A PANEL ANALYSIS OF INSTITUTIONAL FINANCES OF MEDICAL RESIDENCIES AT NON-UNIVERSITY-BASED INDEPENDENT M.D. GRANTING MEDICAL SCHOOLS IN THE UNITED STATES

Ah Ra Cho

Dissertation Prepared for the Degree of

DOCTOR OF PHILOSOPHY

UNIVERSITY OF NORTH TEXAS

May 2017

APPROVED:

Barrett Taylor, Major Professor
P. Daniel Chen, Committee Member
Jason Simon, Committee Member
Janice Holden, Chair of the Department of Counseling and Higher Education
Bertina Combes, Interim Dean of the College of Education
Victor Prybutok, Vice Provost of the Toulouse Graduate School

Cho, Ah Ra. *A Panel Analysis of Institutional Finances of Medical Residencies at Non-University-Based Independent M.D. Granting Medical Schools in the United States*. Doctor of Philosophy (Higher Education), May 2017, 175 pp., 37 tables, 22 figures, references, 199 titles.

Traditionally, medical residency positions have been primarily funded by the federal government. However, due to declining governmental funding support over time, medical schools have resorted to fund these programs through other means such as clinical fees and payments for services. This change has affected the number and types of residencies available to medical school graduates. The purpose of this study was to measure how the availability of fiscal resources shape mission-related outputs, particularly medical residency positions at medical schools. Using academic capitalism as the theoretical framework provided a lens through which to examine how federal policies have shaped the availability and funding of medical residencies today at the institutional level. This concept has been studied in traditional colleges and universities and how they balance mission and money, but less so in the context of medical schools. This study used a fixed effect panel analysis to study the impact of selected variables over a 10-year period on financing of medical residencies. Findings included that tuition revenues, paid for by undergraduate medical students, are increasingly funding medical residency positions. There was little to no effect from hospital revenues and federal research monies on increasing the number of medical residency positions. The funding of university based medical education is particularly timely and of national importance to understand the consequences of federal policies for medical schools and how medical

residency funding caps and limits have affected one of the missions of medical schools which is to train physicians.

TABLE OF CONTENTS

Page

LIST OF TABLES

Page

LIST OF FIGURES

Page

CHAPTER 1

INTRODUCTION

Although the uncertainty of meeting future demand for physicians and current supply of practicing physicians has been always present, concern has increased due to recent policies and changes from the federal government and projected shifts in the U.S. population. This makes predicting physician supply and demand difficult (Carrier, Yee, & Stark, 2011; Cooper, Getzen, McKee, & Laud, 2002; Dill & Salsberg, 2008).

As a result, the United States is predicted to have a shortage of 46,000-90,000 practicing physicians by 2025 (American Association of Medical Colleges (AAMC), 2015c). In 2015, the AAMC estimated in the next 10 years there will be a shortage of 12,000-31,000 primary care physicians and 28,000-63,000 non-primary care physicians, particularly specialists in surgery. Although entering medical school classes have increased by 30% between 2002-2016, one large barrier still remains; there are insufficient residency positions for recent medical school graduates creating a bottleneck effect (Iglehart, 2013). Some states, such as Texas and Florida, have increased the number of medical schools, thereby increasing the number of medical school graduates, yet residency positions have not met demand (Cooper, 2007; Iglehart, 2013). For states with not enough residency positions, has led the state's medical school graduates, for which a state has invested a considerable amount of state educational resources towards their medical school education, to seek and do their residencies out-of-state.

To start, a definition of a medical residency, analogous to the term graduate medical education (GME), will be given to provide context to what it is. Cooke, Irby, and

O’Brien (2010) define a medical residency in the United States as a period of time after an individual receives a medical degree (Doctor of Medicine, MD, or Doctor of Osteopathic Medicine, DO), to further specialize in a particular area of medicine. Currently, there are over 140 specialties and subspecialties categorized by the Accreditation Council for Graduate Medical Education (ACGME) (AAMC, 2012a). Residencies are extensive and intensive clinical experiences done in a teaching hospital, area clinical sites, or academic health centers. Most residencies are associated with an affiliated medical school.

The goals of medical residencies are very specific, whether training physicians to serve a particular area of the state or population, preparing faculty for academic medicine careers, or conducting clinical research. At the end of residency, physicians have the option to become board certified in a particular specialty which are administered by the American Board of Medical Specialties (ABMS) member boards (American Board of Medical Specialties, 2016). Upon completion of residency, graduates can go directly into practice or pursue further training in a subspecialty in which length depends on type of subspecialty chosen (AAMC, n.d.a.).

Training takes between three to seven years based on specialty, from family medicine and pediatrics taking three years to neurosurgery and plastic surgery taking seven years to complete. During this training period, individuals will finish the final licensing exam, the United States Medical Licensing Exam (USMLE) or Comprehensive Osteopathic Medical Licensing Examination (COMLEX-USA), to become licensed to practice in the United States as an allopathic MD or osteopathic DO physician

respectively. This study will only focus on medical schools that provide MD medical residency training.

What makes the topic of medical residencies particularly tied to finances and higher education? The training of a medical resident is expensive, and is highly subsidized as an educational entity within medical schools and academic medical centers. Unlike most aspects of higher education (Heller, 2006), these subsidy dollars are derived primarily from the federal government rather than from states. It costs approximately $145,000 a year to train a new resident, and Medicare funds more than 75% of medical residency positions in the U.S. (AAMC, 2011; Anderson, Greenberg, & Wynn, 2001). Although some funding comes from other federal agencies, like the Department of Defense, Department of Veterans Affairs, and the National Institutes of Health (COGME, 2000; 2014), the majority of residency funding is derived from Medicare. Costs that are associated with medical residents include: resident and faculty supervisor stipends and fringe benefits, staff salaries in GME administrative offices, and institutional overhead costs (AAMC, n.d.a).

