Demographic and Financial Trends Among Southeastern Universities in the U.S.A.

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***Abstract*—This Work-In-Progress (WIP) research paper summarizes and compares institutional demographic and financial trends among five Southeastern engineering institutions through 2000-2015. This WIP is part of a larger study investigating the effect of institutional characteristics on first- to second- year retention among undergraduate engineering students. Using two databases, we compared institution demographics, number of degrees granted, and institution expenditure both at the university level and engineering college level. The authors will use the results of this WIP to further investigate the effects of these variables on engineering students' academic performance by using these results and applying additional quantitative models to a longitudinal and multi-institutional database.**

Keywords—Engineering Education, Undergraduate, Policy, Institutional Characteristics, MIDFIELD.

I. INTRODUCTION

Every college of engineering at universities in the USA creates policies that are aligned with institutional goals. These policies, combined with other institutional characteristics, affect their students' overall experiences. Institutional factors, such as institution size and location, and policies, such as selectivity in the admissions process for engineering students, can all impact students' experiences and outcomes. A substantial body of research has reported the effect of student characteristics on student retention [1-3]. However, less attention has been paid to the effect of institutional characteristics on student success.

Prior research has taken various approaches to measuring the factors that affect students' academic outcomes. In some cases, state legislatures and higher education governing boards have tied higher education funding to student educational outcomes [4, 5]. Administrators and other policy makers within institutions have responded to the research and the public policy consequences in an effort to improve undergraduate students' experience and, more importantly, to improve student retention [6]. However, much of the research has focused only on student demographics and pre-college factors without considering institutional factors [7]. This limitation suggests the importance of investigating other institutional factors that can directly or indirectly impact students' success [8]. To have a more complete understanding of what affects student success, it is necessary to consider both levels of factors (student and institution) [9].

II. BACKGROUND

Reason, et al. [10] describe seven general institutional practices that significantly affect the first-year experience and suggest that institutions are more successful in supporting students when they: (1) Formulate organizational structures and policies that provide a comprehensive, integrated, and coordinated approach to the first year; (2) Facilitate appropriate recruitment, admissions, and student transitions through policies and practices that are intentional and aligned with institutional mission; (3) Make the first college year a high priority for the faculty; (4) Serve all first-year students according to their varied needs; (5) Engage students, both in and out of the classroom, to develop attitudes, behaviors, and skills consistent with the desired outcomes of higher education and the institution's philosophy and mission; (6) Ensure that all first-year students encounter diverse ideas, worldviews, and people as a means of enhancing their learning and preparing them to become members of pluralistic communities; (7) Conduct assessment and maintain associations with other institutions and relevant professional organizations in order to achieve ongoing first-year improvement.

Other researchers have focused on investigating the effect of institutional factors on student retention. The wide variety of factors investigated includes: institution selectivity [11, 12], public or private control, enrollment size [13, 14], educational and general expenditures [15], diversity and inclusivity climate [16, 17], curricular structure [10, 18], matriculation models, and Carnegie classification [19].

Three main limitations can be seen in these prior works. From a data analysis perspective, they are either unable to substantiate their findings across institutions or they do not investigate longitudinal trends within institutions. They also do not address the beyond-institution financial and geopolitical trends that may affect these variables.

This paper begins to address these limitations as part of a larger project. We investigate the trends among institutions in a specific region (Southeastern US). Using two databases, we look at each university as a whole as well as the engineering program to enable us to get a better understanding of how engineering colleges follow the university trends. Concentrating on one

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region will help to mitigate regional financial and geopolitical factors that may affect these variables. By later joining these findings to student data, we can add another level to our investigation.

III. Framework

Terenzini and Reason's Model of Influences on Student Learning and Persistence [20] extends on previous foundational theories which collectively suggest that both student and institutional variables should be considered to understand student outcomes. The model is designed to "guide understanding of the effects of the college experience on any given educational outcome" [21, p. 64] . It divides the factors into two main areas: students' pre-college characteristics and experience, and the college experience. The college experience is further subcategorized into: (1) organizational context, which includes: internal structures, policies, and practices; academic and co-curricular programs' policies and practices; and faculty culture policies; and (2) peer environment which includes the classroom experience, out of class experience, and curricular experiences.

Here, we focus on the organizational context part of the model represented as a latent variable encompassing institutional differences. This work will be the foundation for later studies in which the authors will focus on other constructs of the model.

