasing trend in graduates of the humanities field in all institutions, suggesting government intervention in maintaining the provision of such programs. This descriptive evidence paves the way for future research.

INTRODUCTION

The strength of a country's post-secondary education system often ties strongly to the strength of the county's individual industries. Notably, higher education within the United States has undergone various transformations throughout the past century, making it one of the most renowned systems in the world. Since 2019, the number of degree-granting postsecondary institutions within the US has increased to more than 3,982 —which includes 1,625 public four-year and two-year colleges, 1,660 private nonprofit

four-year and two-year schools, and 697 for-profit schools (US News 2021). From 2020-2021, the total revenue generated by these institutions was $993 billion (National Center for Education Statistics 2023).

Historically, the higher education industry has often been framed as a market model, where competition for talented students, prestigious titles and endowments for research drives the behaviour and actions of individual institutions (Krücken 2019). Consequently, researchers treat institutions as firms that employ various strategies with the goal of overtaking their competitors, and students are viewed as consumers who aim to invest in their education. To be exact, the market structure of the higher education industry is often seen as a monopolistic competition (Farhan 2016), where institutions are price-setters with a set amount of market power. Other interpretations, such as viewing the higher education industry as several submarkets restricted by region and geographical barriers, also exist (Leslie and Johnson 1974). Nonetheless, the strategies that institutions utilize have been often evaluated through a business lens. While certain studies discuss tactics of differentiation and specialization, other studies discuss convergent behaviour is more common due to both the lack of industrial diversification and imitation strategies of smaller institutions (Codling and Meek 2006).

While many studies have examined how institutions differentiate through their degrees offered, campus culture, and program structure, there has been rarely any analysis of quantitative data on whether institutions in the same state but of different sectors and institutional type compete for the same students, and if they compete for students that are interested in the same fields. Thus, through analyzing 2006-2024 enrollment and completion data from IPEDS, this paper aims to test the following hypotheses:

Hypothesis 1: Even if institutions are not in the same sector or do not follow the same institutional type, they still compete for the same pool of students, meaning that an increase in student enrollment in one sector/institutional type will cause a decrease in the other.

Hypothesis 2: Like firms in a monopolistic competition market structure, American post-secondary institutions within the same state but of different sectors or different institutional types differentiate by specializing in one specific field (STEM or humanities) over time through increasing the number of graduates in a unique field.

This paper will examine if the result for each hypothesis is different depending on if institutions are divided by sector (public/private) or when institutions are divided by institutional type (non-liberal arts/liberal arts).

Within the Literature Review section of this paper, a thorough review of previous scholarly discussions on comparative advantage and competitive strategies employed by post-secondary institutions will be conducted. The section will then end with the gaps that this paper will fill. The Methodology section outlines the sampling strategy of institutions and the data that was collected in order to test the hypotheses stated above. The Economic Analysis section then defines the variables used and highlights the regressions and equations used to analyze the relationship between them. The Results section will present

all findings from the analysis process, followed by the Discussion section which will attempt to explain the possible causes of each finding and their limitations. Lastly, the Conclusion section will summarize the key findings from the study, the implications that such results have on individual stakeholders and conclude with suggestions for future areas of research.

LITERATURE REVIEW

In the field of higher education, a wide range of research has been conducted. While some researchers have discussed the importance of diversity of programs and systems within different post-secondary institutions, other researchers have directed their focus towards the societal value of higher education and the negative impacts of a fall in investment towards post-secondary education (Greenfield and Natalia 2022). This literature review will primarily focus on past studies that have investigated trends of differentiation and specialization, competitive strategies of institutions, institution student pools, and competitive dynamics between institutions of different sectors and institutional types. Lastly, this section will conclude with the research gaps that this paper will fill in.

Differentiation and Specialization Trends

Various research on incentives for diversification within post-secondary institutions has been conducted. In earlier stages of research during the late 1990s, researchers such as Barrow recognized specialization in institutions as a foreseeable trend due to pressures from the changing American economy (Barrow 1996). He concluded that institutions are likely to be pushed towards reforms favouring differentiation to create workers with high flexibility. However, due to the large differences between the current economic environment and that of the late 1900s, it is difficult to conclude that such trends remain relevant to the present.

In contrast, studies from recent decades provide other perspectives on the trends of diversification and the factors that reduce diversity among post-secondary institutions. Notably, researchers have provided the examples of Canada, New Zealand and the United States. They claim that in environments where there is little regional variation to the economy, such as Canada or New Zealand, there is lacking diversity in institutions. While in the United States, institutional and government responses may vary depending on region, increasing diversity (Codling and Meek 2006). This paper also suggests institutions often follow a convergent behaviour, and thus, the researchers emphasize the importance of government intervention in the diversification of institutions and that without it, imitation occurs naturally for struggling institutions to survive. The paper also adds that during times of economic prosperity, smaller universities are more likely to mimic, while during times of recession, such institutions are forced to innovate to compete for students. An article by Jafar agrees with the statement that government intervention plays a vital role in diversification within the setting of the Ontario post-secondary education system (Jafar 2015).