Increasingly, the growing demand for residency positions has prompted teaching hospitals to fund these programs through clinical fees and payments for services. A small but growing fraction of residencies is funded through private funding from corporations or pharmaceutical companies (Advisory Board Company, 2013). Innovative programs such as Duke University's quasi-endowment for GME is also a way that residencies are getting creative in producing more residency positions and funding them accordingly (Andolsek et al., 2013).

This is somewhat comparable to the changes in traditional higher education institutions (HEIs) as public funding has declined and higher education institutions are having to find other means to fund their institutions. However, one difference is medical schools pay a modest salary to residents and do not charge residents tuition and fees (AAMC, 2013). This is comparable to using post-doctoral students in higher education institutions, as they have obtained advanced degrees but work for the institution for the additional training and experience and also are provided a modest salary (Stephan, 2012). These types of positions are unlike other traditional higher education consumers (undergraduate, graduate, and professional students) who are charged tuition and fees for seeking higher education.

The Current State of Medical Schools

Today, a great majority of universities are characterized by scarcity of resources, competition between institutions, and more reliance on external funding as public funding both state and federal has diminished in recent decades. Yet, medical schools should be framed in a different manner in contrast to traditional HEIs (Porter, 1980). Medical schools are their own unique type of entity within higher education and should be analyzed in that manner due to the nature of their missions, purpose, and organizational activities specifically focused on one discipline: medicine (Clark, 1998).

The following paragraph summarizes the current state of medical schools. "Like today's research universities, medical schools have more outputs than ever before. These include: knowledge creation, human capital creation, transfer of existing services,

technological innovation, capital investment, provision of regional leadership, knowledge infrastructure, regional milieu" (Goldstein, Maier, & Luger, 1995).

Unlike traditional colleges and universities, medical schools, due to the nature of specialized professional faculty, expensive labs and equipment, and highly scientific and clinical nature of its enterprise, it is extremely cost prohibitive to create a new medical school (Smythe, 1967). Some states have worked around this issue on limited number of medical schools and instead have expanded their existing medical schools in size and added other site locations and affiliations (Feldman, 2009).

Due to the specialized nature of these schools, there are only a few hundred in existence, not thousands like traditional HEIs. Medical schools are restricted in the size of their medical school classes unlike HEIs which are able to have large undergraduate bodies and ability to provide mass education with better efficiency and economies of scale (Brinkman & Leslie, 1986). This is in part due to accreditation requirements, which tries to maintain the quality of education, but also, similar to graduate education, the very nature of medical education requires smaller faculty-to-student ratios.

Having one additional medical student and medical resident costs considerably more than adding one additional undergraduate student within an HEI. Estimates vary but Scheffler (2008) estimates the annual instructional cost for each medical student is $73,807. These exclude scholarly activities and patient care costs and only a small portion of the instructional costs are paid by the student in the form of tuition (Roth, 2009). For medical schools and teaching hospitals, the costs to train one medical resident per year is considerably higher at $134,803 per year (AAMC, 2011; Wynn et

al., 2013). Previous studies found that variations due to specialty and program size do not vary systemically on per resident costs (COGME, 2000; Anderson, 1996).

Another consideration what makes medical schools unique is the function of medical research, particularly applied research, can be easily translated into marketable products like pharmaceuticals and technology but still can be justified as a part of education and research as teachable experiences to students while in the clinical and production steps (Clark, 1998; Etzkowitz, 1997).

Medical schools along with their teaching hospitals and clinics, creates an intricate system of providing education, research, and patient care services. Hospitals, both private and non-profits, have dealt with the rise in commercialization and competition between each other. This has led non-profit hospitals, like teaching hospitals, to pursue more commercial activities to keep up with private hospitals which have more opportunities to create revenues without the burden of trying to maintain non-profit status, providing charity care, and paying for teaching costs (Sloan, 1998). Similarities exist in how HEIs are dealing with the difficulties of decreased public funds from the government and resorting to find other financial sources to fund their institutions.

This study will only focus on independent non-university affiliated MD-Granting medical schools which further differentiates from university-affiliated medical schools. This was done for two reasons: (1) distinctiveness of independent medical schools as a distinct entity in higher education and (2) the bounded nature of finances of independent medical schools. Further, only MD (Doctor of Medicine) granting institutions will be

studied and all DO (Doctor of Osteopathic Medicine) granting institutions will not be included.

Studying non-university affiliated independent medical schools differentiates them from university affiliated medical schools. With independent medical schools, they thrive on being distinctive as a group, have very specific missions, and are protected from academic drift or deviating into other academic ventures. This is ideal to study the effects of how medical residency funding has changed as medical schools focus on medical education, research, and service activities without being influenced by the parent university and their priorities. Scant research exists on the interrelationships of medical schools and universities in general, but this provides a way to learn more about how medical school finances play a role for independent institutions which can give a sense of where revenues flow.

Finances are bounded within an independent medical school which can show a clearer view of how finances have changed in the past without influence from a parent university. Using independent non-university affiliated medical schools limits the medical school to generate funding from only within the medical school and inability to gain funds from its parent university. Cross-subsidization occurs between academic programs and departments, and as medical education is expensive, it is likely other departments and programs from the parent HEI is subsiding costs for medical education. This justifies small medical school classes in contrast to large undergraduate programs which can number into the hundreds and thousands. University-affiliated institutions have the capacity to provide more resources to medical school departments than say the humanities departments or programs that are able to provide high

economies of scale, lower costs to the institution, but high student yields (Clark, 1978; 1995).