This effort will help to validate and explain trends seen in students' performances among institutions and through different years. Understanding where institutions stand at different points of time (in comparison to other institutions), will validate the multi-institutional analysis. By providing changes and trends across multiple years (within an institution), these studies will also help validate longitudinal studies in this area.

IV. Dataset

A. Database

We used the Delta Cost Project IPEDS database [22] and ASEE's Engineering Data Management System (EDMS) [23]. The former is an open source database that consists of finance, enrollment, staffing, completions and student aid data for academic years 1987-2015. The data is collected from the IPEDS annual survey which is collected from institutions and summarizes the data of each institution as a whole. The EDMS data includes information from more than 75% of the engineering programs across the nation, though the list and number of participating institutions varies from year to year. EDMS contains information from 1998 to 2018.

B. Institutions

We will merge the results of this study with student data. The student data will be extracted from the Multiple Institution Database for Investigating Engineering Longitudinal Development (MIDFIELD). Although the MIDFIELD database includes longitudinal data from 22 institutions, we will only focus here on five Southeastern US institutions, in part because MIDFIELD contains more institutions from the Southeast than any other region. We choose one region to control for external geopolitical differences between different regions and to take advantage of the regional variables of the Delta database that can be taken into consideration to compare with institutional trends.

The institutions considered in this study are Embry-Riddle Aeronautical University - Daytona Beach (Embry-Riddle), Georgia Institute of Technology (Georgia Tech), North Carolina Agricultural and Technical State University (NCA&T), University of Florida, and University of North Carolina Charlotte (UNCC). They were chosen because they represent a variety of institutional missions (e.g., land grant, regional university, Historically Black University); Carnegie Classifications (Doctoral, Very High Research Activity; Doctoral, High Research Activity; Master's Colleges & Universities: Medium Programs); control (public and private); as well as percentage of undergraduate students who are majoring in engineering (9% - >60%).

C. Variables

The inclusion criteria for choosing variables for this study was to use variables that, based on literature, have been affecting student outcomes, have been changing over time, vary among institutions, and can be linked and used in the future steps. Therefore, for this study we analyzed and compared institutions' bachelor's degrees awarded, engineering bachelor degrees awarded, institutional diversity, and per student expenditure from 2000 to 2015.

V. Results

Figs. 1a-1d visualize some of the findings. Fig. 1a compares bachelor's degrees and engineering degrees awarded by institution from 2000 to 2015, Fig. 1b visualizes the engineering degrees awarded by institution Fig. 1c illustrates the expenditure across institutions over time, and Fig. 1d shows the diversity index.

Fig. 1a shows how the number of bachelor degrees have been increasing over time. However, in 2011 there is a sudden drop which may be due to the 2008 recession in the US affecting higher education enrollment. The slope of this drop is steeper for all bachelor's degrees than the drop in slope of degrees awarded in engineering and shows that engineering majors started to recover sooner and with a higher rate in comparison to all majors combined. This may be because of the spike in the demand of educated engineers in the workforce [24].

Fig. 1b breaks down the degrees awarded in engineering by institution. As noted, the drop that we saw in the previous figure is not as obvious except for Georgia Tech, the largest engineering school among the institutions that are included in this study. The relative size of Georgia Tech may have a significant role in the overall drop in Fig. 1a. As seen, other institutions have recovered from the drop and the number of the engineering degrees has been increasing after the drop except NCA&T which has remained relatively flat.

Fig. 1c shows the expenditure of each institution through multiple years. This variable explains: all instructional expenses and the expenses related to department research [25] per student. The expenditure has been converted into constant 2015 dollars using the Higher Education Cost Adjustment (HECA) scale [26]. On average, institutions have kept a constant expenditure throughout the years. However, University of Florida has

increased its instructional expenditure in recent years, taking the lead among other institutions after 2009, while Georgia Tech has reduced its expenditures, falling to second place among the five schools.

We calculated the diversity of each institution using the Simpson's diversity index [27]. This measure takes into account the number of groups (categories) present, as well as the relative population of each individual within each group. For this paper, the index was calculated using the entire population of each institution and by considering the counts of White, American Indian, Asian, Black, Hispanic, and Other ethnicities within each institution. This is a scale from 0 to 1, and the higher the number, the more diverse the institution will be. Surprisingly all institutions are moving towards a less diverse population. Also, NCAT has been leading with the highest diversity index among other institutions. This may be because the fact that this institution is a predominantly Black institution and may have been attracting other minority ethnicities.

