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**THE IMPACT OF STATE APPROPRIATIONS
ON CURRICULAR CHANGE
AT PUBLIC COLLEGES AND UNIVERSITIES**

A Dissertation in

Higher Education

by

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ABSTRACT

State appropriations for public higher education has significantly declined over the past few decades, and in response, public colleges and universities have intensified their efforts to pursue alternative sources of revenue or adjust cost. This study examines how public colleges and universities have altered their curriculum in response to growing scarcity of financial support from the state. First, I examine whether declines in state appropriations are associated with expansion or contraction of degree program offerings. Second, I explore how declines in revenue from state appropriations are associated with changes in the composition of the curriculum based on curricular content, average earnings of graduates, gender of graduates, and program type. Lastly, I explore how the impact of state appropriations on the curriculum varies by institutional type.

I utilize institution-level longitudinal data on public four-year institutions from the Integrated Postsecondary Education Data System (IPEDS) between 2000 and 2019. I employ panel fixed effects regression to estimate the association between state appropriations and curricular change, reflected through changes in the annual number of programs offered. More specifically, I estimate how changes in revenue from state appropriations, averaged across the previous three years, are associated with the overall number of degree programs offered, number of degree programs offered in academic and occupational fields of study, number of degree programs offered in ‘high-earning, high-cost’ and ‘low-earning, low-cost’ occupational fields, number of non-degree certificate programs, and the number of programs in fields with relatively high proportion of women graduates and high proportion of men graduates.

The study produces a number of important findings regarding how curricular changes occur in response to changes in revenue from state appropriations. First, curricular adjustments

vary by institutional type. While public research universities with the highest research intensity (“R1 universities”) contract their curriculum, public baccalaureate colleges expand their curriculum in response to state appropriation declines. Such differences may be attributable to differences in fiscal and educational circumstances. Second, with the exception of R1 universities, state appropriation declines are associated with an increase in curricular emphasis toward occupational fields of study, either through program declines in academic fields or program increases in occupational fields. At public R1 universities, on the other hand, state appropriation declines are associated with declines in occupational fields, but not academic fields. Third, state appropriation declines are significantly associated with increases in the number of non-degree certificate programs, which generally emphasize occupational education. Fourth, some analyses hint at the existence of gendered patterns of curricular change for programs in academic fields of study. Among academic fields of study, state appropriation declines tend to be associated with declines in fields that have relatively higher proportions of women graduates. Lastly, the association between state appropriations and the curriculum are more evident during the post-2008 financial crisis period compared to before.

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CHAPTER 1: INTRODUCTION

State appropriations comprise a critical source of financial resources for public colleges and universities in the United States. They support the basic operations of higher education institutions and enable students to pay less than the actual per-student expenditure that goes into a college education (Mclendon & Mokher, 2009). In 2016-17, total state appropriations for public institutions amounted to \$68.6 billion, accounting for 17 percent of total revenue and 18 percent of total expenditure. However, state funding for higher education has significantly declined over the last few decades, with per-student support dropping by more than 30 percent over the past 30 years at four-year public institutions (Webber, 2017).

A number of factors have played a role in state funding declining for public higher education. First, due to increased funding needs for other areas, including health, criminal justice, and K-12 education, higher education has fallen behind in the resource allocation priority of state governments (Hovey, 1999; Kane et al., 2005). Second, in times of fiscal difficulty, budget cuts for higher education have tended to occur more frequently and to a greater extent than other policy areas, partly due to institutions' capacity to collect tuition from students (Delaney & Doyle, 2011). Third, the growing perception that the benefits of higher education accrue predominantly to individuals, rather than the public, has strengthened the idea that individuals should be the ones bearing most of the cost, rather than the state (Hossler, 2006; Longanecker, 2006). Lastly, some policymakers believe that guaranteed money from the government leads colleges to become more bureaucratic and unresponsive to public needs, and thus declines in state support will encourage more efficient modes of operation (Ehrenberg, 2006; Slaughter & Rhoades, 1993).

In response to diminishing support from the state, public higher education institutions have given more weight to financial cost and revenue in their decision-making while competing with other institutions for non-state resources (Gumport, 2002; Priest & St. John, 2006; Slaughter, 2002; Weisbrod et al., 2008). Changing fiscal circumstances and budget constraints have increased the idea of higher education as an industry, where public colleges and universities are expected to behave like quasi-corporate entities that produce goods and services in the market, while students are increasingly viewed as consumers (Gumport, 2000). From recruiting students to the hiring of faculty, declines in state appropriations have had a significant impact on the ways public colleges and universities operate (Bound et al., 2019; Bound et al., 2020; Cheslock & Callie, 2015; Jaquette & Curs, 2015; Leslie et al., 2012; Ortagus & Yang, 2018).

While the existing literature has examined various ways in which public colleges and universities have responded to state funding declines, little attention has been given to curricular decisions. The curriculum, or what colleges and universities teach, is directly tied to higher education's core educational function (Hannan & Freeman, 1984). It not only represents the purpose and contribution of colleges and universities to students and society, but it is the bases on which resources are distributed and constitutes one of the most significant areas of institutional expenditure. As a key component of colleges and universities, the curriculum is susceptible to changes in fiscal circumstances (Brinkman, 1990; Mingle & Norris, 1981). Changes in the curriculum can have significant educational, social, and financial implications for public higher education, and this study will examine its relationship with state funding.

Curricular change in response to state appropriation declines can come in multiple forms, including expansion, contraction, and a combination of both. Creating new programs can allow institutions to teach and research in new areas, potentially reaching new users of their knowledge

in the way private firms expand to new markets. On the other hand, closing existing programs can directly diminish cost and allow institutions to financially adjust to declines in revenue.

Whether it be expansion or contraction, or a combination of the two, all approaches can entail both financial and non-financial costs and benefits.

Beyond overall expansion and contraction, the composition of programs can change in response to state appropriation declines, depending on the factors that influence curricular decisions. One factor that could drive curricular decisions is market demand. When considering the growing importance of tuition revenue (Hillman, 2012), coupled with students increasingly viewing the attainment of employable skills as their motivation for college (Eagan et al., 2016), declines in state funding may encourage colleges and universities to create programs in occupational fields of study with clear connections to the labor market. Following this logic, concerns have been raised over the death of the humanities. However, when considering the cultural norms and values historically associated with higher education, blindly following market demand could threaten institutions' perceived legitimacy as organizations of higher learning (Hearn & Belasco, 2015). As such, institutions may opt to protect traditional academic fields for their cultural and historic value more so than their economic value (Osley-Thomas, 2019). Also, decision-making processes can be driven by political economic power, which means that certain groups, namely women and marginalized race groups, would be at a disadvantage over others, regardless of technical demand or cultural norms (Gumport, 1993; Slaughter, 1993).

One important factor that may influence the ways in which institutions respond to state appropriation declines is institutional type (Winston, 1999). Institutional type reflects variation in educational focus and mission (e.g., emphasis on research versus teaching), resources, culture, and the market that institutions operate in (Hearn & Belasco, 2015; Morphew & Taylor, 2010;

Taylor et al., 2013). Therefore, whether and how public colleges adjust their curriculum in response to state appropriation declines may not occur in a homogenous way across all institutional types.

Amid growing interest over the consequences of declining state funding for higher education, concerns have been raised regarding the increased role of money motivating the decision-making of colleges and universities. For example, the pursuit of higher-tuition-paying students have led to lower enrollment by socioeconomically disadvantaged students (Jaquette et al., 2016). The pursuit of research dollars and commercializable patents have increasingly led scholarship to be judged based on their immediate financial value, as opposed to broad long-term benefits for society (Slaughter & Leslie, 1997).

Despite being directly tied to what students learn, less attention has been given to how the growing scarcity of state funding has influenced the curriculum taught by public higher education institutions. As of 2017, public colleges and universities enrolled 74 percent of all postsecondary students and 64 percent of all students attending four-year institutions (National Center for Education Statistics, 2018). Thus, changes in the curriculum at public institutions would affect the type of knowledge taught to the majority of students in U.S higher education. It also has direct implications for the organizational identity and governance of public colleges and universities, as well as the type of knowledge that is legitimized in society (Gumport & Snyderman, 2002).

Research Questions

The primary goal of this study is to investigate the association between state appropriations and curricular change at public colleges and universities in the U.S. Regression-based methods are employed on institution-level longitudinal data spanning two decades. To understand the relationship between revenue from state appropriations and changes to the curriculum, I utilize multiple theoretical perspectives on organizational behavior, including those focusing on strategic adaptation, culture, and political economic power. The research questions that guide this study are as follows:

- *How do changes in state appropriations affect the total number of degree programs that public colleges and universities offer?*
- *How do changes in state appropriations affect the composition of the curriculum across different fields of study and program types that public colleges and universities offer?*
- *How does the association between state appropriations and the curriculum vary by institutional type?*

The first research question addresses whether public colleges and universities are more likely to expand or contract their curriculum in response to state appropriation declines. Specifically, I examine how changes in revenue from state appropriations are associated with the total number of degree programs offered, combined across all degree levels, as well as for programs at the bachelor's, master's, and doctoral degree levels separately.

The second research question focuses on how state appropriation declines are associated with changes in the composition of the curriculum across multiple dimensions. First, I examine

differences between degree programs in occupational fields of study and academic fields of study. Occupational fields refer to areas of study that focus on the development of practical skills, such as business administration or engineering, while academic fields are broadly based on the liberal arts, including history, philosophy, and math. Second, to account for the role of market demand and cost, I examine if there are differences in how state appropriations are associated with occupational programs whose graduates have high earnings but require relatively high costs of instruction versus those whose graduates have lower earnings but require relatively low costs of instruction. Third, I examine changes in the number of certificate programs offered in relation to state appropriations. Certificates tend to be occupational in nature, but generally serve a different population of students compared to traditional degree programs, allowing for diversification of revenue sources. Lastly, to consider political economic power relations in curriculum change, I examine the role of the gender composition of programs. In the relationship between curricular change and state appropriations, I explore if there are differences between fields of study that have relatively high proportions of women graduates versus those that have high proportions of men graduates.

To examine differences across institutional type, I conduct analyses with all public four-year institutions pooled together, as well as for each institutional type separately. Specifically, I rely on the 2005 Carnegie Classifications to categorize institutions as either R1 universities, less research-intensive doctoral universities, master's universities, or baccalaureate colleges. Differences in institutional type reflect systematic differences across a number of dimensions, including reliance on state funding, access to alternative resources, institutional culture, goals, and mission.

When it comes to organizational change, some have argued that higher education institutions are very slow and unresponsive to changes in the environment, particularly in core areas of operation like the curriculum (Hannan & Freeman, 1984). Rather, changes are more likely to take place in peripheral areas of operation, such as the creation of non-degree extension programs, whose revenue would be used to support traditional degree programs comprising the core (Weisbrod et al., 2008).

While such views on curricular change provide meaningful insights into how colleges and universities operate, such perspectives may be outdated when considering the drastic changes that have taken place in the financial environment of public higher education. Significant changes have occurred throughout the higher education landscape, including changes in state policies, demographics, public expectations, and increased competition from new forms of education providers (Meyer & Rowan, 2006). What held true for higher education in the past may not hold up as well in the present or the future. For example, when it comes to changes in faculty employment in response to fiscal constraints, significant attention has been given to the rise in non-tenure track positions (e.g., Zhang & Liu, 2010). However, in recent years, even tenured positions have experienced layoffs (Nietzel, 2020), and the increased vulnerability of tenure represents a drastic change in higher education, perhaps not imaginable in the past. Therefore, it is reasonable to expect that even the curriculum, despite comprising the core, could be altered in response to growing fiscal constraints.

In addition, the goal of a college education and what should be included in the curriculum has been debated throughout the history of higher education (Geiger, 2016). Some argue that the aim of a college education is to equip students with a set of skills that are in-demand in the labor market, and thus the knowledge taught and learned in higher education should serve as a means

for employment and increased earnings. Others believe higher education institutions should promote and preserve the free flow of knowledge rooted in the liberal arts, and that a college education should not be evaluated based on its immediate economic contributions. While the purpose of this study is not to make normative claims on what should be taught in higher education, the persistent debate over the curriculum, dating back to when colleges were first formed, reflects how important the curriculum is to higher education. Against this backdrop, this study will examine how changes in state appropriations, a critical form of financial resource, is associated with the curricular direction of public higher education institutions.

Organization of the Dissertation

The remaining chapters of this dissertation will provide an overview of the existing literature, outline the data and methods to be used for examining the research questions, report the results, and discuss the implications of the findings. Chapter 2 begins by reviewing existing studies on institutional responses to state appropriation declines, including responses geared toward generating and diversifying revenue and those focused on adjusting expenditure. It then provides a brief overview of how the college curriculum has evolved over time. Next, it reviews empirical studies on specific factors associated with changes in the higher education curriculum. Lastly, it describes the conceptual framework used to understand how state appropriation declines might be linked to changes in the curriculum.

Chapter 3 outlines the data sets and methods to be used to estimate the impact of state appropriation changes on changes in majors. I use a panel data of public colleges and universities in the U.S, constructed through information in the Integrated Postsecondary Education Data System (IPEDS). The analytic period spans approximately two decades, from 2000 to 2019. The main analytic approach to estimation will be ordinary least squares (OLS) regression with the inclusion of fixed effects at the institution and year levels. Since the main dependent variables constitute count data containing non-negative integers, the main results will be supplemented by estimation using the Poisson regression. Chapter 4 presents the results and Chapter 5 discusses the theoretical and practical implications of the findings and suggests future areas of research.

CHAPTER 2: LITERATURE REVIEW

This chapter begins by examining studies that analyze how public higher education institutions have responded to state appropriation declines. The studies describe the ways in which public colleges and universities have adjusted organizational behavior with the purpose of generating revenue or containing cost. Next, a brief history of major changes and events relating to the curriculum in U.S. higher education is described. Then, I review studies that explore various factors associated with curricular change, including factors that are both internal and external to colleges and universities. Lastly, conceptual frameworks for understating how curricular changes might be associated with state appropriation declines are discussed.

Institutional Response to Changes in State Appropriations

State divestment in public higher education represents a decline in a critical resource for public colleges and universities. Declines in state funding have caused institutions to adjust their activities in a variety of areas, including tuition, enrollment, research, and instruction. Institutional responses can largely be categorized as those that aim to enhance and diversify revenue, or those that focus on reducing cost and reallocating resources.

One of the major institutional responses to state appropriation declines have been increases in tuition price (Rizzo & Ehrenberg, 2004). According to Webber (2017), the average pass-through rate of state appropriations on tuition at public four-year institutions is approximately 25.7 percent. In other words, when state appropriations decline by \$1,000 per student, tuition has gone up by \$257, on average. What is significant is that the pass-through rate has increased over time, with larger increases found after 2000 compared to before. At the same time, institutions have increasingly engaged in what is known as tuition discounting, which is the provision of institutional financial aid that effectively lowers the actual tuition paid by students

(Hillman, 2012). What has resulted is a high-tuition high-aid model, or a price differentiation scheme designed to maximize overall tuition revenue by better matching net tuition price with students' ability to pay.

Amid demographic changes resulting in declines in the number of potential students (Grawe, 2018) and growing public concerns over the affordability of college, maintaining sufficient net tuition revenue through the high-tuition high-aid model is not a sustainable strategy for most public institutions. Another way by which public institutions have increased tuition revenue is increasing the enrollment of higher-tuition-paying non-resident students, who typically pay two to three times higher rates of tuition than in-state students. Using institutional-level data spanning the decade between 2002 and 2012, Jaquette and Curs (2015) find a negative relationship between changes in state appropriations and non-resident student enrollment at public four-year institutions. On average, a 1 percent decline in state appropriations is associated with a 0.27 percent increase in non-resident freshman enrollment. When disaggregating the effects by institutional type, the increase is greater at doctoral institutions, which tend to experience higher levels of demand from out-of-state students compared to master's and baccalaureate institutions. Similar patterns are found by (Bound et al., 2020) on the enrollment of international students, whose capacity and willingness to attend U.S. higher education institutions have grown significantly over the past two decades. In line with findings on enrollment by higher-tuition-paying non-resident students, state appropriation declines have been found to be linked to recruitment efforts being geared toward wealthy, out-of-state communities (Han et al., 2019).