Changes in a university's revenue profile predict changes in the degrees that it offers. This is why it is important to understand the funding mechanisms of graduate medical education within medical schools and its ability to sustain training physicians for the future. Various available streams of funding affect the focus of the activities that are emphasized in the institution (Lepori, Usher & Montauti, 2013; Taylor, Cantwell, & Slaughter, 2013). For U.S. research universities, revenues are used in strategic ways, whether to attract high-quality students, invest in student learning and success, or pursue research funding (Leslie, Slaughter, Taylor, & Zhang, 2011; Pike, Kuh, McCormick, Ethington, & Smart, 2011; Ryan, 2004). In this study, the focus is placed on how medical residency funding has impacted medical schools in the past 10 years.

Problem Statement

One problem with research on graduate medical education is that it is limited in scope with the focus and existing research on the education of medical residents rather than the organization of GME. These two elements go hand in hand as training of physician takes both time and finances: the years invested in medical school and the cost of medical training. Medical education is highly subsidized, with a vast investment of resources that a medical school puts into residency programs. This further affects organizational behavior, as the training of a physician may be an organizational goal and a part of the institution's mission, but institutional priorities can shift to other more lucrative and prestige-maximizing activities such as revenue generation and focus on

research activities. This in turn creates competition, rise in complexity within these institutions, and questions the true societal role and mission aims of medical schools (Tuckman, 1998; Weisbrod, 1998).

However, in today's higher education environment, it is inevitable. This "two-good" framework is a delicate balancing act between institutions doing unprofitable mission activities such as teaching, basic research, and service versus pursuing lucrative revenue generating and commercial activities, such as applied research, patents, advancement pursuits, and endowments. Each "good" is dependent on the other due to declining revenues from public funds. Public funds today are insufficient to make up for the costs of mission activities of the institution; therefore, other means of revenue generation have taken place to make up the loss of funding sources to advance their goals (Weisbrod, Ballou, & Asch, 2008). This concept has been studied in traditional colleges and universities and how they balance mission and money, but less so in professional schools, a distinct type of higher education institution, in the context of their own missions, institutional priorities, and current funding mechanisms.

There is little research in this area of looking at institutional factors that impact the state of medical education in U.S. medical colleges. Accordingly, this study would explore the relationships between financing and training in medical education over the past 10 years. This study entails clear policy implications. Funding for medical education and, in particular, federal funding for GME is integral to societal health care access and delivery. Teaching hospitals and residencies, particularly in urban areas, serve a disproportionately larger number of poor, very ill, and uninsured patients (Moy, Valente, Levin, & Griner, 1996). This role in health care delivery is only likely to

increase, as dramatic shifts in federal healthcare involvement could occur, and any subsequent changes in the future, may further increase the need for trained physicians to meet the growing influx of patients (Ighehart, 2013).

However, levels of GME support and public sources of funding have been approximately fixed since the late 1990s causing medical schools to pursue other forms of funding (Iglehart, 2013). These relative declines in GME funds in relation to costs have made it likely that teaching hospitals will pursue revenue-generating activities rather than training and the delivery of health care services to under-served populations. This has lead to creation of distracted “false non-profits” as institutions benefit from their non-profit status, with tax breaks and subsidizes and more positive perception in society, but behave more like private entities in generating money through other activities (Weisbrod, 1998). This behavior is similar to what non-profit hospitals have been doing since the late 1990’s, focusing on commercial activities and ancillary services, downplaying the mission activities of uncompensated patient care and charity services, and charging higher “user fees” for their services. Non-profit hospitals have justified this behavior as this generated revenue can also achieve the organization’s mission of providing uncompensated patient care. This is similar to medical schools/teaching hospitals, as they do provide indigent and more costly care, in this case, even more so than non-profit and private hospitals. But there is one added mission component for medical schools, as non-profit hospitals do not have major commitments to medical education and research (Sloan, 1998). In the past, the federal government was able to subsidize this medical education and research activities for medical schools, but this is no longer the case, therefore this has lead to medical

schools to use other means of revenue, to support the educational mission of residency education.

This research will use various data sources in order to provide context in how medical residency funding has changed in the past few years. The collection and analysis of data will support policy and practice decisions. There is quite a debate of the federal government providing more funding for medical residencies, whether it be through Medicare or similar federal programs (Anderson, Greenberg, & Wynn, 2001, Schwartz, 2012). Also taxpayers want to know what the social return of contributing to graduate medical education is (Baron, 2013; Cohen, Cruess, & Davidson, 2007; Sutz, 1997). Congress and legislators gets conflicting predictions on the future of physician workforce which creates a problem as policymakers want to see quantitative data that strongly support one way or another.

Further, the majority of current research on medical residencies focuses on the medical education of residents. Existing research specific to funding of medical residencies is limited and more opinion-based, focused in academic medicine journals, and although an important source to know the current landscape of the views of medical residency funding today, should be viewed cautiously as viewpoints, not as research. I will be able add to the limited body of research in higher education that focuses on funding of medical schools and the programs they support which in this case, are medical residency programs.

Purpose of Study

The purpose of this study has multiple facets. I am trying to measure how the

composition of sources of money shapes mission-related outputs. I argue that there is increasing conflict between the mission and finances of independent, non-university affiliated medical schools. This argument is similar to the conflict of mission and money that other higher education institutions face (Jaeger & Thornton, 2005; Weisbrod et al., 2008).

The theoretical framework to be used in this study is academic capitalism (Slaughter & Leslie, 1997). Using academic capitalism is an appropriate theory for this study as it emphasizes that higher education organizations matter both in field conditions and organizational characteristics they possess. This in turn, affects the behavior of organizations in how they pursue goals, frame policy, and affect outcomes. Medical schools are a distinctive type of HEI, with specific missions and goals different from traditional HEIs. Medical schools have similarities like traditional HEIs in their teaching, research, and service mission, but also have a component of patient care and services that are not easily substitutable. Therefore, studying medical schools as a separate entity is appropriate for this study.