Competitive Strategy and Student Pool

Researchers that have studied the competitive strategies of post-secondary institutions have often concluded through qualitative analysis that institutions execute specific strategies with the goal of building either prestige or reputation. Past literature claims that, for students, higher education is a positional good, where increased rarity increases its value, making them emphasize quantifiers such as institution rankings (Marginson 2006). Thus, certain researchers have suggested that institutions attempt to obtain reputation and prestige by choosing to invest in student quality, research or sports, which may come in the form of hiring elite faculty members or providing funds for improvement of research facilities (Brewer et al. 2002). Being able to obtain a high level of prestige and reputation consequently becomes the institution's main form of differentiation from other competitors.

Similar research also adds that the differentiation of institutions makes price wars an unlikely strategy to be employed by institutions as products are difficult to compare (Musselin 2018). Instead of using the price of tuition as a tool to attract students, increased selectivity based on grades and student quality indicates the institution's prestige (Brint 2002). However, it remains unclear whether differentiation in fields of study, which may guide investing direction or enrollment decisions, is an important factor considered by institutions aiming for prestige.

In correlation with how institutions compete for students, a quantitative study that evaluated which institutions students send their SAT scores to, measured the number of competitors and the characteristics of a college's primary competitors. The study concludes that more selective institutions compete on a national level (beyond its state) and that public and selective colleges face the most intense competition (Smith et al. 2017).

Competitive Dynamics by Sector and Institutional Type

Varying perspectives on the dynamics of cross-sector competition of institutions exist. While the results from earlier studies indicate an inverse relationship between the growth of public and private institutions, more recent studies within the last decade suggest that institutions of different sectors experience complementary competition. In the study presenting an inverse relationship, researchers compared the student preferences of public versus private institutions between the years 1964-1965 and 1972-1973. The study found that although private institutions were in general more preferred, the attractivity of public schools increased across the two periods while the attractivity of private schools fell (Anderson 1975). Nonetheless, since the study only measures a change between two time periods, it is hard to determine whether the results will remain an aggregate trend.

In contrast, researchers that suggest public and private institutions are involved in a complementary competition claim that while these institutions may compete for resources such as funding, faculty members and student talent, they often expand in unison (Hart and Rodgers 2023). Other studies on the higher education system in Europe have indicated an expansion in private institutions covers the excess demand that public institutions cannot satisfy (Rey and Romero 2004). However, differences in educational standards may exist depending on the country’s education system.

In summary, while previous literature highlights the prestige and reputation as a goal and tool for differentiation for most institutions, contentions remain on the topic of competitive dynamics between public and private institutions. More importantly, investigations on the trend of specializing within a specific field of study is heavily underresearched, especially for institutions of higher rankings located within the same state. Additionally, while most studies have been focused on qualitative analysis of interviews and past literature, there remains a shortage of quantitative analysis on student demographic data. Consequently, to address this gap, this paper will utilize student enrollment and completion data to evaluate the competitive dynamics and strategies between institutions of different sectors and institutional types.

METHODOLOGY

To evaluate the question "Do post-secondary institutions compete against each other through comparative advantage by specializing in a single field", the study was conducted using quantitative data from IPEDS (Integrated Postsecondary Education Data System), a system provided by the US government. Through collecting and analyzing the change in institution enrollment and completion by major, the study provides the patterns and shifts of institutions' focus on specific educational fields in comparison to its competitors.

Sampling Strategy

A total of 192 post-secondary institutions were part of the sample for this study. Institutions, which are defined to be four-year colleges or universities that offer Bachelor's degrees, were selected using the US News 2026 University Rankings (US News 2026). Four institutions were selected per US state. Half of the institutions selected for each state were the institutions that were ranked highest on the "National Universities" rankings. If the state did not have any institutions ranked in national universities, the top 2 universities on the "Regional Universities" rankings within that state were used instead. The second half of the four institutions were the top two ranked "National Liberal Arts Colleges" within the state.

If the state did not have two liberal arts colleges (i.e. only have one or no liberal arts colleges), the remaining top private institutions within the state were chosen to fill any empty slots. Certain states only had one liberal arts college and no other private institutions, and therefore had a total of three institutions in the sample. If the state did not have any private post-secondary institutions or liberal arts colleges, only the state's top two public non-liberal arts institutions were included in the sample. All states had at least one institution within the sample. Each of the institutions were identified by their UNITID, an unique 6-digit code.

The study specifically chose the top ranked institutions to ensure that the level of financial funding and prestige were relatively equal, preventing large gaps in strategy due to differences in need for survival from heavily affecting the study findings. The sampling strategy also ensured that the proportion of

non-liberal arts to liberal arts colleges within the sample were relatively equal. A random sample would have resulted in a sample primarily made up of non-liberal arts institutions due to its overall commonality, making it more difficult to compare patterns among institutions of different types and sectors.