The pursuit of revenue driven by declines in state funding also influences the research and teaching functions of public colleges and universities. As a way of making up for revenue

lost from state appropriations, public universities have increased organizational efforts toward scholarship in areas that are in demand by external funders or patents with commercial value (Slaughter & Leslie, 1997; Slaughter & Rhoades, 2004). Hence, research has become increasingly viewed as a means to generate revenue. On the teaching side, online education has been deemed a promising source of revenue (Bowen, 2013). Amid the spread and growth of online technology, the convenience and flexibility provided by online learning could allow institutions to widen the pool of tuition-paying students. At the same time, due to relatively lower variable costs compared to traditional residential courses, online education could contribute to lowering the per-student cost of instruction. Using institutional-level panel data for the years 2012 to 2015, Ortagus and Yang (2018) find that the proportion of students enrolled in online courses is negatively associated with changes in state appropriations, suggesting that online learning is being strategically used as a means to address state appropriation declines. Across all public four-year institutions, a 10 percent decline in state appropriations is associated with a 3.06 percent increase in the number of students enrolled in some or all online courses, with the increase being mostly attributed to doctoral institutions.

In addition to pursuing revenue, higher education institutions have responded to state appropriation declines by adjusting institutional expenditure, including the amount used toward research, instruction, and institutional support (Bound et al., 2019; Leslie et al., 2012). As a labor-intensive field, expenditure for personnel comprises a major share of the total cost of operation for higher education institutions (Desrochers & Kirshstein, 2014), making them likely targets of cost-cutting measures. Using faculty-level salary data for full-time business school faculty from 1999 to 2006, Cheslock and Callie (2015) examine how faculty salary structure is influenced by declines in state appropriations. They find that declines in state support is

significantly associated with changes in both the level of salary and the composition of faculty. A 1 percent decrease in state appropriations is associated with declines in salary of 0.06-0.11 percent, with the declines strongest for professors at the associate level. The composition of faculty is also affected, with the largest declines found for full professors, who are typically paid the highest among all faculty. Increasing the hiring of non-tenure track faculty is another way in which institutions have reduced personnel expenses (Frye, 2018; Goldenberg & Cross, 2009; Weisbrod et al., 2008; Zhang & Liu, 2010). Declines in state appropriations have been found to be related to increases in the share of part-time faculty, particularly at non-research oriented public institutions (Frye, 2015).

In summary, declines in state appropriations have significantly altered the ways in which public colleges and universities operate, with revenue-generation or cost-reduction driving organizational behavior. In particular, previous studies indicate that changes in state appropriations have significantly affected the educational function of public colleges and universities in terms of who enrolls (e.g., higher-tuition-paying students), who they are taught by (e.g., non-tenure track faculty), and how they learn (e.g., online courses). What is less known in the literature is how state appropriations affect what public institutions teach, which is determined by the curriculum.

Brief History of Curricular Change in Higher Education

Ever since its inception, the curriculum in higher education has continuously changed over time. Throughout this process, various constituencies, including students, faculty, leadership, as well as business and government actors, have argued for or against what the purpose of a college education should be. What should be included in the college curriculum have been and still is, to this day, the subject of intense debate.

During the early years of higher education, in the 17th and 18th centuries, colleges had direct affiliations with religious denominations, and the central purpose of a college education was to educate ministers (Bastedo, 2016). The curriculum focused on providing a liberal education, and was comprised of the classical languages like Latin and Greek, as well as philosophy and logic (Geiger, 2016). Gradually, the number of professionals and merchants grew among the general population, and an increasing proportion of college graduates pursued careers outside of ministry. This led colleges to incorporate more secular content into their curriculum, while maintaining a fundamental focus on the classical languages and religious studies (Geiger, 2016).

In the first half of the 19th century, criticism grew over the college curriculum's remaining focus on the classical languages while neglecting subjects with more practical purposes. At the same time, advocates of the classical languages strongly defended its educational and cultural value. One such effort was the *Yale Report* of 1828. The *Yale Report* defined the purpose of college to be laying the foundations for higher learning, and viewed the classical languages to be ideal for developing mental discipline and advanced levels of thinking (Lane, 1987). Although many in the higher education community agreed with the thesis of the *Yale Report*, demands for curricular reforms remained strong in the midst of changes in the society and the development of new knowledge (Bastedo, 2016). Although not always successful, efforts were made by colleges to reform its curriculum in ways that incorporate practical needs of industry and commerce (Geiger, 2016).

Significant changes in the US higher education landscape occurred throughout the mid-19th century to WWI, and such changes have had major influences on the curriculum. The Morrill Act of 1862, which allowed for the creation of land-grant colleges, contributed to the

expansion of higher education opportunities to the working classes. This created an environment conducive to the curricular growth of practical areas of study, including engineering, agriculture, and other forms of applied sciences with connections to the work and lives of ordinary citizens (Geiger, 2016). Also, a major curricular reform took place in the country's leading institutions, including Harvard and Brown University, where the classical curriculum was replaced with an elective system comprised of subjects in diverse areas (Bastedo, 2016). Following the lead of major universities, higher education as a whole experienced growth and standardization during this period. Also, major disciplinary associations were formed, and the departmental structure of colleges were shaped to reflect the disciplinary boundaries set in the academic community (Geiger, 2016).

The periods following WWI to the late 20th century witnessed dramatic growth and massification of higher education enrollment. Growth was driven by municipal universities, including the College of the City of New York, New York University, Northwestern University, and the University of Southern California, which enrolled more part-time than full-students, and aimed to equip graduates with employable skills to be used in the region (Geiger, 2016). Such institutions' curriculum included areas like engineering, home economics, commerce, and teaching. Also, programs in science expanded through strong support from the federal government, as competition for technology advancement with the Soviet Union intensified during the Cold War period (Geiger, 2016). However, there was also growth in the arts and sciences, as institutions focusing solely on occupational programs, such as teacher education schools, gradually added programs in the arts and sciences to transition to comprehensive institutions teaching a wide range of curricular areas.

In the 1960s and 1970s, student movements influenced the curriculum. Students actively voiced their opinions and staged protests demanding that the curriculum take on greater social relevance, and encouraged institutions to play more active roles addressing social problems (Geiger, 2016). Such movements have resulted in the creation of new programs of study, including African American studies and gender studies (Boxer, 1998; Rojas, 2006, 2007). Later, in the 1980s and 1990s, students' demand for relevance shifted toward occupational programs, and the number of degrees awarded in the arts and sciences declined significantly (Geiger, 1980; Turner & Bowen, 1990).

As a reflection of the relationship between higher education and the society, changes in the curriculum provides a valuable lens through which to examine the history of higher education (Bastedo, 2016). Throughout history, new forms of knowledge have been added to the curriculum, while existing forms of knowledge have been highly resilient in maintaining their presence. In this way, the college curriculum has gradually adapted to changing social, economic, and political circumstances over time (Bastedo, 2016).

Empirical Literature on Curricular Change

How curricular decisions are made

Making curricular changes in the face of fiscal challenges involve strategic assessments of relative value across programs based on factors like quality, demand, cost, and mission centrality (Dickeson, 2010; Gumport, 1993; Slaughter, 1993). Specifically, Dickeson (2010, p. 66) recommends using the following ten criteria in making curricular decisions: 1) History, development, and expectations of programs; 2) External demand for the program; 3) Internal demand for the program; 4) Quality of program inputs and process; 5) Quality of program outcomes; 6) Size, scope, and productivity of the program; 7) Revenue and other resources

generated by the program; 8) Costs and other expenses associated with the program; 9) Impact, justification, and overall essentiality of the program; 10) Opportunity analysis of the program. While the specific criteria used by individual institutions can vary, they generally encompass these ten elements, particularly those related to financial revenue and cost (Eckel, 2002; Gumport, 1993; Slaughter, 1993)

Studies have also examined how the above criteria are actually utilized in curricular decisions in times of fiscal challenges. Ashar and Shapiro (1990) use departmental data from a public research university and test whether departmental performance on the stated criteria for faculty layoffs matches actual decisions. They find that quantitative indices reflecting departmental performance on productivity, mission centrality, and external support are significantly correlated with faculty layoff decisions, indicating that decision-making was done by rationally connecting rules, information, and decisions. On the other hand, qualitative studies have highlighted the irrational ways in which decisions are reached, owing to the difficulty of measuring and objectively comparing programs across different criteria (Eckel, 2002; Gumport, 1993; Slaughter, 1993). These studies demonstrate how valued judgements, preferences, and structural factors can determine curricular decisions. Despite the seemingly conflicting findings on the rationality of curricular decisions across these studies, it would likely be inaccurate to conclude that only one perspective is correct. Rather, the studies as a whole highlight the complexity of decision-making in higher education institutions.

Factors associated with curricular change

Market demand. A major factor deemed to be associated with curricular change is market demand. The basic idea is that colleges and universities monitor market signals and use them as the basis for making curricular adjustments (Engell & Dangerfield, 1998). The market

for the higher education curriculum can include multiple actors, including employers in the labor market, students, and providers of gifts and grants. In a study of 246 colleges and universities from 1980 to 2000, Brint and colleagues (2012) assessed how the demand by each of these market groups is associated with curricular change. Although the study finds no clear connection between the income growth of occupations and curricular change in related fields, the study does find positive correlations between the number of graduates in a given field and the fields' curricular expansion across the entire landscape of higher education institutions. Also, for some fields, like computer science, a positive correlation was found between funding by the National Science Foundation and curricular expansion, but in other areas, particularly the humanities and the arts, no such relationship was found.

Through an in-depth qualitative study conducted at a large public research university, Armstrong and Hamilton (2013) document the role of social class in how the university incorporates student demand in curricular decisions. The authors find that the institution creates and supports “easy majors,” which are programs with undemanding academic requirements, with post-graduate success depending on individual characteristics and social ties more so than GPA. The purpose of expanding such programs is to allow students from wealthy backgrounds, or those with the greatest ability to pay tuition, to enjoy their social experiences (e.g., parties) while not failing academically. The study demonstrates that the way in which colleges and universities account for student demand may not be simply driven by students' intellectual curiosities, but by the ways in which students, particularly those from wealthy backgrounds, desire to consume the higher education experience.

Social movements. In addition to market demand, social and political movements have influenced the higher education curriculum. In the midst of the Civil Rights Movement of the

late 1960s, rallies and demonstrations by Black students, demanding that institutions incorporate knowledge of Black culture into the curriculum, led to the creation of programs in African American studies (Rojas, 2006). In similar ways, movements led by students and faculty led to the creation of programs in women's studies and ethnic studies (Boxer, 1998; Rojas, 2007). These movements also had an indirect effect on the curriculum through increased use of ethnic- or gender-focused theory and materials in courses and the growth of courses focusing solely on study of marginalized ethnic groups (Cole, 2006). The incorporation of ethnic and gender studies was not demanded solely for the purposes of satisfying intellectual curiosity or because they were deemed to carry economic value. Rather, they were demanded out of the belief that higher education had a responsibility to represent and disseminate knowledge that reflects the viewpoints of marginalized populations of society, and the process of their creation highlights the social role that is expected of the higher education curriculum.

Institutional characteristics. Studies have also explored various institutional characteristics associated with curricular change. Using a nationally representative sample of US colleges and universities, Brint and colleagues (2011) identify newly established and emerging fields of study and explore institutional characteristics that are linked with their adoption. They find that institutions located in geographic regions with larger numbers of early adopting institutions are positively associated with the likelihood of adopting new fields themselves. This implies that the behavior of peer institutions can drive curricular change. Also, larger institutions are more likely to adopt new emerging fields of study. Larger institutions likely have greater capacity in terms of resources, students, and personnel to create and maintain programs in new areas. Institutional mission also plays a role as colleges with higher levels of commitment to the

arts and sciences in 1970, the base year of the study, were found to be more likely to adopt new programs in the arts and sciences while less likely to adopt new programs in occupational areas.

Cultural legitimacy of programs. The perceived legitimacy of programs can also play a role in curricular decisions. In an in-depth qualitative study of program decisions at public universities, Eckel (2002) finds that although market-related factors like cost and revenue are mentioned, at times, programs were closed for being too “professional,” or too “close to the market.” In addition, using large-scale, longitudinal data covering 1975 to 2010, Osley-Thomas (2019) compares the likelihood of closure between academic and occupational fields of study. Using event history analysis, the study finds that programs in practical fields closed at a faster rate than liberal arts programs, with differences being attributed to their cultural value. Occupational programs are viewed to be more susceptible to change due to rapidly changing market demand, while academic programs are more likely to be protected by institutions for their cultural legitimacy.

Institutional revenue. Institutional revenue from various sources have also been found to be associated with curricular change. In a study of private liberal arts colleges, Kraatz and Zajac (1996) find that proportion of revenue from tuition and fees is positively associated with the adoption of professional degree programs. Although they examine degree production rather than curricular change per se, Taylor and colleagues (2013) find that at private bachelor’s degree-granting colleges, net revenue from tuition is positively correlated with the number of bachelor’s degrees awarded in the humanities in the early 1990s, but this relationship dissipates over time and becomes negative in more recent years. Also, they find that revenue from federal grants and contracts is negatively correlated with degree production in the humanities at private

research universities, which may be due to institutions shifting their focus toward science and technology areas funded by grants.

Politics. A number of qualitative studies have shed light on the role of politics in curricular decision-making. Eckel (2002) finds that department leaders' capacity to mobilize political support, both within and outside of the institution, played a critical role in the decision for program discontinuance. Other studies perceive the politics of prestige and status to be systematically embedded in higher education organizations, and that this strongly influences curricular outcomes. In particular, these studies shed light on how such power dynamics work to disadvantage programs disproportionately represented by women and racially marginalized groups, irrespective of how well they meet the stated criteria for decision-making (Gumport, 1993; Slaughter, 1993). The studies highlight that curricular change is not necessarily the outcome of value-neutral processes.

Limitations of Existing Studies

Existing studies in the higher education literature have examined various organizational behavior associated with declines in state appropriations, as well as factors associated with changes in the curriculum. However, to date, no study has examined the direct link between state divestment and curricular change. A contribution of this study is to fill this gap in the literature by assessing the impact of state appropriation declines on changes in programs offered by public colleges and universities.

Also, existing studies on curricular change tend to either be qualitative case studies that examine a single or small number of institutions, or quantitative studies that rely primarily on descriptive analysis. Although these studies provide meaningful insights into curriculum, the

findings of qualitative studies may be limited in generalizability and descriptive studies may not adequately account for factors that can bias estimates.

Lastly, most studies on curricular change have used data that are at least a decade old. In particular, qualitative studies examining decision-making processes took place in the early 1990s or 2000s. Significant social, political, and economic changes that have taken place since then may have altered the ways in which curricular changes are made. For example, state funding mechanisms have increasingly become performance-based, where funding is provided based on how well institutions meet pre-determined measures of performance (Kelchen, 2018).

Demographic changes, with steep declines in the college-age population in some parts of the country, have seriously threatened the survival of colleges and universities (Grawe, 2018). At the institution level, an increasing number of public colleges and universities have adopted decentralized funding systems known as responsibility center management (RCM), which encourages inter-departmental competition for students and resources while enhancing departments' fiscal autonomy (Jaquette et al., 2018). Rapid changes in the labor market's demand for skills (Deming & Noray, 2020), and significant increases in tuition and student debt may have changed what students expect and demand from a college education. By using the most recently available data on public colleges and universities, covering the past two decades, this study will provide the most up-to-date analysis on curricular change.

Conceptual Framework

Theoretical perspectives on organizational behavior

As highly complex organizations with multiple goals and objectives, no single conceptual framework is sufficient for completely explaining the behavior of all colleges and universities. In particular, given the visibility and strong connection to institutions' core identity, changes in the curriculum in response to state funding changes may not necessarily follow the same patterns as

that of other outcomes, such as out-of-state student enrollment. Building on the previous literature, the current study will consider three broad conceptual perspectives in understanding organizational behavior on curricular change in association with changes in state funding. They each shed light on how colleges and universities can be viewed as entities that strategically adapt to the changing environment, as actors constrained by norms and legitimacy, and actors influenced by political power. While these different perspective are at times viewed to be competing against each other (Kraatz & Zajac, 1996), all perspectives contribute to understanding different aspects of the behavior of colleges and universities, and observed changes in the curriculum are likely the result of the combination of these different dynamics.

Strategic adaptation. The strategic adaptation perspective gives agency to colleges and universities, viewing them as entities capable of strategically adapting to the changing environment (Kraatz & Zajac, 1996). Rooted in the strategic adaptation perspective, resource dependence theory focuses on the relationship between organizations and their resource streams. The theory views the maintenance of stable and sufficient supply of resources to be one of the most critical functions of organizations (Pfeffer & Salancik, 1978); Tolbert, 1985). From this perspective, making changes to the curriculum in response to declines in state appropriations could be viewed as a strategy designed to manage declines in a major resource stream.