GME funding and the availability of medical residency positions can be explored through current revenue sources that medical schools have such as federal research funding, Medicare graduate medical education funding, hospital revenues, and other funding sources. Contemporary medical schools follow the idea that to be competitive in today's society, one must look for resources and programs outside the institution that intersect with the market demands (Slaughter & Cantwell, 2012; Slaughter & Rhoades, 2004). Further, organizational segmentation also occurs as research revenues from high resource fields are more favored than low resource fields, like in the example when

comparing science and engineering (S&E) fields to the humanities. Yet this organizational response is driven from both within and outside of the institution on why S&E revenues are more valued than humanities revenues (Rosinger, Taylor, Coco, & Slaughter, 2016; Taylor, Cantwell, Slaughter, 2013). My argument is this is similar within medical schools that some departments, particularly those that focus heavily on research and technology generation such as pharmacology and cardiology, are favored than medicine departments which focus on teaching and patient care such as anatomy and family medicine. Unlike traditional HEIs, the delineation between departments is less clear cut as some basic science departments can generate more lucrative, therefore more favored research revenues, than some clinical medicine departments that focus primarily on educational activities of medical students and residents.

Method and Data Sources

This study will use a fixed effect panel analysis to study the impact of variables over time on the financing and number of medical residencies. Variables will be obtained from the following sources: IPEDS (Integrated Postsecondary Education Data System), National Science Foundation (NSF), National Institutes of Health (NIH), Centers for Medicare and Medicaid Services, the National Resident Matching Program (NRMP), and American Association of Medical Colleges (AAMC). Each of these datasets provide information important to study the effects of funding on medical residency training positions and will be further explained in detail in the Methods chapter.

Research Questions

The following research questions guided this study:

- RQ1: What is the general variation in sources of financial support over time at university-based medical schools in the past 10 years?
- RQ2: Has the number of residency positions increased over the past 10 years even as Medicare-funded residency positions have remained relatively constant?
- RQ3: What university and medical school characteristics have predicted variation in the number of residency spots at university-based medical schools over time?

Limitations

Limitations are present for this study which include the (1) variables used in this data set and (2) creation of panel data sets, changing the structure of data slightly.

First, as this is an institutional level analysis, variables are very specific and limited. Other means of funding provided by individual states on medical residency funding may or may not be captured by the data and variables chosen for this analysis. This limitation can be beneficial as it will ignore other sources of revenue and make the data on a more even playing field.

Second, since this study will be using a panel model, panel data sets will be created. Creating panel data sets typically require collapsing data by reshaping data from long to wide format, process by which observations (rows) turn into variables (columns) (Jaquette & Parra, 2014). Jaquette and Parra (2014) also warn to be careful when using multiple data sets and take heed to making sure variables match by level (institution to institution or state to state) and definitions of variables are carefully

considered. If not, it may lead to erroneous results and recommendations that are misguided.

Delimitations

The delimitations or self-imposed limitations for the study are (1) the sample chosen, (2) the time period studied, and (3) level of analysis. First, the sample chosen is very specific to my study. The focus of this analysis is using a sample of medical schools that are independent, non-affiliated, without a research university or system associated with it and grants a Doctor of Medicine (M.D.) degree. Out of all the medical schools, this only comprises a much smaller group of 32 M.D. granting medical schools out of the 172 currently operating medical schools in the United States. This comprises 18.6% of the total number of medical schools in the United States.

However, this differentiation of looking solely at medical schools can be useful as complexity increases within universities both in scale and scope (Clark, 1995). By using only independent medical schools, the nature of their missions, purpose, and organizational activities of this particular institutional type will only focus on one discipline: medicine. This is useful as if this study were to use all U.S. medical schools, it would also add university-affiliated medical schools. Using these types of institutions would complicate the analysis as the parent university's mission, purpose, and organizational activities encompass much more than one discipline versus those medical schools that are independent and non-affiliated (Clark, 1998).

Second, only the last 10 years of data will be analyzed. One reason is the Balanced Budget Act of 1997 froze the number of residency spots supported by

Medicare (Dower, 2012), therefore using that as a cutoff point provides a good way to see the effects of that federal policy. Second, is due to IPEDS data reporting changes which are clearly defined on the IPEDS website (IPEDS, n.d.). Careful examination of survey materials for each year's data for each data source to be used will be examined for any changes and noted in the results section.

The final delimitation is the level of analysis. For this study, it will be at the institutional/organization level, not higher at the state or national level or below at the individual department level that have residency programs. Each residency program/department may have differing budgets of funding and means to procure outside funding. One example is the ability to get funding by external entities such as pharmaceutical companies, separate external donor giving, and hospital services revenue. Particularly for the last point, hospital services are billed in multiple levels as specialty services may bring in more revenue than generalist services rendered by the department.

Assumptions

This study includes the following assumptions: (1) secondary data retrieved by the various data sources such as IPEDS, NRMP, AAMC, etc. are accurate and/or up-to-date and institutions have provided data according to the instructions provided by organization (2) definitions of variables used and collected from the various data sources have not changed for the time period selected for analysis, and (3) residency positions have remained relatively constant without large changes or gaps, unless noted.

Significance of Study

The funding of university-based medical education is particularly timely and of national importance. Changes have occurred in health care due to the complex interplay of an increasing aging population, rising demand for access to health care, the complex influences of the federal government on healthcare, and soaring health care costs. Not only are physicians in primary care needed, but there is also concern for more specialists, particularly in surgery (Cooper, Getzen, McKee, & Laud, 2002; Dill & Salsberg, 2008). Yet, there is debate of how federal subsidies should support both the number and scope of medical residency training in the midst of federal support proving less adequate as costs rise. This debate is especially pointed because, as documented previously, relative declines in the share of costs borne by direct federal support may have heightened the importance of revenue generation at teaching hospitals (Clark, 1998).

It is important to understand the consequences of federal policies for medical schools and how medical residency funding caps and limits have affected one of the missions of the medical school to train physicians. Understanding these conflicts and their potential consequences may contribute to the development of effective, equitable funding mechanisms for medical education.