Data Collection

To analyze the change in competitive dynamics over time, the data collected for all sample institutions spanned from 2006 to 2024 (n=192 institutions*19 years=3648 observations). Firstly, data from on fall enrollment of all first-time, undergraduate, degree-seeking students were collected so that quantitative analysis on the change in student count could be conducted. Secondly, data on bachelor's degree graduates by the first two digits of their major's Classification of Instructional Programs (CIP) code was collected. The data allows for an evaluation on whether institutions focus on the graduation rate of a specific field more. A total of 20 fields were collected and categorized into STEM (stem completion) or Humanities (humanities completion), with 11 fields being STEM and 9 being humanities. STEM fields were categorized based on the 2024 DHS STEM Designated Degree Program List (Study in the States 2024) while humanities fields were selected based on the definition that they involve the study of a subject that relies on qualitative studies to investigate human society, traditions and creations and primarily focus on the analysis and interpretation of qualitative data. The STEM and humanities fields (and first 2 digits of their CIP codes) included within data set were as follows:

STEM Fields	Humanities Fields
● agriculture, agriculture operations and related sciences (01) ● natural resources and conservation (03) ● computer and information sciences and support services (11) ● engineering (14) ● engineering technologies/technicians (15) ● biological and biomedical sciences (26) ● mathematics and statistics (27) ● military technologies (29) ● physical sciences (40) ● science technologies/technicians (41) ● health professions and related clinical sciences (51)	● area, ethnic, cultural and gender studies (05) ● communication, journalism and related programs (09) ● foreign languages, literatures and linguistics (16) ● english language and literature/letters (23) ● liberal arts and sciences general studies and humanities (24) ● philosophy and religious studies (38) ● theology and religious vocations (39) ● visual and performing arts (50) ● history (54)

Certain CIP codes that were on the 2024 DHS STEM Designated Degree Program List were excluded from the data collected as some did not exist consistently across different years within the IPEDS database. To ensure consistency of definition, fields were defined by the first two digits of their CIP code instead of the full six-digit identifier. Additionally, the grand total of bachelor's degree graduates (grand

completion), which includes graduates that studied majors outside the scope of STEM and humanities, was collected for each observation.

ECONOMIC ANALYSIS

The data analysis process was conducted using the StataNow 19 BE software package. Before analysis, all schools within the sample were identified by sector (public or private) and type (non-liberal arts or liberal arts). The analysis process first began with analysis of fall enrollment. Observations were ordered by state ID and student enrollment from observations within the same state was summed to find the total enrollment for public institutions (pub_enroll) and total enrollment for private institutions (priv_enroll) for that state for each year from 2006-2024 (n=50 states*19 years=950 observations). If a state did not have an institution in a sector (public or private) the enrollment amount for that sector was set to 0. The variables d_pub and d_priv were created for each observation, where d_pub is the difference in public enrollment in the state compared to the previous year and d_priv is the difference in private enrollment in the state compared to the previous year. An ordinary least squares regression model was used to measure the linear relationship between d_pub and d_priv. The model is defined by Equation 1:

$$Y_{st} = \beta_0 + \beta_1 X_{st} + \varepsilon_{st}$$

where:

- Y_{st} is d_priv for state s in year t
- β_0 is the y-intercept
- β_1 is the slope coefficient
- X_{st} is d_pub for state s in year t
- ε_{st} is the error term

The regression was repeated after observations from Arizona, an outlier, were removed. Then the OLS regression was conducted again but with year fixed effects included. The model is defined by Equation 2:

$$Y_{st} = \beta_0 + \beta_1 X_{st} + \varepsilon_{st} + \lambda_t$$

All variables remain the same only with the addition of λ_t, the year fixed effects, which absorbs nationwide shocks in year t. The process above was repeated after schools were divided by institutional type (non-liberal arts and liberal arts) and variables Y and X were redefined based on context.

Analysis of completion by CIP code was then conducted. Completion by CIP code was first summed to find the total STEM completion and total humanities completion for all 3648 observations. Observations with a STEM or humanities completion of zero were kept as zero. STEM share and humanities share were both then calculated where STEM share = stem completion / grand completion and humanities share = humanities completion / grand completion. Changes in STEM share and humanities share over time within public and private institutions were then examined using a two-way fixed effects regression model with a time-varying treatment interaction. The model is defined by Equation 3:

$$Y_{it} = \alpha_i + \lambda_t + \gamma(t*D_i) + \varepsilon_{it}$$

where:

- Y_{it} is the STEM share/humanities share for UNITID i in year t

- α_i is the UNITID fixed effects
- λ_t is the year fixed effects
- $\gamma(t*D_i)$ is the sector-specific differential linear time trend
- ε_{it} is the error term clustered at the state level

STEM and humanities completions from each institution were then summed to STEM and humanities completions by state (n=50 states*19 years=950). Then, STEM, humanities and total completions in a state for a specific year were then divided by sector (public or private). Share for STEM and humanities within public and private institutions was then calculated, creating the variables public stem share, public humanities share, private stem share and private humanities for all 950 observations. The relationship between public sector STEM share and private sector humanities share was then evaluated using a two-way fixed effects regression defined by Equation 4:

$$Y_{st} = \beta_1 X_{st} + \alpha_s + \lambda_t + \varepsilon_{st}$$

where:

- Y_{st} is private humanities share for state s in year t
- β_1 is the slope coefficient
- X_{st} is public stem share for state s in year t
- α_s is the state fixed effects
- λ_t is the year fixed effects
- ε_{st} is the error term that varies across states and time

The regression controls for state (α_i) and year (λ_t) fixed effects and it tests the effect of changes in public stem share on private humanities share. The process above was repeated after schools were divided by institutional type (non-liberal arts and liberal arts) and variables Y and X were redefined based on context.