Institutionalism. A different perspective on organizations, referred to broadly as institutionalism, emphasizes how the behavior of educational organizations are driven by institutionalized norms, culture, and expectations of legitimacy (Powell & Dimaggio, 1991). From this perspective, given the ambiguity of the goals and technology associated with colleges and universities, conforming to order can be a crucial factor for organizational survival (Meyer & Rowan, 1977). In the absence of tangible, universal measures of performance, the formal

structure of schools and colleges, including the curriculum, would be influenced by the pursuit of maintaining legitimacy. Simply put, rational calculations of financial costs and benefits alone would not be sufficient to drive curricular change, as colleges and universities would also be sensitive to notions of legitimacy within the cultural and historical parameters of higher education.

Political economic power. In addition to strategic decision-making and institutional norms, political economic power is another factor that can play a role in how curricular adjustments are made in response to state funding declines. This view focuses on the fact that higher education institutions are comprised of programs (or departments) that have their own interests, agenda, and preferences (Slaughter, 1997, 2002). Curricular changes, whether new programs are added or existing ones are removed, can directly and indirectly affect programs' interests, opening up the possibility of power relations to influence directions of change. Such power relations, in turn, are affected by the power structure of the broad society through the various relationships that programs have with external actors, including the graduates that they produce, the beneficiaries of their research, professional organizations, and funding providers. Hence, curricular changes do not simply reflect value-neutral scientific advancement, but involve power struggles both internal and external to institutions, and programs associated with entities on the lower end of the power hierarchy would be at a disadvantage in curricular decisions (Gumport, 1993; Slaughter, 1993).

Changes in the curriculum

As described above, various factors can influence and shape the behavior of colleges and universities, and multiple perspectives can shed light on different aspects of their behavior. The following sections will describe how these different perspectives can help explain how public

higher education institutions would adjust their curriculum in response to declines in state appropriations.

Expansion versus contraction. When experiencing declines in revenue from state appropriations, one way in which institutions can respond is by reducing the number of programs offered. This would directly lower costs, and perhaps contribute to leaner management and more efficient allocation of resources (Gumport & Pusser, 1997; Mingle & Norris, 1981; Slaughter & Rhoades, 2004). As public colleges and universities increasingly adopt managerial practices that emphasize cutting costs in the name of improving fiscal efficiency (Gumport, 2000), contraction of the curriculum may be particularly encouraged in the face of state funding declines. However, diminishing the number of programs may be easier said than done. First, closing programs will likely face backlash from faculty, staff, students, as well as from those outside of the institution, such as alumni. Second, contracting curricular offerings may not necessarily be in the best interest of the institution. Higher education institutions generally strive to enhance their organizational status (O'Meara, 2007), and this involves maintaining a comprehensive curriculum across diverse fields of study, as well as advanced degree programs. Third, from a financial perspective, eliminating programs alone may not be enough to fully address the declining trends in state appropriations, and institutions must also consider ways to generate revenue in order to achieve long-term survival.

A possible way for public colleges and universities to generate revenue would be to expand its curriculum as a way to attract and attain more tuition-paying students (Brinkman, 1990; Grawe, 2018; Hearn & Ciarimboli, 2017; Mingle & Norris, 1981). Expanding the curriculum would allow institutions to cater to a wider range of student needs and demands, not only in terms of different areas of study, but also across different degree levels. However,

creating new programs would require hiring additional personnel, using additional space, and other forms of financial and administrative costs. The absence of sufficient investment would lower the quality of programs, which would not be conducive to attracting students. Also, for programs in similar fields, the addition of a new program would not necessarily be welcomed by faculty in existing programs, so careful coordination would be needed. Therefore, even if institutions opt to expand its curriculum as a means to attract revenue, this would require significant cost.

Occupational versus academic fields of study. In addition to overall expansion or contraction of the curriculum, public colleges and universities can alter the composition of programs across different fields of study in response to declining support from the state. In order to increase and stabilize tuition revenue, institutions could expand programs in areas that teach the skills and knowledge demanded by tuition-paying students. Student preferences, as reflected by enrollment patterns, have increasingly tilted toward occupational areas of study relative to the liberal arts (Turner & Bowen, 1999). Annual surveys of college freshman indicate that a growing proportion of students make college decisions based on career-related reasons (Eagan et al., 2016). Increases in tuition and student debt, which are attributable to declines in state funding, may have contributed to students increasingly making college decisions based on career prospects and choosing programs in occupational fields. Hence, as a way of aligning curricular offerings with student preferences, institutions may increase curricular focus in occupational areas. This could be done by increasing the number of programs in occupational fields, or decreasing the number of programs offered in academic fields, or some combination of both.

While market demand might predict curricular shifts toward occupational fields of study, public colleges and universities also have reasons to maintain programs in academic fields. First,

academic fields often serve as the academic foundations for occupational fields, which tend to utilize the theories and methods developed by scholars in academic fields of study. Second, colleges and universities are sensitive to maintaining and enhancing perceived academic legitimacy, which is generally associated with academic fields of study due to their deeper histories and traditions within higher education (Geiger, 1980). Third, demand still exists on the part of students to study academic fields. In particular, the most selective institutions have maintained a relatively stable number of graduates in academic fields (Hearn & Belasco, 2015). For these reasons, colleges and universities may be hesitant to close academic programs when facing state appropriation declines. Even if occupational programs do increase owing to their closer connections to the labor market, this may not necessarily be accompanied by program declines in academic fields.

Certificates. In addition to traditional degree programs, the offering of non-degree certificate programs is another way in which public colleges and universities can pursue revenue. Certificates refer to non-degree programs, typically focused on occupational areas, that take less time to complete than bachelor's degrees. Also, certificate programs generally have an open admissions policy, have lower prices than traditional than degree programs, and offer flexible course scheduling. For these reasons, certificates have become significant access points for postsecondary education to those who cannot or do not need traditional degree programs. A certificate is the highest level of education for approximately 10 percent of the adult population, and many individuals who already have associate's or bachelor's degrees have attained a certificate of some form (Baum et al., 2020; Carnevale et al., 2012). Also, studies find that certificate programs have positive labor market outcomes in terms of earnings and employment probability (Xu & Trimble, 2015). Since individuals that seek certificates typically differ from

those seeking degree programs, the creation of certificates could allow institutions to diversify the pool of students from whom they receive tuition. Furthermore, due to the shorter duration of and narrower focus of study, it will likely be easier for institutions to create (or close) programs. Therefore, for potential revenue gains and flexibility of operation, public colleges and universities may expand certificate programs in response to declines in state appropriations.

Gender composition and curriculum change. The relationships of political economic power within higher education are viewed to reflect the power relationships embedded in the broader society (Gumport, 1993; Slaughter, 1993). In particular, gender stratification in society may be associated with gender relations in higher education, where programs that serve a disproportionately large number of women are disadvantaged compared to programs serving a large proportion of men (Gumport, 1993; Slaughter, 1993). Relatedly, gendered practices and biases have contributed to women faculty being disadvantaged over men faculty in terms of pay, promotion, status, and work recognition (Acker, 1990; Johnson & Taylor, 2019; Maliniak et al., 2013; O'Meara et al., 2017; Toutkoushian & Conley, 2005). Therefore, the gender composition of programs can be a factor that influences curricular changes associated with state appropriation declines, with women-majority fields being more likely to become closed compared to men-majority fields.

Institutional variation. Colleges and universities vary on a number of dimensions which could be associated with differences in how they make curricular adjustments in response to state appropriation declines. In particular, institutions vary in terms of the degree of resource dependence on state appropriations. The concept of dependence on a given resource can be defined through the following conditions: 1) the resource is critical for organizational survival; 2) other organizations have discretion over the resource; 3) there are few alternative sources of

resource (Pfeffer & Salancik, 1978). While these conditions generally hold for state appropriations in U.S. public higher education, the degree of dependence varies across institutional type. Doctoral universities, particularly those that are the most research-intensive, rely relatively less on state appropriations for their revenue, meaning that the criticality of state appropriations would be lower than that of other institutional types, such as master's universities or baccalaureate colleges. Also, doctoral institutions tend to have greater capacity than other institutions to obtain revenue from alternative sources, such as private gifts and research grants. On the other hand, revenue from state appropriations comprise a larger proportion of overall revenue for master's and baccalaureate institutions, and other than revenue from tuition, are limited in their capacity to obtain revenue from alternative sources. Such differences in fiscal circumstances across institutional type, particularly as it pertains to the role of state appropriations, can drive how curricular adjustments are made in response to state appropriation declines.

Furthermore, colleges and universities vary in terms of their educational goals and circumstances. Public R1 universities, by definition, give relatively greater emphasis to research over teaching compared to other institutional types, and their institutional reputation depends more so on their research quality rather than what they teach. At other institutional types, relatively more emphasis is given to teaching over research. Relatedly, the reason why students decide to go to R1 universities may be driven more by the overall institutional reputation, as opposed to the availability of specific programs, while the greater emphasis on teaching may make program offerings a more important factor for students' decisions at other institutional types. Institutions may also vary in terms of the areas of study in which they carry relative expertise. For example, with greater experience in teaching and researching liberal arts and basic

science fields, R1 universities may have relatively more expertise in academic fields of study compared to other institutional types. Declines in financial support from the state may force institutions to survive on their own, leading to specialization in areas in which they have comparative advantages. For these reasons, the marginal benefits of different directions of curricular change, such as creating new programs overall or creating programs in certain fields, will vary across institutional types, which in turn can influence how curricular changes are made in response to state appropriation declines.

CHAPTER 3: DATA AND METHODS

Data

The main data for this study comes from the Integrated Postsecondary Education Data System (IPEDS), comprised of annual surveys for higher education institutions in the U.S. Managed by the Department of Education, all colleges and universities that participate in federal aid programs (i.e. Title IV institutions) are annually required to provide information to IPEDS. IPEDS survey components cover a wide range of institutional characteristics, including admissions, enrollment, completion, and finance. In particular, the Finance survey contains detailed information on revenue, including the amount received from state appropriations. Information on program offerings is derived from the Completion survey, which provides information on the number and types of programs offered. Each college or university is consistently identified across surveys and years through a unique ID.

Fields of Study

Classification of fields of study of programs in the IPEDS data is done through the NCES' Classification of Instructional Programs (CIP). The CIP is the US federal government's standard on instructional program classifications, and is utilized in surveys and databases pertaining to education. The CIP classifies programs into two-, four-, and six-digit series, designed in a hierarchical classification scheme. The two-digit series reflect the broadest grouping of related programs and the six-digit series provide the most detailed categorization of programs. For example, 13 is "Education," 1304 is "Educational Administration," and 130406 is "Higher Education." There is a total of 47 two-digit series, 422 four-digit series, and 1,848 six-digit series. The CIP was originally created in 1980 and updated with revisions in 1985, 1990, 2000, and 2010. With each update, adjustments were made in the coding scheme, with some existing codes removed and new codes added. I used the crosswalk files developed by the NCES

to adjust for revisions in codes and maintain consistency across the entire time span of the data used in the study.

Sub-categorization of fields of study

Occupational and academic fields of study. Using NCES classifications, programs for traditional degree programs (BA, MA, Doctoral degrees) are categorized as being part of either “occupational” or “academic” fields of study based on two-digit CIP codes.¹ Occupational fields consist of programs that are focused on developing practical skills relevant for specific jobs and industries, such as engineering, business, and education. Academic fields are those whose programs have a liberal arts focus, including philosophy, history, and English. Table 1 presents the specific fields of study that are classified as either occupational or academic.

‘High-earning, high-cost’ and ‘low-earning, low-cost’ occupational fields. To account for heterogeneity within occupational fields, I separately categorize occupational fields of study that are in high-earning fields; those whose graduates’ median earnings exceeds the overall median earnings across all fields of study.² High-earning occupational fields include architecture, business, computer science, engineering, and health. These fields are also relatively more expensive to operate, compared to other occupational fields, based on comparisons of the average cost of instruction (Hemelt et al., 2020). Therefore, on average, high-earning occupational fields may have greater potential for generating revenue due to higher demand, but they also require greater costs to operate, which can be a financial burden for institutions. Such fields are categorized as ‘high-earning, high-cost.’ Occupational fields of study that are not categorized as ‘high-earning, high-cost’ are separately categorized as ‘low-earning, low-cost.’ As

¹ More information on NCES classifications of occupational and academic fields of study can be found here: https://nces.ed.gov/surveys/ctes/tables/postsec_tax.asp

² Information on earnings of graduates across fields of study were obtained from Carnevale et al. (2015).

for programs in academic fields, graduates generally tend to have lower earnings and have relatively lower costs of instruction, and the lack of within-field variation makes it difficult to make distinctions based on earnings and cost. Hence, this section will only include occupational fields of study.

Fields of study by gender composition. Based on the gender composition of graduates within each field of study, I categorized fields of study as either ‘women-majority or ‘men-majority’ among occupational or academic fields. First, using data pooled across all years included in the study, I calculated the percentage of women graduates. Second, I calculated the median percentage of women within academic and occupational fields, respectively. Among academic fields, the median percentage of women is 60.10 percent, and among occupational fields, the median percentage of women is 47.39 percent. Third, for fields of study whose percentage of women exceeds the median within academic or occupational fields, I classified those programs as ‘majority-women,’ and others as ‘majority-men.’ In total, I have the following four groups based on gender composition: 1) Academic majority-women programs; 2) Academic majority-men programs; 3) Occupational majority-women programs; 4) Occupational majority-men programs. The specific fields of study categorized as either ‘majority-women’ or ‘majority-men’ are presented in Table 1.

Certificate programs. In addition to traditional degree programs (i.e., BA, MA, Doctoral), I examine changes in the number of certificate programs. Certificate programs refer to programs in the data defined as one of the following: 1) Award of less than one academic year; 2) Award of at least one but less than two academic years; 3) Award of at least two but less than four academic years; 4) Postbaccalaureate certificate; 5) Post-master’s certificate.

Measuring Number of Programs

The main dependent variable of this study is the number of programs offered by each institution. The number of programs offered are derived from the IPEDS Completion Survey, which provides annual information on student completion by CIP codes, for each degree level. For a given institution in a given year, the number of programs is represented by the number of unique six-digit CIP codes,³ as this is the level used by institutions and policy makers when referring to program count.

Separate program counts will be used for each sub-categorization of degree programs across each program level (bachelor's degrees, master's degrees, and doctoral degrees). Program counts will also be used for certificates requiring less than four years to complete, but because certificate programs are primarily occupational in nature, I do not make distinctions between occupational or academic fields. In order to assess the relative emphasis given to occupational versus academic fields, I also include an outcome variable measuring the percentage of programs in occupational fields among the total number of programs.

In summary, the dependent variables of this study are the total number of degree programs, the number of degree programs in occupational fields, the number of degree programs in academic fields, the percentage of degree programs in occupational fields, the number of degree programs in 'high-earning, high-cost' and 'low-earning, low-cost' occupational fields, the number of certificate programs, and the number of degree programs in women- and men-majority fields within occupational or academic fields. Table 2 reports the list of dependent variables used in the study.

³ IPEDS only reports CIP codes for programs in existence. Thus, programs that are reported to have zero completers are included in the program counts.

Table 1. Categories of fields of study for degree programs

	Occupational	Academic
Men-majority	Agriculture; Natural resources; Architecture; Journalism; Computer and Info sciences; Engineering; Engineering technologies; Law; Theology; Science technologies; Business	Biological/life sciences; Mathematics; Philosophy; Physical sciences; Social sciences; Fine/performing arts; History
Women-majority	Family/consumer sciences; Library sciences; Health; Public administration and social services; Education; Communication; Personal services; Parks, recreation, fitness; Protective services;	Psychology; Foreign languages; English; Area/ethnic studies; Interdisciplinary studies; Liberal/general studies;

Table 2. List of dependent variables

Variable
<ul style="list-style-type: none"> • Total number of programs • Number of programs in occupational fields • Number of programs in academic fields • Number of programs in women-majority occupational fields • Number of programs in men-majority occupational fields • Number of programs in women-majority academic fields • Number of programs in men-majority academic fields • Number of programs in high-earning, high-cost occupational fields • Number of programs in low-earning, low-cost occupational fields • Number of programs in certificate programs

Measuring State Appropriations

The independent variable of interest is the natural log of institutional revenue from state appropriations per full-time equivalent student (FTE), averaged across the previous three years. The variable was designed in this way to account for the likely lag between changes in funding and curricular decisions, and to model accumulation of funding changes rather than year-to-year changes. FTE was calculated using information on credit hours provided in IPEDS. All monetary values are adjusted for inflation based on the 2015 Consumer Price Index (CPI).