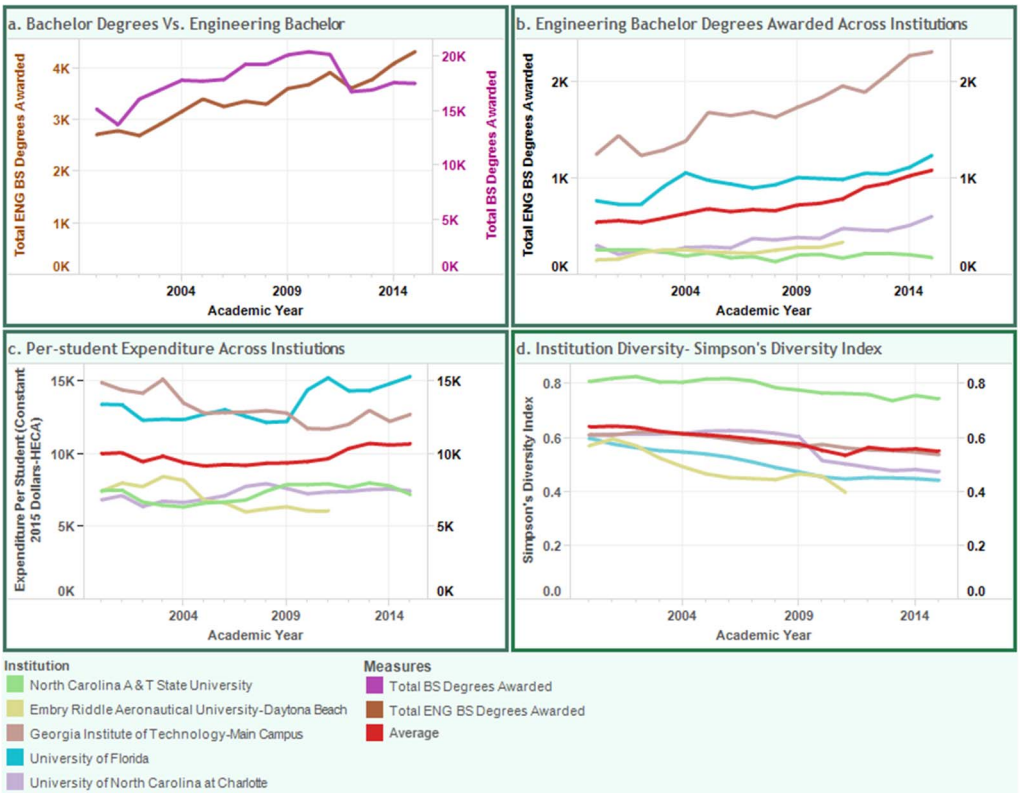

Fig. 1. (a) Total bachelor degrees awarded by the five institutions (brown) Vs. total engineering bachelor's degrees awarded by the five institutions(purple); (b) number of engineering bachelor's degrees awarded by institutions across years 2000-2015 ; (c) instructional expenditure per student from years 2000-2015, (d) diversity index of institutions calculated using Simpson's diversity index

VI. Discussion

In this WIP, we have used two open source databases to investigate financial and demographic trends among five Southeastern universities. We illustrated the number of students enrolled, bachelor's degrees granted, and the expenditure of each institution from 2000 to 2015. This WIP will be a foundation study for future research to investigate student success among these institutions by considering both institutional and student factors. The results provide a perspective of the current trends and differences across multiple years. The findings guide us to have a deeper investigation and use other databases to get more context on some of the different trends among institutions. The analysis so far raises several questions—did NCA&T face greater challenges in recovering from the recession than other schools? If so, why? Are there state funding and policies that may have impacted Georgia Tech? Are any of the observed trends tied to federal or state elections? What effect does the relative importance of engineering to the institution as a whole (in terms of enrollment fraction) have?

In this paper, we analyzed some of the measurable factors that each have been investigated individually by other researchers. However, the uniqueness of this paper is that it gives a holistic view of institutional factors that may affect students' experience. In addition, it provides a multi institutional comparison among institutions in a region. This accounts for un observed geopolitical factors that influence institutions in a region.

VII. Future Steps

The authors will further investigate other institutional characteristics using other resources. We will use the framework mentioned in this work to investigate student success by

considering the trends and differences seen in this WIP. We will use quantitative methods to be able to consider both levels of factors (institution and student).

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