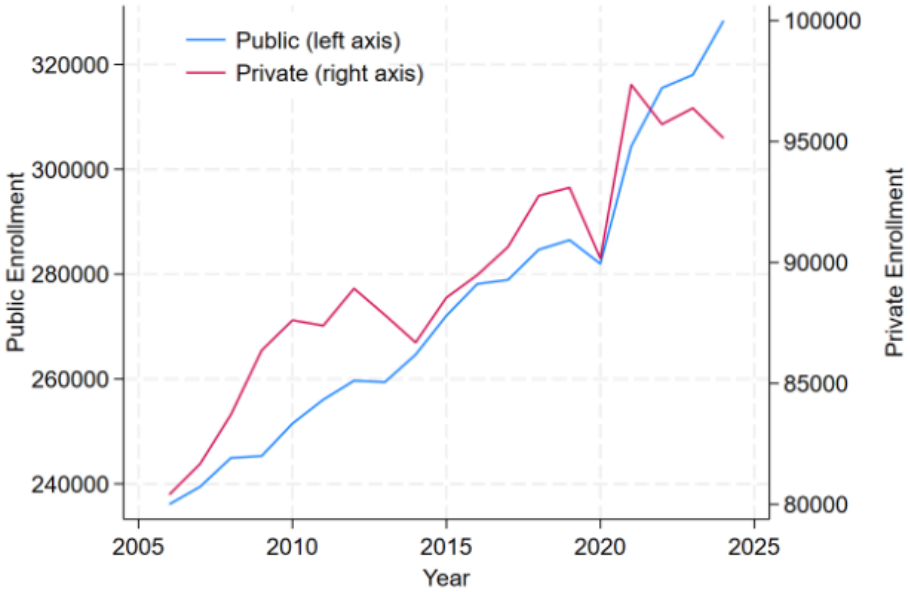
RESULTS

I evaluated whether competition for the same student pool exists between institutions of different sectors and institutional types by analyzing two indicators of growth, fall enrollment and completion by major. The first subsection focuses on analyzing enrollment by sector (public, private) while the second subsection focuses on analyzing enrollment by institutional type (non-liberal arts, liberal arts). While the results will present a general increase in enrollment for all institutions, a statistically insignificant relationship between public and private enrollment and a positive relationship between liberal arts and non-liberal arts enrollment will be found. The third subsection presents results on completion analysis by sector while the last subsection focuses on analyzing completion by institutional type. The results will present a general increase in STEM share and a general decrease in humanities share across all institutions over time. The results also demonstrate that there is no statistically significant relation between the major shares of oppositely defined institutions, no matter if institutions are divided by sector or type.

Enrollment Analysis: Public vs. Private

The purpose of this section is to evaluate whether a tradeoff exists between public enrollment and private enrollment. Figure 1 displays the overall trend in public versus private enrollment.

Figure 1: Public vs. Private Fall Enrollment (2006-2024)



Note: Sample consists of 192 institutions (N_{Public} = 74, $N_{Private}$ = 118). The blue line and left y-axis represent public enrollment while the red line and right y-axis represent private enrollment.

From 2006 to 2024, public enrollment grew by 39.08% while private enrollment increased by 18.33%. However, starting from 2021, private enrollment has been experiencing a gradual decrease. Additionally, the private sector's share of enrollment contracted from 25.4% to 22.5% over the sample period. Although Figure 1 is able to present an aggregate trend for enrollment in for institutions from both sectors, it is unable to demonstrate the relation between the two. Thus, to begin testing whether enrollment in public institutions comes at the cost of private institutions, ordinary least squares regressions were run as defined by Equations 1 and 2.

Table 1: Bivariate OLS Regression of Change in Private Enrollment on Change in Public Enrollment

	DV: Change in private enrollment	DV: Change in private enrollment	DV: Change in private enrollment (outlier AZ excluded)
Change in public enrollment	0.071*** (0.015)	0.059*** (0.015)	0.015 (0.013)
Year FE	No	Yes	No

R^2	0.025	0.071	0.0016
Observations	900	900	882

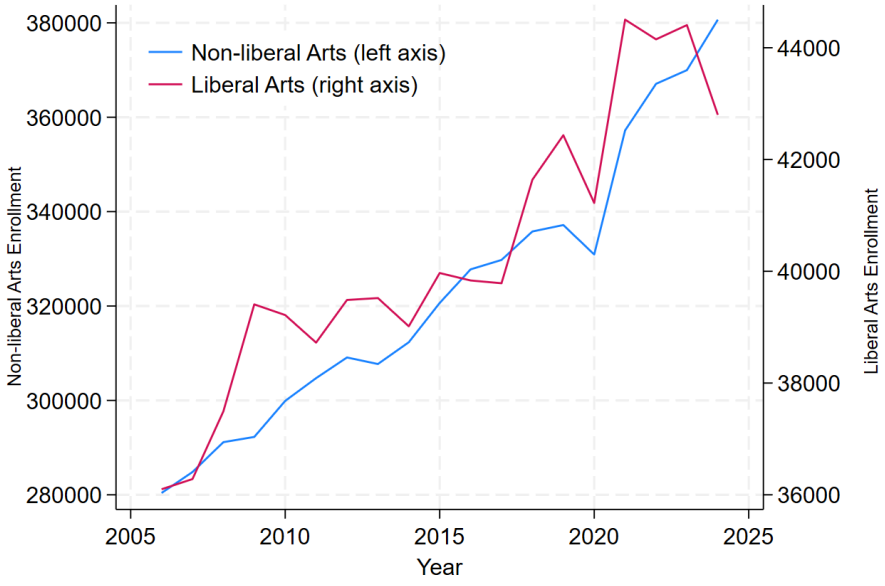
Note: Standard errors are in parentheses, * p < 0.10, ** p < 0.05, *** p < 0.01