Control variables

I include a number of state-level control variables that could be associated with curricular change. Specifically, I control for each state's college-age population (aged 19-23), unemployment rate, and income per-capita. These factors are associated with the state's overall applicant pool for higher education, individuals' capacity to enroll in higher education, as well as the type of programs or fields of study that individual's might be interested in studying. For example, increases in the unemployment rate might induce more individuals to attend college to improve their human capital, and might also encourage individuals to study in areas with a direct link to labor market skills conducive to employment.

I do not include institutional-level control variables because previous studies have found that state appropriations affect a variety of institutional outcomes, including student enrollment, expenditure, and revenue from other resources. Hence, including a variable that might be an outcome of state appropriation changes could bias the estimate of the main coefficient of interest. Similar approaches were taken in recent studies examining the impact of state appropriations on various college and university behavior (e.g., Bound et al., 2019; Webber, 2017).

Sample

The analytic sample for this study includes bachelor's degree-granting public higher education institutions in the U.S, defined by the 2005 Carnegie Classification of Institutions of Higher Education (Carnegie Foundation, 2005)⁴ as either a research/doctoral university, master's university, or baccalaureate college. Among doctoral/research universities, institutions with the highest level of research intensity ("Research university (very high research activity)"), often referred to as "R1" institutions, are classified into a category of their own. The final categorization of institutions used in the study are the following:

- 1) R1 universities
- 2) Less research-intensive (LRI) doctoral universities
- 3) Master's universities
- 4) Baccalaureate colleges

The study excludes special-purpose institutions that focus on specific areas of study, such as religion, music, health, and military training, as well as institutions that grant both associate's and bachelor's degrees.

The full period of data used for this study ranges from 1999-2000 to the 2018-2019 academic years.⁵ For institutions that are part of multi-campus systems, a survey component of the IPEDS data may be reported only for the main campus or the system as a whole, rather than at the level of the individual campus. This is referred to as a "parent-child relationship" in reporting. To address this issue, I removed all institutions that took part in parent-child reporting

⁴ The Carnegie Classifications, originally developed by the Carnegie Foundation, classify institutions into roughly comparable subgroups based on academic activities and curricular structure and offerings. It includes all degree-granting colleges and universities in the U.S. that are accredited by agencies recognized by the U.S. Department of Education.

⁵ Year refers to the spring year of the fall-spring academic year.

during the duration of the study's data. To check for the consistency of estimates, I conducted analyses where all data is aggregated to the parent level based on 6-digit OPEID codes, and found that the results do not meaningfully vary.

As is typical of most survey data, IPEDS contains missing values. Hence, the analytic data is an unbalanced panel, where values for some institutions will be missing for certain years. Stepwise deletion was used to remove observations that have missing values for any of the variables included in the analysis. The final analytic sample consists of 443 institutions, with an overall sample size of 8,785 across all years included in the data. Descriptive statistics are reported in Table 3.

Table 3. Descriptive statistics

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(7)	(8)
	All institutions		R1 universities		LRI doctoral universities		Master's universities		Baccalaureate colleges	
	2000	2019	2000	2019	2000	2019	2000	2019	2000	2019
Total number of programs	62.17	86.65	118.43	165.80	83.59	112.67	52.93	73.79	26.57	37.90
	(36.20)	(50.10)	(38.17)	(47.53)	(30.45)	(40.48)	(22.56)	(33.47)	(14.64)	(21.88)
Occupational programs	36.82	52.61	66.98	95.08	51.25	70.65	31.16	45.17	16.62	22.97
	(23.34)	(31.46)	(24.35)	(29.07)	(21.15)	(28.03)	(16.72)	(22.79)	(13.36)	(16.89)
Academic programs	25.35	34.04	51.45	70.71	32.34	42.02	21.77	28.62	9.95	14.93
	(15.69)	(21.40)	(18.99)	(24.34)	(12.03)	(15.77)	(9.31)	(13.59)	(6.51)	(8.96)
Occupational programs (%)	58.32	60.44	56.47	57.51	60.69	62.46	57.63	60.62	59.34	59.32
	(13.86)	(10.98)	(8.81)	(7.39)	(8.98)	(7.80)	(12.15)	(9.85)	(24.54)	(18.58)
High-earning, high-cost occupational programs	15.37	23.65	31.22	49.29	23.46	34.31	11.56	18.29	7.40	9.57
	(11.55)	(17.23)	(11.62)	(17.26)	(10.30)	(14.29)	(7.90)	(11.56)	(7.01)	(8.99)
Low-earning, low-cost occupational programs	21.44	28.96	35.76	45.80	27.80	36.34	19.60	26.87	9.22	13.40
	(13.85)	(16.84)	(17.05)	(17.78)	(13.55)	(16.97)	(10.62)	(13.56)	(8.24)	(9.89)
Certificate programs	3.18	19.19	5.94	42.24	4.34	28.14	2.56	14.78	1.97	5.80
	(4.88)	(21.66)	(5.68)	(30.40)	(5.83)	(23.23)	(4.46)	(15.87)	(3.06)	(9.75)
Women-majority academic programs	15.57	22.38	35.16	50.49	19.96	27.53	12.67	18.11	5.95	9.48
	(11.36)	(16.16)	(15.36)	(20.63)	(9.16)	(12.14)	(6.24)	(9.82)	(3.70)	(5.96)
Men-majority academic programs	46.60	64.27	83.27	115.31	63.63	85.14	40.26	55.67	20.62	28.42
	(26.77)	(36.05)	(27.09)	(32.13)	(23.40)	(30.89)	(18.34)	(25.48)	(13.42)	(18.32)
Women-majority occupational programs	24.52	35.19	44.65	62.88	32.65	44.34	21.69	31.53	9.29	14.68
	(16.53)	(21.82)	(19.77)	(23.61)	(15.70)	(21.09)	(12.05)	(16.39)	(8.01)	(9.35)
Men-majority occupational programs	37.65	51.46	73.78	102.92	50.94	68.34	31.24	42.26	17.29	23.22
	(21.70)	(30.73)	(22.22)	(28.67)	(17.73)	(22.82)	(12.48)	(19.47)	(9.13)	(15.26)

State appropriations per FTE (\$)	11301.44	7292.98	15616.60	9800.78	13618.98	7605.30	9821.67	6487.15	10693.59	8063.09
	(20902.0)	(4096.22)	(14907.90)	(4260.27)	(34706.23)	(4282.05)	(17177.56)	(3427.28)	(11872.82)	(5126.77)
Reliance on state appropriations revenue (%)	39.96	27.86	31.56	18.60	38.76	25.34	41.37	29.33	42.48	32.97
	(9.10)	(10.35)	(9.72)	(9.05)	(8.05)	(9.03)	(8.55)	(9.56)	(8.31)	(10.80)
Reliance on tuition revenue (%)	24.49	42.69	17.36	31.24	24.41	43.37	26.05	44.89	24.02	42.24
	(8.05)	(13.13)	(6.25)	(12.01)	(6.82)	(12.07)	(7.89)	(12.12)	(8.52)	(14.68)
Number of institutions	443		49		83		248		63	

Source: Integrated Postsecondary Education Data System (IPEDS).

According to Table 3, there has been an increase in the average number of programs across all program types offered by public colleges between 2000 and 2019. The overall average number of programs has increased from 62.17 to 86.65. Also, the average number of both occupational and academic programs for degree programs have increased during this period, increasing from 36.82 to 52.61 and 25.35 to 34.04, respectively. The percentage of occupational programs out of all programs has increased from 58.32 to 60.44 percent. There also have been increases in both the average number of ‘high-earning, high-cost’ occupational programs and ‘low-earning, low-cost’ occupational programs. In terms of percentage increase, the average number of certificate programs has increased the most across all program types. For all public four-year institutions, the average number of certificates programs increased from 3.18 per institution in 2000 to 19.19 in 2019, an increase of approximately six folds. The average number of both women-majority and men-majority programs have also increased during this period.

Changes in revenue have also occurred over time. Across all institutional types, average state appropriations per FTE have declined. Overall, for all institutional types combined, average state appropriations per FTE have gone from \$11,301.44 in 2000 to \$7292.98 in 2019, a decline of approximately 35 percent. Reliance on state appropriations have also declined over this period for all institutional type, but there are significant differences in the absolute degree of reliance. Among all institutional types, reliance on state appropriations is lowest at public R1 universities, comprising 18.60 percent of total revenue in 2019. On the other hand, public baccalaureate colleges receive approximately one-third of its total revenue from state appropriations. Amid declines in reliance on state appropriations, reliance on tuition revenue has increased, with different levels of reliance across institutional types. In 2019, reliance on tuition revenue was 31.24 percent at public R1 universities, and exceeded 40 percent at other institutional types.

Empirical Model

To examine how state appropriations influence curricular change, I will estimate a panel fixed effects model through ordinary least squares (OLS) regression. The regression model to be estimated is expressed as follows:

$$\log(y_{it}) = \alpha_i + \gamma_t + \beta \log(\text{StAppropriation}_{i-3yravg}) + \boldsymbol{\theta} \mathbf{X}_{st} + \varepsilon_{it} \quad (1)$$

where i indexes institutions, s indexes state, and t refers to year. y is the outcome variable; number or percentage of programs. α_i and γ_t are the institution and year fixed effects, respectively. $\log(\text{StAppropriation}_{i-3yravg})$ is the natural log of institutional revenue received from state appropriations per FTE enrollment, averaged over the previous three years. \mathbf{X}_{st} is a vector of state-level covariates, including the natural log of the college-age population (age 19-23), the natural log of income-per-capita, and the unemployment rate. ε is the stochastic error term. For all regressions, standard errors are clustered at the institution level to make statistical inference robust to heteroscedasticity and serial correlation within institutions over time. The coefficient of interest is β , which represents the change in the curriculum associated with changes in the average revenue from state appropriations from the previous three years. The model will be estimated for all public four-year institutions combined, and for subsamples of institutions based on institutional type.

Pre- and Post-2008 Financial Crisis

The 2008 financial crisis was an extreme economic shock that affected all parts of the society and economy, including higher education. It not only negatively affected the financial budget of colleges and universities, but was detrimental for the economic status of individuals and households. The drastic fiscal changes brought upon by the financial crisis could have altered the behavior of colleges and universities, as well as individual and households, both of

which could have implications for curricular change. It may have caused institutions to take a more conservative fiscal approach to managing the curriculum. For individuals and households, the scarcity of employment opportunities could have influenced the types of degrees or fields of study pursued. Therefore, in addition to the main analysis covering the entire duration of the data, I conduct separate analyses using data for the pre-financial crisis (2000-2008) and post-financial crisis (2009-2019) periods.

State-By-Year Fixed Effects

The main results derived from Equation 1 control for institution and year fixed effects, meaning that time-invariant cross-sectional differences between institutions and average year-to-year changes are controlled for. In addition to controlling for these two dimensions, it may be necessary to control for state-specific changes over time that could potentially influence changes in the curriculum. For example, states have adopted different forms of higher education governance systems over time, granting varying degrees of autonomy to public colleges and universities in making curricular changes. Also, some states have adopted the practice of charging differential tuition across fields of study (Stange, 2015), which could influence both student demand and institutions' resource allocation decisions regarding the curriculum.

The inclusion of state-by-year fixed effects in the regression model would control for state-specific year-to-year changes, and their inclusion could provide more accurate estimates on the relationship between changes in state appropriations and the curriculum. However, when considering the fact that state appropriations trend variation likely occurs more so between states than within states, the state-by-year fixed effects may soak up an excessive amount of variation in revenue from state appropriations. Also, because estimates would be identified through within-state, within-year differences in state appropriations and the curriculum, sample sizes may

be insufficient when estimating the models separately for each institutional type, particularly for public R1 universities and baccalaureate colleges.

Poisson Regression

In addition to the linear relationship estimated through Equation 1, I also estimate the association between state appropriations and the outcome variables using a fixed effects Poisson model. The main outcome variables for this study are the number of programs among different sub-categories of fields of study, and thus constitute count data of non-negative integers. When outcome variables contain these characteristics, the distributional assumptions of the Poisson model may be applicable. The specific model estimated is expressed as follows:

$$y_{it} = \exp [\alpha_i + \gamma_t + \beta \log (StAppropri_{t_3yrravg}) + \boldsymbol{\theta} \mathbf{X}_{st} + \varepsilon_{it}] \quad (2)$$

with subscripts and indices identical to those of Equation 1. The major difference between Equations 1 and 2 is the functional form of the model. Rather than a linear model, as in Equation 1, the model expressed above is an exponential function. Standard errors are clustered at the institution level.

Limitations

The current study carries a number of limitations. First, data limitations prevent direct measurement of decisions to either create new programs or close existing programs. The main outcome variable used in the study, the number of programs, would be the result of net changes between creation and closure of programs, but the data does not allow for examining the underlying dynamics involved with program change. One possible way to measure program creation and closure using the available data would be to define creation as cases where a program appears for the first time for a given institution, and define closure as cases where a previously existing program no longer appears in the data. However, even this approach carries

significant limitations, as the coding of programs have been found to be inconsistent, particularly at the 4- and 6-digit CIP levels (Jaquette & Parra, 2014). With inconsistent coding, it would be difficult to distinguish whether the appearance of a new CIP code is due to the actual creation of a new program or a different CIP code being given to an existing program. The same concerns would apply to the removal of a CIP code being indistinguishable between actual program closure and change in codes for a given institution in a given year. Examining the number of programs as done in the current study does contribute to understanding the general direction of program changes, but directly assessing program creation and closure as outcomes would provide additional nuance to understanding how state appropriations are associated with curricular changes.

The second limitation of the study relates to the fact that the dependent variables only measure the curriculum in terms of quantitative counts, and cannot account for qualitative changes. For the same program or field of study, there can drastic qualitative differences over time. For example, although the number of programs within a field of study may remain the same throughout the duration of the data, state appropriation declines may cause significant declines in the number of faculty and staff, as well as other resources. In 2018, the University of Wisconsin – Stevens Point announced it would cut a number of programs in the liberal arts (Flaherty, 2018). That plan was ultimately cancelled, but only after a number of faculty had been laid off or relocated. In qualitative terms, drastic changes had occurred, but the dependent variable used in this study is not able to capture such changes as long as programs continue to be offered.

The third limitation of the study pertains to the degree to which causal interpretations can be made on the relationship between state appropriations and curricular change estimated

through the study's model. By including institution fixed effects, the model controls for all unobservable time-invariant differences across institutions. The inclusion of year fixed effects controls for average year-to-year changes applicable to all institutions. If these factors were the only sources of bias in the relationship between state appropriations and curricular change, the estimates obtained from the model would reflect causal relationships. However, I cannot completely exclude the possibility of bias rooted in unobservable time-varying factors. Previous studies examining how state appropriations affect institutional behavior and outcomes have used instrumental variable (IV) estimation to isolate exogenous changes in revenue from state appropriations (Bound et al., 2019, 2020; Chakrabarti et al., 2020; Deming & Walters, 2017; Webber, 2017). These studies use aggregate state-level appropriations as an IV for state appropriations received at the institution-level. However, there are concerns over the applicability of this approach to the current study, since state-level variation related to aggregate state funding, such as higher education governance systems and other policies, could be associated with curricular change at the institutional level. For example, changes in the state governance structure could directly affect curricular change at public institutions, but governance structure is itself related to levels of state funding (Tandberg, 2013). Hence, the conditions of exogeneity and the exclusion restriction, required for valid instrumental variable estimation, are likely not met.

CHAPTER 4: RESULTS

This chapter presents the results of the empirical analysis. I first present the regression results on the association between state appropriations and the overall size and composition of the curriculum, for all public four-year institutions and by institutional type. Next, I present results based on analyses run separately for the pre- and post-financial crisis periods. Lastly, I describe the results through alternative approaches, including models controlling for state-by-year fixed effects and estimates obtained through Poisson regression.