CHAPTER 2

LITERATURE REVIEW

Background of Medical Residencies

In the United States, medical residencies have played a crucial stage in training the physician workforce since the early 1900. The physician workforce levels have varied in supply and demand levels in the past, but nothing as extensive as to what is to come. The newest pressing concern is in the next few years, there is projected to be a heavy physician and health care provider shortage due to shifting of federal involvement in providing access to healthcare. Also, the number of older physicians who are ready to retire will increase, leading to a need for newly trained physicians to take their place in the U.S. workforce. What may be affected is access to care, quality of care, and meeting the health needs of the U.S. population. The U.S. population trends show that the current population is rapidly aging and expanding due to the rise in life expectancy. Also more chronic diseases are present in the population which exacerbates the need to have an adequate supply of physicians in place (Dall, West, Chakrabarti, & Iacobuci, 2015). Due to the changes in federal involvement in its role of providing healthcare to citizens, there are provisions in place to expand the workforce, but these are unlikely to cover the increased demand that is to come in the next few decades (Schwartz, 2012).

Predicting physician demand is difficult as projections of physician supply versus demand made in the past were miscalibrated. Even with this historical background, predictions for the future supply and demand still are unpredictable. Most recently in 1994, it was predicted that there would be a surplus of 165,000 physicians in 2000, but it did not happen and led to an insufficient physician supply. The concern is that in the

next ten years, there will be a huge demand for physicians, particularly those in primary care, but the current supply of physicians and residents being trained currently will not meet this demand. Although the numbers of active practicing physicians have increased, many physicians from the baby boomer generation who were licensed in 1940-1970 are projected to retire soon, increasing the demand. The projected shortfall is a total between 46,100-90,400 physicians by 2025, which broken down, is a demand of primary care physicians numbering in 12,500-31,100 and non-primary physicians by 28,200- 63,700 physicians (Dall et al., 2015; Petterson et al., 2012).

Although the reliance of non-physicians in the health care sector has grown, there still will be a shortage in both primary care and surgery-related specialties. The problem is exacerbated as medical students are opting to go into very specialized forms of medicine, rather than primary care specialties which are the areas that most needs physicians (Medicare Payment Advisory Commission, 2010; Sklar, 2013). When surveying the U.S. graduating medical school classes of 2012, after taking out those graduates going into primary care, pediatrics, and internal medicine residencies later intending to subspecialize, only 20% intended that they will be going into primary care and staying within that specialty (Schwartz, 2012). This discrepancy is often overlooked when analyzing who enters primary care residencies and those who actually will eventually practice as primary care physicians, and not further subspecialize.

The creation of a physician is a multiyear process. This process involves years of education and training, funding support, medical school and residency position slots, current and projected physician workforce predictions and other considerations. Training a resident takes a lot of resources and time from both individuals and

educational institutions from start to finish. Having to project the supply and demand of physicians is difficult, due to the time of training a physician from a student gaining a baccalaureate degree, going to medical school, doing a residency, and joining the physician workforce which in total takes at least 11 years to complete. The best case scenario to filling a physician spot would be a 1:1:1 (medical school, residency, physician workforce) ratio, plus also considering the rates of retiring physicians and workforce demand.

Defining Key Components

The training of a physician has multiple stages, which have very specific meanings, purposes, and defined in multiple ways. The terminology defined here will be specific to U.S. medical education which include undergraduate medical education (UME) and graduate medical education (GME). This study only focused on U.S. medical schools and definition of these terms is specific to U.S. medical education. Defining the terms is important as UME and GME are distinct in nature and wholly separate from the often used terminology of undergraduate and graduate education within traditional colleges and universities. In defining these key terms, both Doctor of Medicine (MD) and Doctor of Osteopathic Medicine (DO) are discussed although the institutions analyzed in this study are only MD-granting medical schools.

Undergraduate Medical Education

Undergraduate medical education (UME) refers to students who have not yet earned a Doctor of Medicine (MD) or Doctor of Osteopathic Medicine (DO) degree from

an allopathic medical school or osteopathic medical school, respectively. This does not refer to students at the undergraduate level pursing a bachelor's degree, who are referred to as "pre-medical students" when in college.

UME is a period of four years of medical school. Traditionally it has been two years of basic science education in topics such as anatomy, biochemistry, pathology, pharmacology, occurring in the classroom and two years of clinical science education in areas of family medicine, pediatrics, obstetrics and gynecology, surgery and psychiatry. However, in recent years, redesigning of the curriculum has taken place with both basic science education and clinical sciences integrating and the increased focus of systems-based, case-based, and/or problem-based learning in addition to other innovative educational practices being used in medical schools around the United States (Ludmerer, 1999; 2015). During the fourth year of medical school, medical students choose an area to specialize, and proceed to the steps of applying for residency. They interview at various residency programs, and in the spring of their graduation semester, match to a particular specialty program to begin their internship (first year) of residency starting in August.

Graduate Medical Education

Graduate medical education (GME) refers to residency and fellowship training programs for graduates of undergraduate medical education programs and who were awarded an MD or DO degree prior to starting residency. The terms GME and residency are often used interchangeably, but GME refers to education after an

individual receives a medical degree, and encompasses internships, residencies, and fellowships.

ACGME (2013) defines graduate medical education, as a period after an individual completes medical school, to learn the didactic and clinical aspects of a particular medical specialty. This is not limited to medical specialty training and if an individual do so chooses, can subspecialize in a particular specialty. Upon completion of specialty training, physicians are prepared to practice in that area of medicine.

GME is often conducted within a teaching hospital or clinical health setting. The internship year is the first year of post-graduate training and can be a part of their residency education or be a transitional year which often is required for specialties in dermatology, surgery, and anesthesiology. Residencies will be further discussed in detail later, but a residency is a period of three to seven years in which a medical school graduate focuses in a particular specialty. Fellowships are post-residency training intended to further subspecialize or focus in a particular area of medicine (Ludmerer, 2015).