Table 1 demonstrates both the summary statistics for the OLS Regression with and without year fixed effects and the summary statistics for the regression after observations from Arizona, the outlier is removed. In the first column, the coefficient of 0.071 is statistically significant at the p<0.01 level, meaning that for every 1000 increase in change in public enrollment, change in private enrollment increases by 71. Only 900 observations were included in the regression as observations in the year 2006 had no previous year to calculate a difference with. After including year fixed effects, the relationship remains positive at a coefficient of 0.059, significant at the 1% level. However, after removing the outliers, there no longer is statistically significant evidence that a correlation exists between change in public enrollment and change in private enrollment.

Enrollment Analysis: Non-liberal Arts vs. Liberal Arts

The purpose of this section is to evaluate whether a tradeoff exists between enrollment of non-liberal arts institutions and enrollment of liberal arts institutions. Through such results, comparisons between dividing institutions by sector and by institutional type can be made. Figure 2 displays the overall trend in non-liberal arts versus liberal arts enrollment.

Figure 2: Non-liberal Arts vs. Liberal Arts Fall Enrollment (2006-2024)



Note: Sample consists of 192 institutions ($N_{Non\text{-}liberal\ Arts}$=104, $N_{Liberal\ Arts}$=88). The blue line and left y-axis represent Non-liberal Arts enrollment while the red line and right y-axis represent Liberal Arts enrollment.

Similar to the trends seen when the institutions were divided by sectors, non-liberal arts and liberal arts institutions both experienced an increase in enrollment from 2006 to 2024 with occasional dips. Non-liberal arts enrollment increased by 35.77% and liberal arts enrollment increased by 18.56%. However, while non-liberal arts enrollment has been increasing exponentially, liberal arts enrollment experienced a large drop in 2023. Thus, liberal arts' share of enrollment has decreased from 11.41% to 10.11% since 2006.

To further assess the relationship between non-liberal arts enrollment and liberal arts enrollment ordinary least squares regressions were run as defined by Equations 1 and 2, where Yst is now d_liberalarts and Xst is now d_nonliberalarts.

Table 2: Bivariate OLS Regression of Change in Liberal Arts Enrollment on Change in Non-liberal Arts Enrollment

	DV: Change in liberal arts enrollment	DV: Change in liberal arts enrollment	DV: Change in liberal arts enrollment (outlier AZ excluded)
Change in non-liberal arts enrollment	0.067*** (0.011)	0.065*** (0.011)	0.016*** (0.006)
Year FE	No	Yes	No
R2	0.044	0.066	0.0087
Observations	900	900	882

Note: Standard errors are in parentheses, * p < 0.10, ** p < 0.05, *** p < 0.01

Table 2 demonstrates the summary statistics for three OLS regressions, one without year fixed effects, one with, and one without observations from the outlier Arizona. The slope of the line of best fit for the correlation is 0.067 and statistically significant at the 1% level while the strength of the relationship is weak. When year fixed effects are included, the coefficient decreases by 0.002 and remains statistically significant at the 1% level. After removing the outlier, Arizona, the slope flattens to 0.016 with a much lower R2 value of 0.0087 but remains positive and statistically significant at the 1% level.

Completion Analysis: Public vs. Private

Through analyzing the proportion of STEM and humanities graduates within public and private institutions, this section aims to evaluate whether public and private institutions obtain competitive advantage by specializing in a specific area of study over time. Table 3 presents the summary statistics for the STEM and humanities completion share.

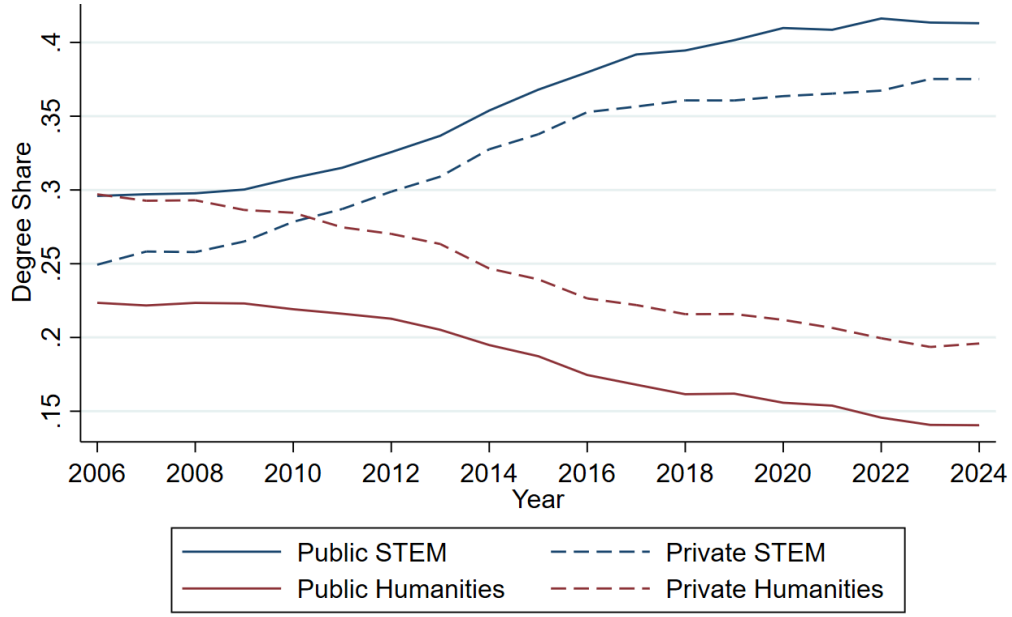
Table 3: Summary Statistics of STEM and Humanities Share by Sector