Expansion Versus Contraction of the Curriculum

Table 4 presents the estimates of the relationship between revenue from state appropriations and the total number of programs offered by public four-year colleges and universities, estimated through Equation 1. It is evident that changes in state appropriations is not significantly correlated with the total number of degree programs offered. However, for doctoral degree programs, a 1 percent decline in revenue from state appropriations is associated with a 0.116 percent decrease in the number of programs. This may be due to the fact that doctoral degree programs generate less revenue and cost more to operate compared to the other degree levels. Doctoral programs tend to enroll a smaller number of students, are more likely to provide tuition waivers and stipends, and require smaller student-faculty ratios. Hence, doctoral degree programs may have been the target of program cuts in response to state appropriation declines.

Table 4. Effect of state appropriations on the total of number of programs: All public four-year institutions

Dependent variable:	(1)	(2)	(3)	(4)
	All programs	BA programs	MA programs	Doc programs
ln(state appropriations per FTE)	-0.045 (0.041)	-0.005 (0.029)	0.032 (0.040)	0.116** (0.053)
ln(college age population)	0.064** (0.031)	0.050** (0.025)	-0.005 (0.029)	0.072 (0.067)
State unemployment rate	0.003 (0.005)	-0.003 (0.005)	-0.002 (0.007)	-0.017 (0.013)
ln(state income per capita)	0.270* (0.142)	0.053 (0.140)	0.266 (0.225)	0.060 (0.361)
Observations	8,778	8,767	8,172	4,311
R-squared	0.947	0.937	0.964	0.966

Notes: *ln(state appropriations per FTE)* is the natural log of the revenue from state appropriations per full-time equivalent student, averaged across the previous three years. All regressions include institution and year fixed effects. Robust standard errors, clustered at the institution level, are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1

The estimated relationship between state appropriations and the number of programs at public R1 universities are reported in Table 5. A 1 percent decline in state appropriations is associated with a 0.117 percent decline in the total number of programs, indicating that public R1 universities tend to contract their curriculum in response to state appropriation declines. When examining each degree level separately, a 1 percent decline in state appropriations is associated with a 0.127 percent decline in master's degree programs and a 0.097 percent decline in doctoral degree programs. Rather than actively pursuing revenue by expanding curricular offerings, public R1 universities appear to reduce the number programs, possibly as a means to diminish cost, when facing state appropriation declines.

Table 5. Effect of state appropriations on the total of number of programs: Public R1 universities

Dependent variable:	(1)	(2)	(3)	(4)
	All programs	BA programs	MA programs	Doc programs
ln(state appropriations per FTE)	0.117** (0.053)	0.066 (0.052)	0.127** (0.058)	0.097* (0.053)
ln(college age population)	-0.018 (0.037)	0.032 (0.041)	-0.047 (0.043)	-0.004 (0.052)
State unemployment rate	0.019** (0.007)	0.010 (0.007)	0.019*** (0.007)	0.016* (0.009)
ln(state income per capita)	0.296 (0.207)	0.154 (0.186)	0.309 (0.227)	0.428 (0.386)
Observations	974	974	974	974
R-squared	0.929	0.937	0.924	0.944

Notes: *ln(state appropriations per FTE)* is the natural log of the revenue from state appropriations per full-time equivalent student, averaged across the previous three years. All regressions include institution and year fixed effects. Robust standard errors, clustered at the institution level, are reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Tables 6-8 report the estimated relationship between state appropriations and the curriculum at less research-intensive doctoral universities, master's universities, and baccalaureate colleges. As reported in Table 6 and Table 7 there is no significant association between state appropriations and the number of programs at less research-intensive doctoral universities and master's universities. On the other hand, as reported in Table 8, there is a negative and significant relationship between state appropriations and the number of programs at public baccalaureate colleges. The relationship is negative for the total number of programs, as well as for the number of programs at the bachelor's and master's degree levels.⁶ In response to

⁶ Baccalaureate colleges generally do not offer doctoral degree programs, so the number of doctoral degree programs were not examined as an outcome variable.

state appropriation declines, public baccalaureate colleges appear to expand its curriculum, perhaps as a strategy for enhancing their ability to gain tuition revenue from enrollment.

Table 6. Effect of state appropriations on the total of number of programs: Less research-intensive public doctoral universities

Dependent variable:	(1)	(2)	(3)	(4)
	All programs	BA programs	MA programs	Doc programs
In(state appropriations per FTE)	0.035 (0.040)	0.046 (0.044)	0.059 (0.039)	0.073 (0.071)
In(college age population)	-0.027 (0.043)	-0.015 (0.046)	0.012 (0.031)	0.129 (0.097)
State unemployment rate	0.002 (0.007)	-0.005 (0.008)	0.007 (0.008)	-0.008 (0.017)
In(state income per capita)	0.082 (0.232)	-0.018 (0.257)	0.025 (0.256)	0.047 (0.463)
Observations	1,645	1,645	1,645	1,639
R-squared	0.928	0.924	0.935	0.928

Notes: $\ln(\text{state appropriations per FTE})$ is the natural log of the revenue from state appropriations per full-time equivalent student, averaged across the previous three years. All regressions include institution and year fixed effects. Robust standard errors, clustered at the institution level, are reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 7. Effect of state appropriations on the total of number of programs: Public master's universities

Dependent variable:	(1)	(2)	(3)	(4)
	All programs	BA programs	MA programs	Doc programs
ln(state appropriations per FTE)	0.038 (0.029)	0.047 (0.031)	0.026 (0.053)	0.081 (0.095)
ln(college age population)	0.071** (0.031)	0.087*** (0.033)	-0.032 (0.039)	0.129 (0.136)
State unemployment rate	-0.005 (0.006)	-0.006 (0.005)	-0.012 (0.009)	-0.070*** (0.026)
ln(state income per capita)	0.133 (0.199)	0.013 (0.179)	0.241 (0.343)	-0.609 (0.967)
Observations	4,919	4,915	4,904	1,675
R-squared	0.912	0.912	0.927	0.791

Notes: *ln(state appropriations per FTE)* is the natural log of the revenue from state appropriations per full-time equivalent student, averaged across the previous three years. All regressions include institution and year fixed effects. Robust standard errors, clustered at the institution level, are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 8. Effect of state appropriations on the total of number of programs: Public baccalaureate colleges

Dependent variable:	(1)	(2)	(3)
	All programs	BA programs	MA programs
ln(state appropriations per FTE)	-0.196*** (0.033)	-0.102*** (0.018)	-0.370** (0.175)
ln(college age population)	0.179 (0.132)	0.045 (0.090)	0.097 (0.160)
State unemployment rate	0.009 (0.016)	-0.007 (0.019)	-0.011 (0.044)
ln(state income per capita)	0.415 (0.328)	-0.226 (0.442)	0.545 (1.243)
Observations	1,240	1,233	649
R-squared	0.865	0.872	0.836

Notes: *ln(state appropriations per FTE)* is the natural log of the revenue from state appropriations per full-time equivalent student, averaged across the previous three years. All regressions include institution and year fixed effects. Robust standard errors, clustered at the institution level, are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Programs in Academic Versus Occupational Fields of Study

Table 9 presents the estimates on the relationship between state appropriations and the number of programs in academic fields and occupational fields, at all public four-year colleges and universities. Column 1 reports the results for all programs, inclusive of all degree levels. Revenue from state appropriations has no statistically significant relationship with the number of programs in academic fields of study nor occupational fields of study. However, a 1 percent decline in revenue from state appropriations is associated with a 1.546 percentage point increase in the percentage of occupational degree programs. When examining each degree level separately, a 1 percent decline in state appropriations is associated with a 0.044 percent decline in master's degree programs and a 0.147 percent decline in doctoral degree programs in academic fields of study. For occupational programs, only doctoral degree programs are significantly associated with state appropriation declines, with a 1 percent decline in state appropriations corresponding to a 0.106 percent decline in the number of occupational doctoral degree programs.

Table 9. Effect of state appropriations on number of programs, by degree level and field of study: All public four-year institutions

Dependent variable:	(1) All programs	(2) BA programs	(3) MA programs	(4) Doc programs
<i>Academic programs</i>				
ln(state appropriations per FTE)	0.021 (0.019)	0.034 (0.021)	0.044* (0.025)	0.147*** (0.046)
Observations	8,750	8,727	7,219	2,926
R-squared	0.945	0.939	0.961	0.967
<i>Occupational programs</i>				
ln(state appropriations per FTE)	-0.057 (0.051)	0.026 (0.025)	0.033 (0.043)	0.106* (0.061)
Observations	8,773	8,756	8,127	4,276
R-squared	0.944	0.933	0.954	0.952
<i>Occupational (%)</i>				
ln(state appropriations per FTE)	-1.546** (0.667)	-1.593* (0.903)	0.211 (0.548)	-0.754 (1.427)
Observations	8,778	8,767	8,172	4,311
R-squared	0.905	0.905	0.906	0.893

Notes: Academic and occupational fields of study are categorized using National Center for Education Statistics (NCES) classifications. *ln(state appropriations per FTE)* is the natural log of the revenue from state appropriations, averaged across the previous three years. All regressions control for natural log of the state's college-age population, state unemployment rate, the natural log of state income per capita, and include institution and year fixed effects. Robust standard errors, clustered at the institution level, are reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 10 presents the estimates on the relationship between state appropriations and the curriculum at public R1 universities. Revenue from state appropriations is significantly associated with the number of programs in occupational fields, but not academic fields. Specifically, a 1 percent decline in state appropriations is associated with a 0.165 percent decline in the overall number of programs in occupational fields. When examining each degree level separately, declines in revenue from state appropriations are associated with declines in the number of master's degree programs and doctoral degree programs in academic fields by 0.165 percent and 0.209 percent, respectively. The proportion of graduate degree programs in occupational fields are also positively and significantly associated with revenue from state appropriations.

Table 10. Effect of state appropriations on number of programs, by degree level and field of study: Public R1 universities

Dependent variable:	(1) All programs	(2) BA programs	(3) MA programs	(4) Doc programs
<i>Academic programs</i>				
<i>ln(state appropriations per FTE)</i>	0.078 (0.053)	0.058 (0.055)	0.077 (0.054)	0.041 (0.048)
Observations	974	974	974	974
R-squared	0.932	0.936	0.945	0.944
<i>Occupational programs</i>				
<i>ln(state appropriations per FTE)</i>	0.165** (0.074)	0.076 (0.070)	0.165** (0.073)	0.209** (0.094)
Observations	974	974	974	974
R-squared	0.920	0.939	0.909	0.911
<i>Occupational (%)</i>				
<i>ln(state appropriations per FTE)</i>	2.176 (1.651)	0.528 (1.610)	2.077* (1.216)	3.593* (1.856)
Observations	974	974	974	974
R-squared	0.928	0.953	0.936	0.882

Notes: Academic and occupational fields of study are categorized using National Center for Education Statistics (NCES) classifications. *ln(state appropriations per FTE)* is the natural log of the revenue from state appropriations, averaged across the previous three years. All regressions control for natural log of the state's college-age population, state unemployment rate, the natural log of state income per capita, and include institution and year fixed effects. Robust standard errors, clustered at the institution level, are reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 11 and Table 12 presents the estimates for less research-intensive public doctoral universities and master's universities. For both institutional types, revenue from state appropriations have positive and significant correlations with programs in academic fields, but no significant relationships with programs in occupational fields. At less research-intensive doctoral universities, a 1 percent decline in state appropriations is associated with a 0.071 percent decline in the total number of programs in academic fields of study. As reported in Columns 2-3, revenue from state appropriations is positively and significantly associated with the number of programs for all degree levels. At public master's universities, a 1 percent decline in state appropriations corresponds to a 0.07 percent decline in the total number of academic programs. The percentage of occupational programs have a negative correlation with state appropriations at both types of institutions, providing support for the idea that state appropriation declines are associated with increased curricular emphasis on occupational, relative to academic, areas of study.

Table 11. Effect of state appropriations on number of programs, by degree level and field of study: Less research-intensive public doctoral universities

Dependent variable:	(1) All programs	(2) BA programs	(3) MA programs	(4) Doc programs
<i>Academic programs</i>				
<i>ln(state appropriations per FTE)</i>	0.071* (0.038)	0.075** (0.036)	0.068* (0.040)	0.204** (0.081)
Observations	1,645	1,645	1,625	1,493
R-squared	0.925	0.910	0.937	0.918
<i>Occupational programs</i>				
<i>ln(state appropriations per FTE)</i>	0.019 (0.045)	0.022 (0.052)	0.063 (0.046)	0.032 (0.083)
Observations	1,645	1,645	1,645	1,638
R-squared	0.928	0.931	0.917	0.889
<i>Occupational (%)</i>				
<i>ln(state appropriations per FTE)</i>	-1.179 (0.742)	-1.322* (0.788)	0.006 (0.836)	-3.918*** (1.347)
Observations	1,645	1,645	1,645	1,639
R-squared	0.923	0.929	0.920	0.868

Notes: Academic and occupational fields of study are categorized using National Center for Education Statistics (NCES) classifications. *ln(state appropriations per FTE)* is the natural log of the revenue from state appropriations, averaged across the previous three years. All regressions control for natural log of the state's college-age population, state unemployment rate, the natural log of state income per capita, and include institution and year fixed effects. Robust standard errors, clustered at the institution level, are reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 12. Effect of state appropriations on number of programs, by degree level and field of study: Public master's universities

Dependent variable:	(1)	(2)	(3)	(4)
	All programs	BA programs	MA programs	Doc programs
<i>Academic programs</i>				
ln(state appropriations per FTE)	0.070*** (0.024)	0.070*** (0.027)	0.027 (0.032)	0.006 (0.140)
Observations	4,919	4,915	4,370	446
R-squared	0.919	0.928	0.930	0.858
<i>Occupational programs</i>				
ln(state appropriations per FTE)	0.027 (0.034)	0.033 (0.033)	0.025 (0.057)	0.084 (0.083)
Observations	4,919	4,913	4,898	1,644
R-squared	0.900	0.915	0.910	0.756
<i>Occupational (%)</i>				
ln(state appropriations per FTE)	-0.770* (0.465)	-0.619 (0.527)	0.262 (0.663)	1.743 (3.020)
Observations	4,919	4,915	4,904	1,675
R-squared	0.904	0.903	0.883	0.789

Notes: Academic and occupational fields of study are categorized using National Center for Education Statistics (NCES) classifications. *ln(state appropriations per FTE)* is the natural log of the revenue from state appropriations, averaged across the previous three years. All regressions control for natural log of the state's college-age population, state unemployment rate, the natural log of state income per capita, and include institution and year fixed effects. Robust standard errors, clustered at the institution level, are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 13 reports the association between state appropriations and curricular change at public baccalaureate colleges. State appropriations do not have a significant relationship with the number of programs in academic fields of study, but a 1 percent decline in state appropriations is associated with a 0.217 percent increase in the number of occupational programs. The proportion of occupational programs also has a significant and negative association with revenue from state appropriations. As was the case for less-research intensive public doctoral and public master's universities, it appears that public baccalaureate colleges increase their curricular emphasis on occupational programs in response to state appropriation declines. However, this is done through increasing programs in occupational fields rather than decreasing programs in academic fields.

Table 13. Effect of state appropriations on number of programs, by degree level and field of study: Public baccalaureate universities

Dependent variable:	(1) All programs	(2) BA programs	(3) MA programs
<i>Academic programs</i>			
ln(state appropriations per FTE)	-0.065 (0.046)	-0.036 (0.025)	-0.096 (0.355)
Observations	1,212	1,193	250
R-squared	0.874	0.884	0.806
<i>Occupational programs</i>			
ln(state appropriations per FTE)	-0.217*** (0.021)	-0.089 (0.079)	-0.325** (0.156)
Observations	1,235	1,224	610
R-squared	0.909	0.868	0.824
<i>Occupational (%)</i>			
ln(state appropriations per FTE)	-3.076*** (0.674)	-3.342*** (1.072)	2.318 (4.803)
Observations	1,240	1,233	649
R-squared	0.902	0.888	0.890

Notes: Academic and occupational fields of study are categorized using National Center for Education Statistics (NCES) classifications. *ln(state appropriations per FTE)* is the natural log of the revenue from state appropriations, averaged across the previous three years. All regressions control for natural log of the state's college-age population, state unemployment rate, the natural log of state income per capita, and include institution and year fixed effects. Robust standard errors, clustered at the institution level, are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Occupational programs in 'high-earning, high-cost' versus 'low-earning, low-cost' fields of study

Tables 14-17 reports the results on the association between state appropriations and the number of occupational programs that are 'high-earning, high-cost' and 'low-earning, low-cost.' Across all institutional types and degree levels, there is no discernible difference between the two types of occupational programs in their relationship with changes in state appropriations. That is, revenue from state appropriations appears to have no particularly strong or weak correlations with either 'high-earning, high-cost' or 'low-earning, low-cost' programs in occupational fields of study.