What Is a Residency and the Importance of Medical Residents

Medical residents, although expensive to train, are a cheap source of labor relative to what medical schools and teaching hospitals have to pay clinical medical faculty and other health care workers like nurses and other allied health professionals (Ludmerer, 2015). Medscape (2015) conducted a study of 1,700 U.S. medical residents in 25 specialties and found the average residency salary for all specialties overall was $55,400. The average salaries by year are $52,000 for the first year of residency to over

$60,000 starting the fifth year of residency. Residency salaries are based on the type of specialty as primary care specialties earn lower, and other specialties such as radiology and critical care earn higher. In comparison to resident salaries, salaries for medical school faculty directly involved in clinical care, range from $90,000 to $300,000 based on area of specialty and rank of faculty member, from instructor to full professors (AAMC, 2015d). These salaries do not include private practice income and other income generated outside of their medical school faculty appointments. As can be shown by the income discrepancy, it is much more cost-effective for a medical school and teaching hospital to use medical residents than to use a clinical medical school faculty physician as a part of their workforce.

A general definition of “medical residency” is a period of three to seven years of extensive and intensive clinical experiences to further develop the knowledge and skills of recent medical school graduates area of chosen specialty. The length varies based on specialty, from three years, in family medicine, internal medicine and pediatrics, to seven years in vascular surgery and neurosurgery. Residents are defined as their graduate-year level (PGY1, PGY2, etc.), yet may not reflect the years of residency they may actually be in, as fellowships would count as a year after residency (ACGME, 2013). Medical residencies typically have specific goals, whether to train physicians to serve a particular area, to prepare faculty for academic medicine, or to foster clinical researchers to do medical research. Following residency, graduates can either go into practice, or further subspecialize in a particular aspect of their specialty with a fellowship (Cooke, Irby, & O’Brien, 2010).

A one year transitional or preliminary year residency is required for particular specialties such as anesthesiology, dermatology, neurology, ophthalmology, radiology, and oncology. This year can be done at the residency location or another location as the individual can have the opportunity to move elsewhere for their residency training. Advanced fellowship training is required for those who want to subspecialize in a field such as those sub-specialties in internal medicine like gastroenterology and cardiology, which are one to three years after residency (American College of Physicians, n.d.).

The role of medical residents has changed little since its beginnings at Johns Hopkins University and was first created from the influences of the model of physician training in Germany (Ludmerer, 2015). There are four main roles of a medical residency program. First, residents have full responsibility of care of patients, under supervision and guidance of an attending physician, a clinical faculty member of the medical school. Second, the period of residency not only involves direct patient care training but further education and training of a particular specialty. Third, clear hierarchies are present, from department head, attending physicians, chief residents, senior and junior residents and medical students, with all the staff in higher level positions, who are expected to teach those in lower positions. Finally, residencies are intended to be extended periods of training, and for physicians to pass the final round of examinations required in order to be certified to practice in the United States. Based on type of degree awarded, to be licensed, a physician needs to pass the United States Medical Licensing Exam (USMLE) administered by the Federation of State Medical Boards and the National Board of Medical Examiners or the Comprehensive Osteopathic Medical Licensing Examination (COMLEX), which is administered the National Board of Osteopathic

Medical Examiners. In the final year of residency and after graduation, residents have the opportunity to be board certified in their specialty of choice, but they need to have fulfilled the requirements during residency in order to do so and take examinations by their particular specialty board.

The only change to happen in recent years is due to the rise in number of other skilled health professionals practicing alongside physicians, and emphasis of teamwork and collaboration, a multidisciplinary and inter-professional team approach to medicine is being used on a more frequent basis today (Grumbach & Bodenheimer, 2004). This now involves less of a hierarchical system of physicians training resident physicians, but a team-oriented teaching and learning of residents by multiple health care educators such as social workers, nurses, and other allied health professionals.

Matching into Residencies

Well known to medical students as “The Match,” this is the process by which medical students get matched into a residency program in the United States. During the 4th year of medical school, students apply to residency programs. Most often, students choose a specific specialty and apply to programs based on the type of residency they are intending to apply, whether that is an allopathic or an osteopathic residency. Most allopathic MD medical students apply to allopathic medical residency programs. There are 23 various allopathic specialties that individuals can apply (NRMP, 2014). The types of specialties currently available are found in Appendix A.

The last round of the National Residency Match Program (NRMP) was in 2015, which matches medical school seniors to allopathic medical residencies, was the largest

in its history with more than 41,000 applicants vying for over 30,000 residency positions in 4,756 programs. Although residency positions had increased from the year before with the addition of 541 positions from 2014, there were 940 more registered applicants to the NRMP match than in 2014 (NRMP, 2015). There were more applicants than positions available; therefore, approximately 5 percent of applicants did not match to a residency, which was comparable to the year before.

These figures suggest that a bottleneck effect has been occurring between medical school graduates and availability of medical residency positions. Since 2013, the NRMP has had more graduates than available residency spots. The inability for a few hundred medical school graduates unable to obtain residencies causes problems in the pipeline of meeting the demand of physicians for the future.

Historical Background: Medical Internships-Precursor to the Medical Residency

Formal medical residency education tied to higher education has existed for over 100 years when it began at Johns Hopkins University in 1889. Prior to this, medical school graduates went directly into practice or made special arrangements with hospitals and practicing physicians for a one to two year informal training experience (Ludmerer, 1999). However, by the end of the 19th century, a more formal approach to medical residency training started occurring in medical school settings with programs based in scientific principles and clinical training. Throughout the early 1900s, the growth of medical schools, internships, and residencies began to change the state of medical education to where it largely in place today.