	Public STEM	Public Humanities	Private STEM	Private Humanities
Mean	0.359	0.186	0.324	0.244
SD	0.146	0.103	0.167	0.169
p50	0.347	0.174	0.297	0.221
N	1406	1406	2231	2231

Note: stem share = stem completion/ grand completion and humanities share = humanities completion / grand completion

Out of the 3648 observations, 11 observations are missing due to missing completion data from Hillsdale College in 2006 to 2014 and missing data from Pillar College in 2006 and 2007. Within public institutions, the mean proportion of STEM completions within the institution is 35.9% while the mean proportion of humanities completions to total completions was 18.6%. Within private institutions, the STEM and humanities proportions are 32.4% and 24.4% respectively. Figure 3 compares the average STEM and humanities share within public and private institutions over time.

Figure 3: Average STEM and Humanities Share over time by Sector



To precisely compare the change in STEM and humanities share within public and private institutions, a two-way fixed effects regression model with a time-varying treatment interaction was used as defined by Equation 3. The equation measures both the change in STEM share and the change in humanities share within public and private institutions over time while absorbing shocks and differences caused by time and institution characteristics.

Table 4: Two-way Fixed Effects Regression on STEM and Humanities Share in Public vs. Private Institutions

	DV: STEM share	DV: Humanities share
Private*Year Trend	-0.0002 (0.0007)	-0.0011* (0.0006)
Year FE	Yes	Yes
UNITID FE	Yes	Yes
R2	0.513	0.460
Observations	3637	3637
Year		
2007	0.0060** (0.0023)	-0.0027 (0.0018)
2024	0.126*** (0.008)	-0.083*** (0.009)

Note: Standard errors are in parentheses, * p < 0.10, ** p < 0.05, *** p < 0.01

Table 4 summarizes the results from the regression. The values in the first row measure the difference in average annual rate of change of the shares, with public institutions as the baseline rate. For STEM shares, the statistically insignificant difference of -0.0002 in rate of growth shows that both public and private institutions experienced the same change in STEM share. In general, the 2024 coefficient shows that STEM share experienced a growth by 12.6 percentage points relative to the baseline year of 2006. For humanities shares, the difference of -0.0011 is statistically significant at the 10% level, meaning that the humanities share for private institutions is decreasing at a rate of 0.11 percentage points faster annually than public institutions. In general, humanities share experienced a decrease for all institutions as shown by the -8.3 percentage points in 2024.

A two-way fixed effects regression, defined by Equation 4, was carried out to analyze the effect of public stem share on private humanities share while accounting for possible errors caused by differences in year and states.

Table 5: Two-way Fixed Effects Regression of Private Humanities Share on Public STEM Share

	DV: Private humanities share

Public STEM share	-0.140 (0.122)
Year FE	Yes
State FE	Yes
R2	0.595
Observations	817

Note: Standard errors are in parentheses and clustered at the state level, * p < 0.10, ** p < 0.05, *** p < 0.01

Table 5 presents the results from the regression, showing a statistically insignificant negative relation between private humanities share and public STEM share at the 10%, 5% and 1% level.

Completion Analysis: Non-liberal Arts vs. Liberal Arts

After analyzing STEM and humanities completion by sectors, Section 4.4 aims to analyze completion in these two fields by institutional type to evaluate whether comparative advantage through specialization over time exists between non-liberal arts and liberal arts institutions. Table 6 presents the summary statistics for the STEM and humanities completion share.