Table 14. Effect of state appropriations on number of high-earning occupational programs, by degree level: All Public four-year institutions

Dependent variable:	(1) All programs	(2) BA programs	(3) MA programs	(4) Doc programs
<i>High-earning, High-Cost</i>				
ln(state appropriations per FTE)	-0.047 (0.038)	-0.003 (0.030)	0.056 (0.040)	0.107* (0.061)
Observations	8,736	8,693	7,574	3,329
R-squared	0.935	0.931	0.945	0.940
<i>Low-earning, Low-Cost</i>				
ln(state appropriations per FTE)	0.002 (0.028)	0.020 (0.028)	0.062** (0.025)	0.036 (0.057)
Observations	8,754	8,735	7,998	3,794
R-squared	0.934	0.923	0.936	0.946

Notes: High-earning occupational are programs in occupational programs whose graduates' median earnings exceed the overall median earnings across all fields of study. *ln(state appropriations per FTE)* is the natural log of the revenue from state appropriations, averaged across the previous three years. All regressions control for natural log of the state's college-age population, state unemployment rate, the natural log of state income per capita, and include institution and year fixed effects. Robust standard errors, clustered at the institution level, are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 15. Effect of state appropriations on number of high-earning occupational programs, by degree level: Public R1 universities

Dependent variable:	(1) All programs	(2) BA programs	(3) MA programs	(4) Doc programs
<i>High-earning, High-Cost</i>				
ln(state appropriations per FTE)	0.135* (0.077)	0.099 (0.080)	0.139* (0.072)	0.231** (0.108)
Observations	974	974	974	974
R-squared	0.923	0.950	0.928	0.911
<i>Low-earning, Low-Cost</i>				
ln(state appropriations per FTE)	0.198** (0.087)	0.089 (0.109)	0.200** (0.096)	0.153* (0.083)
Observations	974	974	974	973
R-squared	0.937	0.934	0.917	0.936

Notes: High-earning occupational are programs in occupational programs whose graduates' median earnings exceed the overall median earnings across all fields of study. *ln(state appropriations per FTE)* is the natural log of the revenue from state appropriations, averaged across the previous three years. All regressions control for natural log of the state's college-age population, state unemployment rate, the natural log of state income per capita, and include institution and year fixed effects. Robust standard errors, clustered at the institution level, are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 16. Effect of state appropriations on number of high-earning occupational programs, by degree level: Less research-intensive public doctoral universities

Dependent variable:	(1) All programs	(2) BA programs	(3) MA programs	(4) Doc programs
<i>High-earning, High-Cost</i>				
<i>ln(state appropriations per FTE)</i>	-0.013 (0.041)	0.012 (0.045)	-0.001 (0.093)	-0.008 (0.090)
Observations	4,730	4,713	4,394	764
R-squared	0.923	0.927	0.905	0.851
<i>Low-earning, Low-Cost</i>				
<i>ln(state appropriations per FTE)</i>	-0.089* (0.052)	-0.100** (0.046)	-0.050 (0.061)	-0.234** (0.114)
Observations	4,739	4,733	4,679	900
R-squared	0.919	0.940	0.924	0.871

Notes: High-earning occupational are programs in occupational programs whose graduates' median earnings exceed the overall median earnings across all fields of study. *ln(state appropriations per FTE)* is the natural log of the revenue from state appropriations, averaged across the previous three years. All regressions include institution fixed effects and year fixed effects. Robust standard errors, clustered at the institution level, are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 17. Effect of state appropriations on number of high-earning occupational programs, by degree level: Public master's universities

Dependent variable:	(1) All programs	(2) BA programs	(3) MA programs	(4) Doc programs
<i>High-earning, High-Cost</i>				
<i>ln(state appropriations per FTE)</i>	0.011 (0.041)	0.005 (0.039)	0.026 (0.046)	0.077 (0.087)
Observations	4,910	4,893	4,616	974
R-squared	0.895	0.904	0.885	0.742
<i>Low-earning, Low-Cost</i>				
<i>ln(state appropriations per FTE)</i>	0.022 (0.038)	0.033 (0.037)	0.057* (0.029)	0.007 (0.060)
Observations	4,919	4,913	4,865	1,190
R-squared	0.889	0.912	0.900	0.737

Notes: High-earning occupational are programs in occupational programs whose graduates' median earnings exceed the overall median earnings across all fields of study. *ln(state appropriations per FTE)* is the natural log of the revenue from state appropriations, averaged across the previous three years. All regressions control for natural log of the state's college-age population, state unemployment rate, the natural log of state income per capita, and include institution and year fixed effects. Robust standard errors, clustered at the institution level, are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 18. Effect of state appropriations on number of high-earning occupational programs, by degree level: Public baccalaureate colleges

Dependent variable:	(1) BA programs	(2) BA programs	(3) MA programs
<i>High-earning, High-Cost</i>			
ln(state appropriations per FTE)	-0.177*** (0.022)	-0.127 (0.113)	-0.182 (0.279)
Observations	1,207	1,181	339
R-squared	0.864	0.831	0.713
<i>Low-earning, Low-Cost</i>			
ln(state appropriations per FTE)	-0.190** (0.080)	-0.198** (0.089)	0.047 (0.163)
Observations	1,216	1,203	514
R-squared	0.922	0.900	0.828

Notes: High-earning occupational are programs in occupational programs whose graduates' median earnings exceed the overall median earnings across all fields of study. *ln(state appropriations per FTE)* is the natural log of the revenue from state appropriations, averaged across the previous three years. All regressions control for natural log of the state's college-age population, state unemployment rate, the natural log of state income per capita, and include institution and year fixed effects. Robust standard errors, clustered at the institution level, are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1

The Number of Certificate Programs

While the previous sections examined curricular change among traditional degree programs, this section examines how changes in revenue from state appropriations is associated with changes in non-degree certificate programs. Results are reported on Table 19. When pooling together all public four-year institutions, there is a negative and significant association between state appropriations and the number of certificate programs. Overall, a decline in state appropriations by 1 percent corresponds to an increase in certificate programs by approximately 0.146 percent.

Table 19. Effect of state appropriations on the number of certificate programs

Dependent variable: ln(Number of certificate programs)	(1)	(2)	(3)	(4)	(5)
	All Institutions	R1	LRI Doctoral	Master's	Baccalaureate
ln(state appropriations per FTE)	-0.146*** (0.050)	-0.198 (0.381)	-0.309* (0.157)	-0.068 (0.070)	-0.174*** (0.043)
ln(college age population)	-0.092 (0.086)	-0.209 (0.309)	0.129 (0.200)	-0.179 (0.113)	-0.197 (0.138)
State unemployment rate	0.015 (0.018)	0.065 (0.052)	0.023 (0.044)	0.008 (0.024)	0.031 (0.039)
ln(state income per capita)	1.634*** (0.501)	4.882*** (1.494)	1.576 (0.976)	1.433** (0.715)	1.638* (0.899)
Observations	8,778	974	1,645	4,919	1,240
R-squared	0.789	0.738	0.767	0.782	0.750

Notes: ln(state appropriations per FTE) is the natural log of the revenue from state appropriations per full-time equivalent student, averaged across the previous three years. All regressions include institution and year fixed effects. Robust standard errors, clustered at the institution level, are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Gender Composition of Programs

Tables 20-24 report the estimates on how the relationship between state appropriations and the curriculum vary between women-majority and men-majority fields of study. Within occupational fields of study, there is no discernible difference between women-majority and men-majority fields in their relationships with state appropriations. However, among academic fields of study, changes in state appropriations are not significantly correlated with men-majority fields, but positively and significantly associated with programs in women-majority fields. Overall, a 1 percent decline in state appropriations is associated with a 0.036 percent decline in the number of women-majority academic programs.

At public R1 universities, however, only programs in men-majority academic fields have a positive and significant correlation with state appropriations. A 1 percent decline in revenue from state appropriations corresponds to a 0.134 percent decline in the number of men-majority academic programs. At less research-intensive public doctoral universities and master's universities, positive correlations with state appropriations are only found for programs in women-majority academic fields. At public baccalaureate colleges, women-majority academic programs have no significant relationships with state appropriations, but men-majority academic programs have negative correlations with state appropriations, implying that institutions increase the number of men-majority programs in response to state appropriation declines.

Table 20. Effect of state appropriations on number of programs, by gender type: All Public four-year institutions

Dependent variable:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	All programs		BA programs		MA programs		Doc programs	
	Men-majority	Women-majority	Men-majority	Women-majority	Men-majority	Women-majority	Men-majority	Women-majority
<i>Academic fields</i>								
ln(state appropriations per FTE)	-0.060 (0.052)	0.036* (0.021)	0.017 (0.021)	0.052** (0.024)	0.033 (0.043)	0.061** (0.027)	0.077 (0.057)	0.172*** (0.051)
Observations	8,773	8,732	8,756	8,706	8,127	7,082	4,287	2,765
R-squared	0.944	0.945	0.933	0.935	0.960	0.953	0.961	0.960
<i>Occupational fields</i>								
ln(state appropriations per FTE)	-0.028 (0.034)	-0.047 (0.048)	0.010 (0.022)	0.016 (0.029)	0.015 (0.031)	0.074*** (0.025)	0.145*** (0.044)	0.092 (0.065)
Observations	8,778	8,692	8,767	8,653	7,804	7,997	3,164	4,135
R-squared	0.946	0.939	0.941	0.921	0.966	0.943	0.972	0.936

Notes: Academic and occupational fields of study are categorized using National Center for Education Statistics (NCES) classifications. *ln(state appropriations per FTE)* is the natural log of the revenue from state appropriations per full-time equivalent student, averaged across the previous three years. All regressions control for natural log of the state's college-age population, state unemployment rate, the natural log of state income per capita, and include institution and year fixed effects. Robust standard errors, clustered at the institution level, are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 21. Effect of state appropriations on number of programs, by gender type: Public R1 universities

Dependent variable:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	All programs		BA programs		MA programs		Doc programs	
	Men- majority	Women- majority	Men- majority	Women- majority	Men- majority	Women- majority	Men- majority	Women- majority
<i>Academic fields</i>								
ln(state appropriations per FTE)	0.134** (0.058)	0.099 (0.066)	0.061 (0.053)	0.079 (0.074)	0.134** (0.061)	0.100 (0.068)	0.121* (0.062)	0.068 (0.062)
Observations	974	974	974	974	974	974	974	973
R-squared	0.924	0.929	0.943	0.928	0.913	0.941	0.933	0.947
<i>Occupational fields</i>								
ln(state appropriations per FTE)	0.061 (0.039)	0.238** (0.098)	0.046 (0.042)	0.101 (0.107)	0.095* (0.056)	0.203** (0.084)	0.058 (0.042)	0.265** (0.131)
Observations	974	974	974	973	974	974	974	962
R-squared	0.925	0.943	0.936	0.941	0.917	0.942	0.946	0.919

Notes: Academic and occupational fields of study are categorized using National Center for Education Statistics (NCES) classifications. *ln(state appropriations per FTE)* is the natural log of the revenue from state appropriations per full-time equivalent student, averaged across the previous three years. All regressions control for natural log of the state's college-age population, state unemployment rate, the natural log of state income per capita, and include institution and year fixed effects. Robust standard errors, clustered at the institution level, are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 22. Effect of state appropriations on number of programs, by gender type: Less research-intensive public doctoral universities

Dependent variable:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	All programs		BA programs		MA programs		Doc programs	
	Men-majority	Women-majority	Men-majority	Women-majority	Men-majority	Women-majority	Men-majority	Women-majority
<i>Academic fields</i>								
<i>ln(state appropriations per FTE)</i>	0.025 (0.039)	0.059 (0.047)	0.024 (0.043)	0.082* (0.048)	0.060 (0.040)	0.064 (0.056)	0.020 (0.078)	0.199** (0.086)
Observations	1,645	1,641	1,645	1,641	1,645	1,616	1,638	1,430
R-squared	0.934	0.914	0.933	0.908	0.930	0.918	0.907	0.906
<i>Occupational fields</i>								
<i>ln(state appropriations per FTE)</i>	0.054 (0.035)	0.034 (0.060)	0.059 (0.039)	0.030 (0.062)	0.069* (0.037)	0.069 (0.057)	0.204*** (0.076)	-0.006 (0.083)
Observations	1,645	1,630	1,645	1,627	1,641	1,628	1,551	1,604
R-squared	0.916	0.939	0.905	0.932	0.948	0.927	0.927	0.874

Notes: Academic and occupational fields of study are categorized using National Center for Education Statistics (NCES) classifications. *ln(state appropriations per FTE)* is the natural log of the revenue from state appropriations per full-time equivalent student, averaged across the previous three years. All regressions control for natural log of the state's college-age population, state unemployment rate, the natural log of state income per capita, and include institution and year fixed effects. Robust standard errors, clustered at the institution level, are reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 23. Effect of state appropriations on number of programs, by gender type: Public master's universities

Dependent variable:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	All programs		BA programs		MA programs		Doc programs	
	Men- majority	Women- majority	Men- majority	Women- majority	Men- majority	Women- majority	Men- majority	Women- majority
<i>Academic fields</i>								
ln(state appropriations per FTE)	0.029 (0.031)	0.085*** (0.027)	0.030 (0.028)	0.090*** (0.031)	0.026 (0.056)	0.048 (0.035)	0.051 (0.087)	0.249*** (0.050)
Observations	4,919	4,919	4,913	4,914	4,898	4,255	1,655	349
R-squared	0.903	0.909	0.921	0.914	0.920	0.918	0.778	0.778
<i>Occupational fields</i>								
ln(state appropriations per FTE)	0.051* (0.027)	0.017 (0.040)	0.056* (0.030)	0.028 (0.037)	-0.007 (0.040)	0.072** (0.029)	0.026 (0.127)	0.097 (0.082)
Observations	4,919	4,913	4,915	4,893	4,770	4,861	626	1,549
R-squared	0.909	0.905	0.913	0.912	0.934	0.905	0.826	0.750

Notes: Academic and occupational fields of study are categorized using National Center for Education Statistics (NCES) classifications. *ln(state appropriations per FTE)* is the natural log of the revenue from state appropriations per full-time equivalent student, averaged across the previous three years. All regressions control for natural log of the state's college-age population, state unemployment rate, the natural log of state income per capita, and include institution and year fixed effects. Robust standard errors, clustered at the institution level, are reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 24. Effect of state appropriations on number of programs, by gender type: Public baccalaureate universities

Dependent variable:	(1)	(2)	(3)	(4)	(5)	(6)
	All programs		BA programs		MA programs	
	Men-majority	Women-majority	Men-majority	Women-majority	Men-majority	Women-majority
<i>Academic fields</i>						
<i>ln(state appropriations per FTE)</i>	-0.227*** (0.019)	-0.044 (0.034)	-0.141* (0.082)	-0.017 (0.018)	-0.317* (0.158)	0.096 (0.265)
Observations	1,235	1,198	1,224	1,177	610	237
R-squared	0.878	0.880	0.829	0.881	0.819	0.855
<i>Occupational fields</i>						
<i>ln(state appropriations per FTE)</i>	-0.166*** (0.036)	-0.193*** (0.022)	-0.073*** (0.023)	-0.214* (0.124)	-0.422** (0.197)	-0.135 (0.200)
Observations	1,240	1,175	1,233	1,160	419	534
R-squared	0.860	0.904	0.867	0.875	0.804	0.841

Notes: Academic and occupational fields of study are categorized using National Center for Education Statistics (NCES) classifications. *ln(state appropriations per FTE)* is the natural log of the revenue from state appropriations per full-time equivalent student, averaged across the previous three years. All regressions control for natural log of the state's college-age population, state unemployment rate, the natural log of state income per capita, and include institution and year fixed effects. Robust standard errors, clustered at the institution level, are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1

With the exception of public R1 universities, the analyses above indicate that state appropriation declines tend to be associated with declines in women-majority academic programs or increases in men-majority academic programs. However, analyses using an alternative criterion for distinguishing gender representation did not produce similar gendered patterns. As an alternative criterion, fields were categorized as ‘women-majority’ if the proportion of women graduates exceeded the overall average proportion of women within academic or occupational fields. Fields of study whose proportion of graduates were below the average were categorized as ‘men-majority’ fields. Findings using this alternative criterion for distinguishing gender type are reported in Table 25. Unlike the results from the previous analyses, revenue from state appropriations is not significantly associated with the number of programs in women-majority academic fields, but positively and significantly associated with the number of programs in men-majority academic fields of study.