The topic of this study is medical residencies, but prior to their formation, internships began as a precursor to the multiyear specialty training known as residency. Internships are one year experiences after medical school intended for additional clinical training. The earliest known formal internship programs began in the early 1900's. Informal programs existed decades earlier, but the quality and rigor of these programs varied considerably (Ludmerer, 1999). By 1910, the American Medical Association Council on Medical Education estimated that about half of medical graduates either were in or attempted to gain further training in an internship (Stevens, 1989). At that time, only a handful of medical schools had an affiliated teaching hospital and other city hospitals took in interns, particularly those hospitals located in large cities. Hospitals found interns to be a source of inexpensive labor and residents found hospitals useful grounds to further their training in a real-world clinical setting. However, at this time, internships were unregulated and often had an imbalance of roles and authority. Also in this period, clinical experience of medical students during medical school was either non-existent or very limited which posed other problems. The AMA realized the problem and in 1917 considered making all internships medical school-affiliated, but instead, created a list of hospitals "apparently acceptable" for internship training as limited resources and staffing were present and affiliating all internships would pose to be challenging at that time.

By 1920, as medical internships grew in popularity, almost all medical schools became affiliated with a teaching hospital. In doing so, this increased the length and value of the medical school education and medical schools added more faculty with non-medical doctorates in the basic science faculties to enhance the scientific basis of

medicine taught to medical students. Further all medical colleges were affiliated with a local hospital, which had ties to faculty who either owned or controlled these hospitals. This idea of ‘clinical excellence’ was increasing as the hospital was seen as a part of the medical college (Kaufman, 1980). By 1923, a 5th year or "internship" year were available to all graduates but only 29 teaching hospitals provided opportunities of residencies focusing in a particular specialty. Already there was a bottleneck of medical school graduates interested in postgraduate year study, but not enough positions available to them. Since there were limited residency positions, only 25% of medical school graduates went on to do residencies, and 75% went into general practitioners straight into practice (Ludmerer, 1985).

Multiyear medical residencies had a slow start in contrast to one year medical internships. Although the first medical residency began at Johns Hopkins University in 1897, it was limited in scope and only open to those physicians who graduated from the Johns Hopkins Medical School. This residency model was derived from the German and American influences of education and unique as it was implemented since the establishment of the teaching hospital at Johns Hopkins. The leaders envisioned the teaching hospital at Johns Hopkins to be more than for patient care, but follow the lofty educational principles of its parent university of Johns Hopkins (Ludmerer, 2015). These scientific principles tied to clinical medicine included: having a resident staff that studied clinical sciences, focusing on having a few graduates or advanced students to promote science and education within the hospital, and promoting the idea that teaching medicine should happen alongside the study of medicine. The main focus of these newly created Hopkins medical residencies was to advance clinical science and make

careers in academic medicine. This focus would limit the growth and interest of other medical schools adopting residencies for their own institutions for a little while until the popularity of medical residencies grew in the mid-20th century. If other institutions did indeed adopt residencies into their teaching hospitals, they were limited to only the best medical school graduates and attrition was high after the first year of residency.

With the growth of medical school standardization and internships, keeping faculty at this time would prove more difficult as private practice salaries was more lucrative than academic medicine clinical faculty salaries. Medical schools tried to mitigate this problem by providing faculty with the privilege of having both limited private practices but still have a large portion of their institutional appointment focus on medical school teaching research and service. The intersection between medical schools, teaching hospitals, and teaching faculty became more integrated as funding of department and research budgets moved between the school and the hospital (Kaufman, 1980).

The Growth of Medical Research and Medical Residencies in the Mid-20th Century

A shift would occur in the mid-20th century, as medical schools and teaching hospitals focused on the growth and professionalization of their institutions and understanding the role of clinical teaching for medical education. Two main changes started to occur. First, the rising focus of clinical science research, which includes medical research during and after World War II. Second, the expanding use of medical residencies in the 1930's as the opportunity to do a residency democratized to all medical school graduates.

The focus on medical research, knowledge production, and funding increased during the 1940's to develop medicines, and cutting edge technology to add to the war effort going on during World War II. A shift occurred in medical schools as knowledge production became a priority, with an increase of faculty hired with Ph.D.'s instead of M.D.s to lead basic science fields (Stevens, 1989). The growth of science and research is similar to the growth of the sciences, engineering, technology and the rise of the American research university occurring in the traditional university setting thanks to the emphasis by the federal government in funding research toward this effort (Geiger, 1993). The National Institutes of Health (NIH), under the Department of Health and Human Services (HHS) along with the National Science Foundation (NSF) and other federal agencies soon provided flush amounts of research funding to both universities and medical schools to support academic research. A form of the NIH was already in existence since 1887, but grew in 1944-46 due to the enactment of the Public Health Service Act in 1944 and NIH later getting the authority to conduct research and administer extramural research grants and fellowship awards to universities and medical schools (National Institutes of Health, 2015). This focus on clinical medical science research grew medical departments both in medical schools and teaching hospitals.

Funding for clinical medicine has benefitted greatly since the 1950's as a priority recommendation was made to give a substantial federal R&D funds to health and medicine (National Science Board, 2000). Today, NIH (HHS) is second only to Department of Defense in the share of federal R&D funds they receive each year. In 2014, out of the total 130.8 billion dollars federal R&D funding available that year, HHS

received 23.2% of the total (30.4 billion dollars). NSF ranked fifth in the share of R&D funding and received 4.2% (5.6 billion dollars) of the total (National Science Board, 2016).