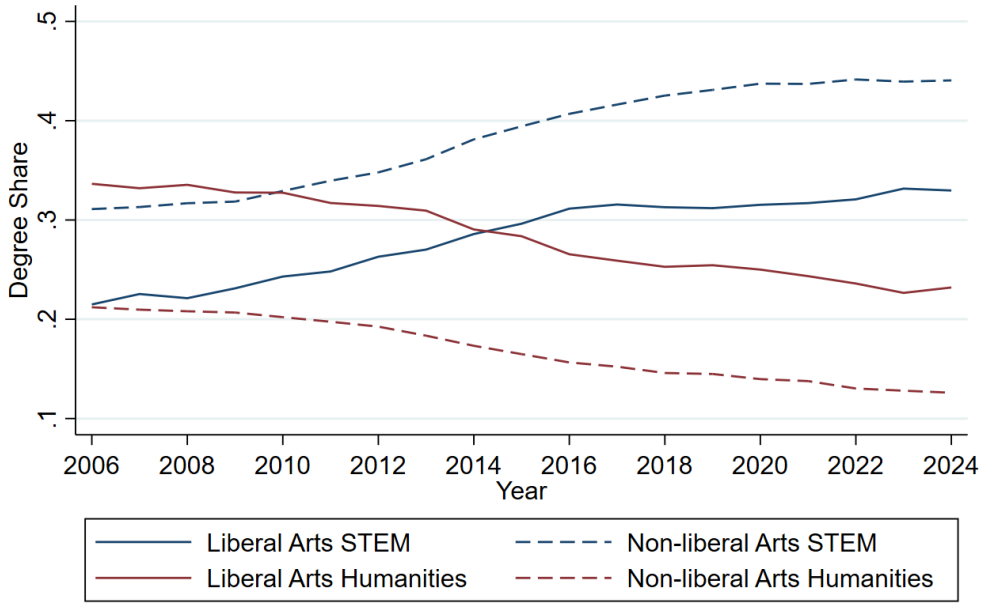
Table 6: Summary Statistics of STEM and Humanities Share by Institutional Type

	Non-liberal Arts STEM	Non-liberal Arts Humanities	Liberal Arts STEM	Liberal Arts Humanities
Mean	0.384	0.169	0.283	0.284
SD	0.160	0.077	0.141	0.188
p50	0.364	0.168	0.269	0.260
N	1976	1976	1661	1661

Note: stem share = stem completion/ grand completion and humanities share = humanities completion / grand completion

Out of the 3648 observations, 11 observations are missing due to the same reasons explained for Table 3. Within non-liberal arts institutions, the mean STEM share is more than double the mean humanities share, with the mean STEM share at 38.4% and the mean humanities share at 16.9%. Within liberal arts institutions, the mean STEM share and mean humanities share are relatively equal, with mean STEM share at 28.3% and mean humanities share at 28.4%. Figure 4 compares the average STEM and humanities share within liberal arts and non-liberal arts institutions over time.

Figure 4: Average STEM and Humanities Share Over time by Institutional Type



To precisely compare the rate of change for STEM and humanities share within non-liberal arts and liberal arts institutions, I used a two-way fixed effects regression model with a time-varying treatment interaction, as defined by Equation 3. The variable γ(t*Di) is now the institutional type-specific differential linear time trend.

Table 7: Two-way Fixed Effects Regression on STEM and Humanities Share in Non-liberal Arts vs. Liberal Arts Institutions

	DV: STEM share	DV: Humanities share
Non-liberal Arts *Year Trend	0.0017** (0.0008)	0.0015** (0.0007)
Year FE	Yes	Yes
UNITID FE	Yes	Yes
R2	0.518	0.463
Observations	3637	3637
Year		
2007	0.0049** (0.0023)	-0.0042** (0.0019)

2024	0.107***	-0.109***
	(0.012)	(0.012)

Note: Standard errors are in parentheses, * p < 0.10, ** p < 0.05, *** p < 0.01

Table 7 displays the results from the regression, with the rate of change in liberal arts institutions as the baseline rate. In terms of STEM shares, non-liberal arts institutions have experienced an annual growth that is 0.17 percentage points quicker than liberal arts institutions, significant at the 5% level. Relative to the baseline year of 2006, STEM shares have increased overall by 10.7 percentage points, significant at the 1% level. In terms of humanities shares, non-liberal arts institutions have experienced an annual decrease that is 0.15 percentage points slower than liberal arts institutions, significant at the 5% level. Relative to the baseline year of 2006, humanities shares have decreased overall by 10.9 percentage points, significant at the 1% level.

A two-way fixed effects regression, defined by Equation 4, was carried out to analyze the effect of non-liberal arts stem share on liberal arts humanities share while accounting for possible errors caused by differences in year and states.

Table 8: Two-way Fixed Effects Regression of Liberal Arts Humanities Share on Non-liberal Arts STEM Share

	DV: Liberal arts humanities share
Non-liberal arts STEM share	-0.087
	(0.137)
Year FE	Yes
State FE	Yes
R2	0.547
Observations	893

Note: Standard errors are in parentheses and clustered at the state level, * p < 0.10, ** p < 0.05, *** p < 0.01

Table 8 presents the results from the regression, showing a statistically insignificant negative relation between liberal arts humanities share and non-liberal arts STEM share at the 10%, 5% and 1% level.

DISCUSSION

Main Findings

The results ultimately disprove our two initial hypotheses. Firstly, competition between same-state institutions of different sectors and institutional types for the same pool of students was not seen. Secondly, such institutions also did not specialize in one specific field over time through increasing graduates in a unique field. Through both the analysis of data on enrollment and data on completion by field, we find that all institutions follow a similar upward trend in enrollment with the exception of the recent five years, STEM share increased no matter sector or institutional type and humanities share decreased no matter sector or institutional type.

In terms of enrollment, there is no statistically significant evidence that proves that a relationship between same-state public and private enrollment exists as shown by Table 1 after the outlier, Arizona, is removed from the regression. While statistically significant evidence from Table 2 supports the relationship between non-liberal arts enrollment and liberal arts enrollment, the relationship is positive, proving the opposite of our initial hypothesis. However, although the OLS regression was run once with year fixed effects, it remains highly vulnerable to other macro variations that may affect all observations.