Table 25. Effect of state appropriations on number of programs, by gender type using an alternative measure: All Public 4-Year institutions

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	All programs		BA programs		MA programs		Doc programs	
Dependent variable:	Men-majority	Women-majority	Men-majority	Women-majority	Men-majority	Women-majority	Men-majority	Women-majority
<i>Academic fields</i>								
<i>ln(state appropriations per FTE)</i>	0.043** (0.020)	0.019 (0.018)	0.038* (0.020)	0.038* (0.022)	0.073** (0.029)	0.027 (0.037)	0.178*** (0.048)	0.068 (0.057)
Observations	8,685	8,715	8,661	8,663	6,394	6,725	2,649	2,444
R-squared	0.940	0.922	0.938	0.906	0.952	0.931	0.957	0.930
<i>Occupational fields</i>								
<i>ln(state appropriations per FTE)</i>	0.007 (0.030)	-0.054 (0.042)	0.005 (0.029)	-0.001 (0.030)	0.039 (0.032)	0.061** (0.027)	0.189*** (0.057)	0.104 (0.069)
Observations	8,756	8,618	8,726	8,460	7,413	7,932	2,644	3,978
R-squared	0.928	0.931	0.932	0.900	0.947	0.932	0.941	0.919

Notes: Academic and occupational fields of study are categorized using National Center for Education Statistics (NCES) classifications. *ln(state appropriations per FTE)* is the natural log of the revenue from state appropriations per full-time equivalent student, averaged across the previous three years. All regressions control for natural log of the state's college-age population, state unemployment rate, the natural log of state income per capita, and include institution and year fixed effects. Robust standard errors, clustered at the institution level, are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Pre- and Post-2008 Financial Crisis

Due to the drastic economic and social changes brought upon by the 2008 financial crisis, I conducted separate analyses using data covering the pre- and post-financial crisis periods. The results for all degree levels combined, are presented in Tables 26 and 27. Across all institutional types and program types, the curriculum appears to be more significantly correlated with the curriculum in the post-financial crisis period compared to before the financial crisis. For example, at less research-intensive doctoral and master's universities, the overall size of the curriculum is not significantly correlated with state appropriations in the pre-crisis period, but is significantly associated with state appropriations in the post-crisis period. Also, expansion of certificate programs in response to state appropriation declines is more strongly evident in the post-crisis period compared to the pre-crisis period.

Table 26. Effect of state appropriations on curricular change: Pre-2008 financial crisis

Outcome variable	All institutions	R1 universities	LRI doctoral universities	Master's universities	Baccalaureate colleges
Total degree programs	0.029 (0.030)	0.071** (0.035)	-0.027 (0.023)	0.044 (0.044)	-0.014 (0.027)
Academic fields	0.038* (0.023)	0.049 (0.046)	-0.017 (0.026)	0.062** (0.030)	-0.025 (0.030)
Occupational fields	0.021 (0.033)	0.081** (0.040)	-0.036 (0.026)	0.034 (0.048)	-0.013 (0.019)
Occupational fields (%)	-0.298 (0.332)	0.752 (1.165)	-0.487 (0.521)	-0.564 (0.351)	0.221 (0.496)
High-earning	0.005 (0.032)	0.054 (0.042)	-0.038 (0.033)	0.012 (0.045)	-0.007 (0.022)
Low-earning	0.058 (0.059)	0.123* (0.063)	-0.016 (0.049)	0.064 (0.069)	-0.020 (0.105)
Certificates	0.016 (0.048)	0.270 (0.246)	-0.215 (0.158)	0.027 (0.068)	0.035 (0.036)
Women-majority academic fields	0.043** (0.017)	0.069 (0.051)	-0.030 (0.035)	0.066*** (0.017)	-0.017 (0.024)
Men-majority academic fields	0.029 (0.034)	0.072** (0.034)	-0.022 (0.022)	0.042 (0.049)	-0.004 (0.013)
Women-majority occupational fields	-0.001 (0.018)	0.113** (0.048)	-0.023 (0.045)	0.001 (0.028)	-0.024 (0.027)
Men-majority occupational fields	0.028 (0.025)	0.050 (0.039)	-0.025 (0.026)	0.047 (0.034)	-0.015 (0.024)

Notes: $\ln(\text{state appropriations per FTE})$ is the natural log of the revenue from state appropriations, averaged across the previous three years. All regressions control for natural log of the state's college-age population, state unemployment rate, the natural log of state income per capita, and include institution and year fixed effects. Robust standard errors, clustered at the institution level, are reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 27. Effect of state appropriations on curricular change: Post-2008 financial crisis

Outcome variable	All institutions	R1 universities	LRI doctoral universities	Master's universities	Baccalaureate colleges
Total degree programs	0.035 (0.032)	0.174** (0.078)	0.112*** (0.043)	0.093** (0.037)	-0.295*** (0.106)
Academic fields	0.062* (0.035)	0.111 (0.097)	0.131*** (0.047)	0.117*** (0.039)	-0.215** (0.106)
Occupational fields	0.041 (0.037)	0.240*** (0.088)	0.102** (0.049)	0.076* (0.044)	-0.233* (0.125)
Occupational (%)	-0.582 (0.721)	3.201* (1.885)	-0.727 (1.150)	-0.724 (0.919)	-1.860 (2.473)
High-earning	0.007 (0.047)	0.230** (0.109)	0.098 (0.060)	0.051 (0.058)	-0.316** (0.152)
Low-earning	0.035 (0.042)	0.230** (0.112)	0.080 (0.064)	0.078 (0.054)	-0.232* (0.135)
Certificates	-0.284** (0.113)	0.629 (0.542)	-0.030 (0.187)	-0.306* (0.163)	-0.606*** (0.192)
Women-majority academic fields	0.093*** (0.035)	0.156 (0.123)	0.167*** (0.057)	0.136*** (0.045)	-0.145 (0.092)
Men-majority academic fields	0.027 (0.035)	0.192** (0.074)	0.092** (0.042)	0.083** (0.039)	-0.285** (0.127)
Women-majority occupational fields	0.060 (0.042)	0.325*** (0.117)	0.133* (0.068)	0.084* (0.050)	-0.249* (0.135)
Men-majority occupational fields	0.026 (0.032)	0.103 (0.066)	0.100** (0.039)	0.091** (0.040)	-0.278*** (0.103)

Notes: $\ln(\text{state appropriations per FTE})$ is the natural log of the revenue from state appropriations, averaged across the previous three years. All regressions control for natural log of the state's college-age population, state unemployment rate, the natural log of state income per capita, and include institution and year fixed effects. Robust standard errors, clustered at the institution level, are reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

State-By-Year Fixed Effects

The estimated relationship between state appropriations and the curriculum, after controlling for state-by-year fixed effects, are reported in Tables 28-31. When examining all public four-year institutions pooled together, a 1 percent decline in state appropriations is associated with a 0.104 percent increase in the overall curriculum. The previously reported coefficient estimates, obtained without the inclusion of state-by-year fixed effects, was also negative, but not statistically significant. Also, as was the case in the main results, state appropriation declines are associated with a curricular shift toward occupational fields relative to academic fields. The number of certificate programs also has a negative correlation with state appropriations. However, when examining each institutional type separately, particularly for different degree levels, changes in state appropriations tends to not be significantly associated with the curriculum.

Table 28. Effect of state appropriations on curricular change controlling for state-by-year fixed effects: All degree levels combined

Outcome variable	All institutions	R1 universities	LRI doctoral universities	Master's universities	Baccalaureate colleges
Total degree programs	-0.104*** (0.033)	0.080 (0.079)	-0.048 (0.042)	-0.029 (0.027)	-0.294** (0.129)
Academic fields	-0.021 (0.016)	0.113 (0.100)	-0.020 (0.042)	0.013 (0.032)	-0.281* (0.162)
Occupational fields	-0.126*** (0.043)	0.078 (0.078)	-0.060 (0.049)	-0.050 (0.032)	-0.217** (0.100)
Occupational fields (%)	-2.078*** (0.684)	-0.81 (1.245)	-0.904 (0.922)	-1.202 (0.731)	-2.397 (2.968)
High-earning	-0.088** (0.035)	0.075 (0.074)	-0.042 (0.055)	-0.013 (0.041)	-0.243* (0.125)
Low-earning	-0.083*** (0.031)	0.074 (0.111)	-0.089 (0.060)	-0.089* (0.052)	-0.241* (0.124)
Certificates	-0.198*** (0.060)	0.120 (0.441)	-0.403* (0.224)	-0.173 (0.109)	-0.264 (0.214)
Women-majority academic fields	-0.003 (0.019)	0.130 (0.125)	-0.020 (0.056)	0.030 (0.038)	-0.285** (0.132)
Men-majority academic fields	-0.126*** (0.043)	0.073 (0.075)	-0.053 (0.041)	-0.044 (0.029)	-0.215** (0.084)
Women-majority occupational fields	-0.125*** (0.037)	0.098 (0.112)	-0.052 (0.060)	-0.093* (0.053)	-0.268* (0.137)
Men-majority occupational fields	-0.076** (0.030)	0.067 (0.072)	-0.041 (0.037)	0.009 (0.030)	-0.253* (0.131)

Notes: $\ln(\text{state appropriations per FTE})$ is the natural log of the revenue from state appropriations, averaged across the previous three years. All regressions control for natural log of the state's college-age population, state unemployment rate, the natural log of state income per capita, and include institution and state-by-year fixed effects. Robust standard errors, clustered at the institution level, are reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 29. Effect of state appropriations on curricular change, controlling for state-by-year fixed effects: Bachelor's degree programs

Outcome variable	All institutions	R1 universities	LRI doctoral universities	Master's universities	Baccalaureate colleges
Total number of programs	-0.054** (0.023)	0.077 (0.069)	-0.049 (0.032)	-0.010 (0.027)	-0.247** (0.103)
Academic fields	-0.008 (0.017)	0.107 (0.095)	-0.031 (0.036)	0.028 (0.032)	-0.283* (0.150)
Occupational fields	-0.029 (0.024)	0.085 (0.072)	-0.067 (0.046)	-0.053 (0.034)	-0.250** (0.104)
Occupational fields (%)	-2.279** (0.980)	-0.720 (1.310)	-0.914 (1.252)	-1.454* (0.859)	-0.847 (2.277)
High-earning	-0.021 (0.034)	0.129 (0.120)	-0.123*** (0.045)	0.012 (0.045)	-0.227* (0.135)
Low-earning	-0.061* (0.032)	0.064 (0.149)	0.002 (0.080)	-0.100** (0.046)	-0.332** (0.133)
Women-majority academic fields	0.020 (0.022)	0.189 (0.131)	-0.016 (0.046)	0.059 (0.038)	-0.255* (0.134)
Men-majority academic fields	-0.031 (0.020)	0.043 (0.068)	-0.054 (0.036)	-0.047* (0.028)	-0.260** (0.113)
Women-majority occupational fields	-0.055* (0.032)	0.109 (0.100)	-0.036 (0.079)	-0.099** (0.046)	-0.380*** (0.137)
Men-majority occupational fields	-0.028 (0.020)	0.065 (0.066)	-0.052* (0.029)	0.032 (0.030)	-0.211 (0.131)

Notes: $\ln(\text{state appropriations per FTE})$ is the natural log of the revenue from state appropriations, averaged across the previous three years. All regressions control for natural log of the state's college-age population, state unemployment rate, the natural log of state income per capita, and include institution and year fixed effects. Robust standard errors, clustered at the institution level, are reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 30. Effect of state appropriations on curricular change, controlling for state-by-year fixed effects: Master's degree programs

Outcome variable	All institutions	R1 universities	LRI doctoral universities	Master's universities	Baccalaureate colleges
Total number of programs	-0.052 (0.058)	-0.007 (0.080)	0.014 (0.049)	-0.098 (0.089)	-0.542 (0.452)
Academic fields	-0.023 (0.039)	-0.020 (0.093)	-0.012 (0.066)	-0.065 (0.061)	0.700 (0.663)
Occupational fields	-0.049 (0.065)	-0.023 (0.093)	0.030 (0.047)	-0.088 (0.102)	-0.910* (0.528)
Occupational fields (%)	0.357 (0.867)	-0.376 (1.922)	0.743 (1.144)	0.275 (1.207)	-10.598 (10.725)
High-earning	0.072 (0.064)	-0.007 (0.092)	0.119 (0.071)	-0.001 (0.093)	-0.526 (0.666)
Low-earning	-0.030 (0.036)	-0.047 (0.106)	-0.021 (0.045)	-0.050 (0.061)	-0.460 (0.390)
Women-majority academic fields	-0.003 (0.038)	0.013 (0.137)	-0.012 (0.076)	-0.037 (0.056)	0.730 (0.561)
Men-majority academic fields	-0.044 (0.065)	-0.017 (0.073)	0.028 (0.046)	-0.085 (0.101)	-0.719 (0.595)
Women-majority occupational fields	-0.001 (0.034)	-0.003 (0.075)	0.015 (0.055)	-0.008 (0.053)	-0.347 (0.429)
Men-majority occupational fields	-0.033 (0.039)	-0.011 (0.092)	0.025 (0.059)	-0.109** (0.053)	0.370 (0.436)

Notes: $\ln(\text{state appropriations per FTE})$ is the natural log of the revenue from state appropriations, averaged across the previous three years. All regressions control for natural log of the state's college-age population, state unemployment rate, the natural log of state income per capita, and include institution and year fixed effects. Robust standard errors, clustered at the institution level, are reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 31. Effect of state appropriations on curricular change, controlling for state-by-year fixed effects: Doctoral degree programs

Outcome variable	All institutions	R1 universities	LRI doctoral universities	Master's universities
Total number of programs	0.095 (0.076)	-0.061 (0.114)	0.011 (0.105)	0.061 (0.117)
Academic fields	0.111 (0.069)	-0.121 (0.159)	0.131 (0.133)	0.280*** (0.068)
Occupational fields	0.084 (0.078)	-0.019 (0.152)	-0.032 (0.102)	-0.014 (0.102)
Occupational fields (%)	-1.009 (1.528)	2.037 (3.959)	-3.107* (1.733)	-1.011 (2.735)
High-earning	0.111 (0.074)	0.056 (0.116)	0.079 (0.112)	-0.008 (0.090)
Low-earning	0.002 (0.068)	-0.057 (0.173)	-0.094 (0.124)	-0.234** (0.114)
Women-majority academic fields	0.110 (0.073)	-0.106 (0.155)	0.097 (0.134)	0.445*** (0.118)
Men-majority academic fields	0.073 (0.078)	-0.035 (0.128)	-0.006 (0.107)	-0.051 (0.094)
Women-majority occupational fields	0.025 (0.076)	-0.161 (0.265)	-0.154 (0.104)	-0.049 (0.093)
Men-majority occupational fields	0.116* (0.062)	-0.063 (0.094)	0.163 (0.114)	0.248 (0.184)

Notes: $\ln(\text{state appropriations per FTE})$ is the natural log of the revenue from state appropriations, averaged across the previous three years. All regressions control for natural log of the state's college-age population, state unemployment rate, the natural log of state income per capita, and include institution and year fixed effects. Robust standard errors, clustered at the institution level, are reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Poisson Regression

Since the outcome variable of the study is count data comprised of non-negative integers, I also estimated the relationship between state appropriations and the number of programs using Poisson regression through Equation 2. The estimates derived from Poisson regression were not qualitatively different from the estimates derived using OLS, providing support for the validity of the main findings. The Poisson regression results for the association between state appropriations and the curriculum for the total number of programs are reported in Table 33-35 in the Appendix.

CHAPTER 5: CONCLUSION

This study examined how changes in state appropriations for public higher education, which have significantly declined over time, are associated with changes in the curriculum at public colleges and universities. Decline in financial support from the state constitutes one of the most significant changes in the resource environment for U.S. public higher education, and public higher education institutions have adjusted their operations in a variety of ways, including making changes to student enrollment, research, faculty salary, and the use of technology. However, less is known about how changes in state funding are associated with the curriculum, which represents the most fundamental component of colleges and universities. To fill this gap in the literature, this study examined the following research questions:

- *How do changes in state appropriations affect the total number of degree programs that public colleges and universities offer?*
- *How do changes in state appropriations affect the composition of the curriculum across different fields of study and program types that public colleges and universities offer?*
- *How does the association between state appropriations and the curriculum vary by institutional type?*

Discussion of the Findings

When it comes to the change in the overall size of the curriculum in response to changes in state appropriations, the study finds evidence of both expansion and contraction. At public R1 universities, state appropriations are positively correlated with the size of the curriculum, indicating that the curriculum contracts in response to state appropriation declines. On the other

hand, at less research-intensive public doctoral universities and master's universities, there is no discernible relationship between state appropriations and the size of the curriculum. At public baccalaureate colleges, changes in state appropriations are negatively associated with the number of programs, indicating that the curriculum expands in response to declines in state appropriations. The narrative on curricular change in relation to fiscal challenges has focused primarily on program cuts (e.g., Bauman (2020)), but the findings of the study demonstrate that contraction of the curriculum is not the only response associated with state funding declines. Differences in curricular response across institutional types may be attributable to differences in reliance on state appropriations, circumstances pertaining to revenue generation, as well as educational goals.

In addition to overall expansion and contraction, this study examined how declines in state appropriations affected the composition of programs. The findings of this study present some evidence to support the idea that declines in state funding are associated with more curricular emphasis being given to occupational fields. At most public colleges and universities, state appropriation declines are associated with either a contraction of programs in academic fields or an expansion of programs in occupational fields. This is in line with the idea that market demand would drive organizational change as colleges and universities receive less funding from the state (Slaughter & Leslie, 1997). It also supports the strategic adaptation perspective; as a means to adapt to declines in state appropriations, colleges and universities may be adjusting their curriculum in ways that would sustain and expand revenue from tuition. In some sense, such patterns of curricular change might indicate public higher education's receptiveness to student demand and needs. However, whether such changes are educationally desirable is debatable. Even in terms of economic returns, which is the basis on which arguments in favor of

occupational education are often made, recent empirical studies have demonstrated that skill-focused education does not outperform more general academic forms of education in the long-run (Deming & Noray, 2020; Hanushek et al., 2017).

At the same time, at public R1 universities, it is programs in occupational, rather than academic fields, that are positively associated with changes in state appropriations. This is consistent with previous studies indicating that cultural legitimacy would contribute to the preservation of programs in academic fields of study, while leaving occupational programs to be more susceptible to change (Osley-Thomas, 2019). In other words, it might be indicative of behavior that is in line with institutionalism, or the organizational desire to meet institutionalized norms and expectations. It could also, in part, reflect the relatively stable student demand to study programs in academic areas at R1 universities. Relatedly, the different patterns found at R1 and other institutional types may be the result of institutions specializing in areas of study in which they have relatively more expertise. As was the case in the findings on overall curricular change, the findings on occupational and academic programs demonstrate the complex dynamics of finance, culture, and educational circumstances that exists across different institutional types.

The study also examined how the number of non-degree certificate programs offered is associated with changes in state appropriations. Certificate programs reflect programs that are occupational in nature, but comprise the periphery of programs offered by colleges and universities, compared to traditional degree programs. Findings indicate that changes in revenue from state appropriations are negatively associated with the number of certificate programs offered. While previous studies on the curriculum have focused on traditional degree programs, this study demonstrates that institutions have also made adjustments to non-degree certificate programs in response to state funding declines. Unlike degree programs, whose magnitude and

direction of change involved considerable variation across different types of institutions, the patterns on certificate change tend to be more consistent across institutional types. Given their relatively lower costs of operation, and the fact they sit at the periphery, rather than the core, of the curriculum, they may not be subject to the same financial, educational, and administrative constraints as degree programs.

To account for political power dynamics in curricular decisions, I examined whether the relationship between state appropriations and the curriculum varied based on the gender composition of fields of study. More specifically, the study examined whether programs in women-majority fields were disadvantaged over those in men-majority fields, as suggested by previous studies in the literature. While no gendered patterns were found among programs in occupational fields, I did find some evidence of state appropriation declines being more strongly associated with declines in women-majority programs, compared to men-majority programs, among academic fields of study. As women are disadvantaged in the broader society, programs with relatively higher proportion of women graduates may be facing disadvantages when it comes to curricular decisions. It should be noted that such patterns were not robust to analyses using alternative criteria for distinguishing women- versus men-majority fields of study. Still, this should not be interpreted as conclusive evidence against the existence of gendered power relations playing a role in curricular decisions. The lack of clear gendered patterns may be due to the inability to precisely categorize women- or men-majority fields using the available data. Also, given that programs in academic fields have a higher proportion of women students than occupational fields, gendered power relations may be partially embedded in the differences found between academic and occupational fields.

Lastly, the study found that the relationship between state appropriations and curricular change is more evident in the period following the 2008 financial crisis. This could be due to the greater magnitude of decline in revenue from state appropriations following significant cuts to the state budget. Also, the severe changes in the fiscal and social circumstances brought upon by the financial crisis, including uncertainty about the foreseeable future, may have led public colleges and universities to become more sensitive to changes in state appropriations. Due to the economic recession induced by the recent COVID-19 pandemic, states across the country have or plan to reduce the budget for higher education, further limiting state financial resources for public colleges and universities, the findings of this study may show how the curriculum might change and adapt in the near future.

Implications for Future Research

One important area of future studies is empirically exploring how curricular changes have affected colleges and universities. Is the expansion of programs effective for increasing enrollment and tuition revenue? Is the contraction of programs conducive to the fiscal health of institutions? Slaughter and Rhoades (2004) argue that although colleges and universities' attempt to generate revenue, such efforts are often not successful. Relatedly, while the containment of cost has been cited as the main reason for increasing the hiring of non-tenure track faculty, Hearn and Burns (2021) find that the hiring of non-tenure track faculty is not actually associated with improved fiscal health of colleges and universities. While the current study focused on how public colleges and universities adjust their curriculum in response to state funding declines, the actual impact of such curricular changes on institutions warrants empirical investigation.

An additional area of future inquiry involves the investigation of qualitative changes experienced by programs in response to state appropriation declines. It is likely that declines in

state appropriations led to changes in fiscal, administrative, and personnel-related resources across fields of study, which are not fully captured by changes in the number of programs. Such qualitative changes, in turn, likely have direct implications for the work and experiences of individuals. For example, Rosinger and colleagues (2016) document segmentation across high- and low-resource departments, where discrepancies in resources are associated with differences in the way faculty work and navigate administrative processes. Studies should use more detailed program-level data to examine how state appropriation declines have affected programs, and how this varies by different fields of study.

In addition, studies should further investigate the role of political economic power dynamics in curricular decisions. The current study found some evidence of gendered patterns in curricular responses to changes in state appropriations. Using more detailed data, future studies should more deeply explore the ways in which power relations can influence curricular decisions across multiple dimensions, including social class and race. For example, future studies can extend upon the findings of Armstrong and Hamilton (2013), and examine how the preferences of students from different income groups are accounted for in curricular change. Furthermore, Hamilton and Nielsen (2021) find that the consequences of the ways in which colleges and universities adapt to fiscal austerity are not race neutral. Future studies should examine the race implications of curricular adjustments to declines in state appropriations, particularly as it pertains to how racially marginalized students are affected.

Lastly, future studies should examine the impact of factors other than changes in state appropriation revenue on curricular changes. For example, as a means to enhance resource allocation efficiency, a growing number of public colleges and universities have adopted responsibility center management (RCM), where management authority is decentralized to

departments (Jaquette et al., 2018). In return for more fiscal responsibility, departments are permitted to retain the revenue that they generate, and thus are incentivized to increase revenue while diminishing cost. Also, there is a growing push by states to focus funding to fields of study deemed to be in high-demand in the economy (Rosinger et al., 2020), or prohibit what colleges can teach due to political and social reasons (Forman, 2021). Such changes in the economic, political, and social dynamics faced by programs could influence the way curricular decisions are made.

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APPENDIX: POISSON REGRESSION ESTIMATES

Table 32. Poisson regression estimates on the effect of state appropriations on curricular change: All degree levels combined

Outcome variable	All institutions	R1 universities	LRI doctoral universities	Master's universities	Baccalaureate colleges
Total degree programs	0.025 (0.019)	0.113** (0.049)	0.031 (0.040)	0.041 (0.030)	-0.185*** (0.057)
Academic fields	0.058*** (0.017)	0.087* (0.045)	0.079* (0.044)	0.075*** (0.024)	-0.132** (0.061)
Occupational fields	0.009 (0.022)	0.134** (0.066)	0.003 (0.043)	0.025 (0.034)	-0.213*** (0.069)
Occupational fields (%)	-0.024** (0.011)	0.039 (0.030)	-0.018 (0.012)	-0.011 (0.007)	-0.054*** (0.014)
High-earning	0.016 (0.028)	0.109 (0.069)	0.041 (0.047)	0.024 (0.047)	-0.168** (0.073)
Low-earning	0.009 (0.021)	0.158** (0.077)	-0.027 (0.047)	0.030 (0.031)	-0.262*** (0.079)
Certificates	-0.219*** (0.074)	-0.091 (0.252)	-0.234* (0.131)	-0.283*** (0.105)	-0.369 (0.262)
Women-majority academic fields	0.073*** (0.021)	0.101* (0.056)	0.090 (0.056)	0.094*** (0.029)	-0.100* (0.054)
Men-majority academic fields	0.013 (0.020)	0.118** (0.054)	0.013 (0.038)	0.030 (0.031)	-0.210*** (0.067)
Women-majority occupational fields	0.016 (0.024)	0.184** (0.086)	-0.004 (0.051)	0.031 (0.035)	-0.227*** (0.068)
Men-majority occupational fields	0.033** (0.017)	0.071* (0.037)	0.055 (0.038)	0.051* (0.028)	-0.155*** (0.057)

Notes: $\ln(\text{state appropriations per FTE})$ is the natural log of the revenue from state appropriations, averaged across the previous three years. All regressions control for natural log of the state's college-age population, state unemployment rate, the natural log of state income per capita, and include institution and year fixed effects. Robust standard errors, clustered at the institution level, are reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 33. Poisson regression estimates on the effect of state appropriations on curricular change: Bachelor's degree programs

Outcome variable	All institutions	R1 universities	LRI doctoral universities	Master's universities	Baccalaureate colleges
Total number of programs	0.033 (0.021)	0.074 (0.055)	0.033 (0.045)	0.037 (0.031)	-0.118** (0.056)
Academic fields	0.062*** (0.017)	0.075 (0.052)	0.082* (0.043)	0.077*** (0.025)	-0.101* (0.052)
Occupational fields	0.015 (0.023)	0.071 (0.071)	-0.003 (0.050)	0.016 (0.032)	-0.134* (0.075)
Occupational fields (%)	-0.030 (0.021)	0.009 (0.032)	-0.023* (0.014)	-0.009 (0.008)	-0.119 (0.077)
High-earning	-0.001 (0.027)	0.048 (0.058)	-0.016 (0.050)	-0.003 (0.039)	-0.101 (0.092)
Low-earning	0.027 (0.026)	0.095 (0.101)	0.013 (0.058)	0.029 (0.033)	-0.172** (0.087)
Women-majority academic fields	0.081*** (0.021)	0.095 (0.070)	0.105* (0.059)	0.097*** (0.029)	-0.069 (0.048)
Men-majority academic fields	0.019 (0.020)	0.065 (0.056)	0.008 (0.043)	0.023 (0.029)	-0.140** (0.070)
Women-majority occupational fields	0.023 (0.026)	0.128 (0.106)	-0.011 (0.057)	0.025 (0.034)	-0.180** (0.091)
Men-majority occupational fields	0.041** (0.018)	0.053 (0.043)	0.055 (0.042)	0.048* (0.028)	-0.092* (0.049)

Notes: $\ln(\text{state appropriations per FTE})$ is the natural log of the revenue from state appropriations, averaged across the previous three years. All regressions control for natural log of the state's college-age population, state unemployment rate, the natural log of state income per capita, and include institution and year fixed effects. Robust standard errors, clustered at the institution level, are reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 34. Poisson regression estimates on the effect of state appropriations on curricular change: Master's degree programs

Outcome variable	All institutions	R1 universities	LRI doctoral universities	Master's universities	Baccalaureate colleges
Total number of programs	0.080*** (0.022)	0.100** (0.048)	0.052 (0.034)	0.082*** (0.031)	-0.419** (0.181)
Academic fields	0.074*** (0.024)	0.073 (0.050)	0.060* (0.036)	0.076* (0.041)	-0.487 (0.599)
Occupational fields	0.084*** (0.025)	0.124** (0.057)	0.050 (0.039)	0.081** (0.034)	-0.449** (0.186)
Occupational fields (%)	0.003 (0.008)	0.039* (0.022)	0.001 (0.014)	0.003 (0.009)	0.022 (0.060)
High-earning	0.132*** (0.033)	0.109* (0.061)	0.129*** (0.050)	0.147** (0.062)	-1.512*** (0.538)
Low-earning	0.070** (0.028)	0.137* (0.072)	0.000 (0.038)	0.080** (0.035)	-0.139 (0.214)
Women-majority academic fields	0.079** (0.033)	0.099 (0.066)	0.061 (0.050)	0.073 (0.053)	-0.353 (0.556)
Men-majority academic fields	0.081*** (0.022)	0.100** (0.047)	0.051 (0.033)	0.083*** (0.031)	-0.445** (0.177)
Women-majority occupational fields	0.088*** (0.028)	0.143** (0.071)	0.044 (0.046)	0.092*** (0.036)	-0.329 (0.238)
Men-majority occupational fields	0.075*** (0.022)	0.077* (0.044)	0.059* (0.032)	0.071* (0.039)	-0.741** (0.357)

Notes: $\ln(\text{state appropriations per FTE})$ is the natural log of the revenue from state appropriations, averaged across the previous three years. All regressions control for natural log of the state's college-age population, state unemployment rate, the natural log of state income per capita, and include institution and year fixed effects. Robust standard errors, clustered at the institution level, are reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 35. Poisson regression estimates on the effect of state appropriations on curricular change: Doctoral degree programs

Outcome variable	All institutions	R1 universities	LRI doctoral universities	Master's universities
Total number of programs	0.158*** (0.046)	0.112** (0.045)	0.161** (0.082)	0.049 (0.198)
Academic fields	0.156*** (0.036)	0.066* (0.039)	0.205*** (0.069)	0.075 (0.200)
Occupational fields	0.181*** (0.061)	0.171** (0.067)	0.149 (0.099)	0.096 (0.205)
Occupational fields (%)	-0.007 (0.022)	0.083** (0.041)	-0.059** (0.023)	0.018 (0.037)
High-earning	0.306*** (0.068)	0.213*** (0.071)	0.354*** (0.132)	0.228 (0.296)
Low-earning	0.087 (0.066)	0.122* (0.068)	0.030 (0.091)	0.040 (0.151)
Women-majority academic fields	0.172*** (0.049)	0.087 (0.058)	0.218** (0.091)	0.335 (0.267)
Men-majority academic fields	0.157*** (0.050)	0.125*** (0.048)	0.141 (0.088)	0.016 (0.188)
Women-majority occupational fields	0.167** (0.074)	0.203** (0.097)	0.084 (0.097)	0.180 (0.188)
Men-majority occupational fields	0.164*** (0.033)	0.079** (0.032)	0.226*** (0.070)	-0.019 (0.147)

Notes: $\ln(\text{state appropriations per FTE})$ is the natural log of the revenue from state appropriations, averaged across the previous three years. All regressions control for natural log of the state's college-age population, state unemployment rate, the natural log of state income per capita, and include institution and year fixed effects. Robust standard errors, clustered at the institution level, are reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

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- Zhu, Q., **Choi, J.**, & Meng, Y. (2021). No-loan policies and economic diversity at public colleges and universities. *Research in Higher Education*.
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- Meng, Y., Zhu, Q., & **Choi, J.** (2019). Geography of opportunity for STEM. American Educational Research Association Annual Meeting, Toronto, Canada.
- Choi, J.**, Lee, J. H., & Kim, B. (2019). How does learner-centered education affect teacher self-efficacy? The case of project-based learning in Korea. American Educational Research Association Annual Meeting, Toronto, Canada.
- Choi, J.**, Rosinger, K., & Ford, K. S. (2019). Holistic admissions and college access. Association for Education Finance and Policy Annual Conference, Kansas City, Missouri.