In terms of completion by field, there is no statistically significant evidence that proves that a relationship between public STEM share and private humanities share exists, nor is there sufficient evidence to support the relationship between non-liberal arts STEM and liberal arts humanities share. When institutions are divided by sector, institutions in both sectors experience a growth in STEM share at the same rate while for the humanities share, private institutions experience a decline that is 0.11 percentage points quicker than public institutions in the same state, ($p<0.10$). When institutions are divided by institutional type, STEM shares within non-liberal arts institutions experience a growth that is 0.17 percentage points quicker than liberal arts institutions in the same state ($p<0.05$), and decline in humanities share 0.15 percentage points slower ($p<0.05$).

Interpretations

Findings from analysis of enrollment show that institutions from different sectors and different institutional types within the same state do not compete for students from the same pool. If such a competition existed, then Figures 1 and 3 and Tables 1 and 3 would have presented a negative correlation between the two sides of enrollment. Tables 2 and 4 also support this conclusion. These results agree with more recent literature that public and private institutions experience complementary competition where expansion is parallel for both sides (Hart and Rodgers 2023). This lack of competition for such institutions in the same state could be explained by factors such as institution capacity, stratified income, or could also be caused by a large student population that is not zero sum. If the student population increases in a state but the institution's capacity does not increase to the same degree, students likely overflow into institutions that are of different sectors or institutional types. Stratified incomes of households may also reinforce the segregated student pools as On average, the tuition of public institutions is 75% less than private institutions (Wood 2025). Student pools may then be defined by income and the ability of households to afford tuition. Previous literature also suggests that competition for prestigious institutions likely doesn’t exist within the state, but instead nationally. However, the recent

drops in private and liberal arts enrollment may indicate that public and non-liberal arts enrollment is gradually intruding on the student pool for private and liberal arts students.

Findings from analysis of completion by field show that institutions don't differentiate by attracting more students of a specific field. An increase in STEM shares for public institutions did not cause private institutions to turn their focus into increasing the enrollment and graduation of students in the humanities. Similarly, this is supported by past literature that explains how institutions often have convergent behaviour. The statistically insignificant relationship between the public STEM share and private humanities share as well as the non-liberal arts STEM share and liberal arts humanities share suggests that the enrollment and graduation of students in a specific field is heavily determined by external factors, such as student interest or industry trends, and not the behaviour of institutions themselves or competing institutions. Institutions do not actively prioritize graduates in a specific field through quantity to differentiate. It is important to note, however, that quantity cannot fully represent whether an institution is specializing in a field. Although the net trend demonstrates decreasing graduates in humanities, institutions may still be investing in research facilities or other resources to improve the quality of the few graduations. Nonetheless, institutions may also be simply focusing on other forms of differentiation such as student benefits, generous financial aid or networking opportunities.

Interestingly, liberal arts colleges, which had a higher mean humanities share, faced a quicker decline in humanities share. However, this may be mainly caused by the fact that liberal arts colleges have a smaller student body.

Limitations

Various limitations exist within this study. Firstly, the sample size used within this study is relatively small. Although the data spans across 19 years and 192 institutions were observed, the sample only covers a small proportion of the total number of institutions that exist within the US, possibly causing certain patterns and relationships to be uncaptured. Additionally, since the public STEM share and private humanities values regressed in equation 4 are recorded within the same year, the direction of the relationship is not established by the regression alone. The sampling strategy also only focused on the best ranked institutions within the US. Although this prevents specific outliers, it prevents the evaluation of strategies of smaller, medium scaled institutions who may be more desperate for survival. Secondly, the study excluded interdisciplinary majors and niche STEM or humanities majors when summing completion for each field. Although the values were likely small and insignificant, possible distortions may have occurred. Lastly, the study did not evaluate other measurements that indicate growth of emphasis on a field within an institution such as funding direction and faculty members by instructing area. If such data was included, a clearer image of competitive strategies employed by institutions may have been presented.

CONCLUSION

The study investigates competition and the presence of differentiation of field of focus within top American post-secondary institutions. The outcomes indicate that separate student pools exist for institutions of different sectors and institutional types. The results also demonstrate that differentiation by increasing enrollment of students in a specific field is not a tactic employed to compete against institutions in the same state. Additionally, the findings show a general decrease in the proportion of humanities graduates and an increase in the proportion of STEM graduates. For students, this may mean that, since institutions do not try to differentiate, less and less institutions will provide humanities programs for the minority of students that are still interested. Policy makers may have to enforce the maintenance of such programs if relevant industries require talent within the humanities fields.

For future research on competitive advantages in post-secondary institutions, scholars should investigate how institutions hire their faculty members, specifically instructional staff, and how they compete against other employers in the labour market. This area of research could consequently demonstrate which areas of instruction such institutions value the most and how their staff demographic reflect their institutional values. Future research could also investigate the graduation outcomes of alumni from different institutions. Comparisons of the salary of such graduates could provide further insights on the quality of students within different institutions over time. Such results could provide better conclusions on whether institutions prioritize students in a specific field through qualitative resource improvements.

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