The growth and number of medical residencies also increased after World War II, and the addition of fellowships, post-residency trainings further gained in popularity. During 1940-1970, a 30 year period, the number of U.S. medical residency positions grew almost 10 fold from 5,800 to 46,000 positions (Ludmerer, 1999). Also at this time, the rise of private insurance, lead to the increased demand of patient care and specialized treatments, which lead to expansion of teaching hospitals, and the need for more specialists. Medical schools also had a part in this shift toward specialties, as opportunities and special privileges were granted to students interested in a particular specialty, the experiences of specialty practice exposure in medical school clinical years increased, and how only having to know a limited amount of knowledge for a specialty versus primary care, needing an increased breath of knowledge were selling points (Becker, Geer, Hughes, & Strauss, 1961). The unintended effects of this led more medical school graduates to be less interested in becoming primary care physicians as the allure of specialties increased and the higher incomes they earned (Cooke, Irby, & O'Brien, 2010).

Due to this massive growth, accurately predicting, or coming close to measuring the supply and demand of physicians for upcoming decades has been difficult. Right after World War II, there was concern that there was going to be too many physicians, but by the time 1972 came around, there was a demand of physicians, especially in inner cities and rural communities (Rousselot, 1973).

Medical School Expansions but Unclear Supply and Demand of Physicians toward the End of the 20th Century

Although growth was steady going into 1960 and beyond, the true driver of medical schools, residencies, and physician training began to be unclear. The federal government foresaw a need for more physicians and due to this demand, medical schools and larger teaching hospitals expanded through many sources. The Health Professions Educational Assistance Act of 1963 and the establishment of the Bureau of Health Manpower Education in 1967 within the Department of Health Education and Welfare was created to help meet the demand of training more individuals to enter the pipeline of becoming physicians. During the late 1960's, the demand was so high that there was an addition of 17 new medical schools which graduated 20% more physicians during that time period. In 1971, the Comprehensive Health Manpower Training Act of 1971 was funded further provided support to educating physicians and other health care professionals (Rousselot, 1973). Also at this time, federal support for medical residencies increased indirectly through the creation of Medicare in 1965, and funding allocated to medical schools and teaching hospitals for medical residency positions, which created a flush of income to these institutions which formerly did many of these services for low to no cost to the patient as a form of charity (Ludmerer, 2015).

Medicare's influence benefitted medical schools and teaching hospitals due to this new source of income but also created some challenges to GME. As more and more patients entered hospitals, this created capacity issues, with the increase of complex and costly specialty cases, and the rise of paperwork and documentation for reimbursements from Medicare becoming the norm (Ludmerer, 2015). Yet overall, Medicare's influence on medical residencies did not change the teaching nature of

residencies as it was similar to what it was before, treating patients under the supervision of an attending physician and the training of medical residents.

It seemed that the federal government would continue to provide funding for medical residencies in abundant quantities as it was seen as a societal benefit and of national interest until the mid 1990's, but the availability of funding would soon come to question as Congress would soon limit funding for residencies through the Balanced Budget Act of 1997. The act would the limit in the number of medical residency positions the federal government would pay for (Iglehart, 2013). The funding of GME will be further discussed in the subsequent section of this chapter but would shift the landscape of medical residencies for years to come. Through all these changes of medical residencies, this lead to how the system is today, with the close interrelationship between the federal government and medical residency training. Much of this centers around the topic of funding, training, and governmental control.

Today: Meeting the Demand for Physicians: Medical Schools v. Residencies

In the past few decades, both allopathic (MD) and osteopathic (DO) granting medical schools have been created or have increased enrollments to anticipate this shortage of physicians in the United States. First-year medical school enrollments around the United States in 2014-2015 have increased by more than 23 percent since 2002, and are expected to increase by 29 percent by 2019-2020 (AAMC, 2015b). But another problem has emerged for medical schools, the availability and number of clinical training sites for third and fourth year students. The number of schools reporting this particular concern has increased by 26 percent since 2010 (AAMC, 2015b). Still the

growth in number of residency positions have not met this demand, and medical schools are concerned with medical school enrollments outpacing GME growth.

Some states are concerned with the difficulty of keeping up with the demand for physicians in their own states and keeping graduates of medical students within their states to do their residency in-state. They have attempted innovative programs and state funding allocated to medical residencies and teaching hospitals. Texas is one example of a state, which is encountering the problem of how can the state ensure a first year GME position is created and maintained from each new medical student position established at a Texas medical school (Texas Higher Education Coordinating Board, 2014).

There is no easy solution as the creation and addition of new residency positions is unlike higher education enrollments at traditional colleges and universities which can easily be implemented through economies of scale, as adding one additional undergraduate student does not incur a large amount of additional costs to the institution (Brinkman & Leslie, 1986; Cohn, Rhine, & Santos, 1989). This is contrary to what happens with a new residency position as each additional resident occurs a large additional cost and requires more commitment of a teaching institution and hospital to train than an undergraduate student therefore causing a diseconomy of scale instead (Wynn et al., 2013).

Residency Education: A Public, Private, or Mixed Good?

Graduate medical education, heavily funded by the federal government, could be considered a “mixed good”, which encompasses both public goods for society and

provides private goods for the individual. A public good is defined in a higher education context as a societal benefit to others, currently and to future generations. Like traditional higher education institutions, medical schools and residency programs educate and develop workers, in this case, physicians who contribute to society in meaningful ways is inherently apparent (McMahon, 2009). With physician training in medical schools and teaching hospitals, an additional benefit arises as physicians contribute to the health and wellbeing in a substantial and definable manner while they are in their training phase. Further physicians benefit from the private goods they receive from their education by the high income they earn, increased social stature, and other social mobility that occurs. Other public benefits from medical schools and teaching hospitals provide to society is through creation of new knowledge and technology through research activities they do.

Teaching hospitals can also be considered as a mixed good in a sense. Although only 6% of total hospitals are teaching hospitals, they provide highly specialized services for patients who need these cutting edge technology and expertise. Teaching hospitals receive burn care units (75%), pediatric ICUs (62%), Level 1 region trauma centers (61%), surgical transplant services (50%), Alzheimer centers (41%), neonatal ICUs (40%), and cardiac surgery services (22%). Plus they provide 41% of all hospital charity care and do more than the typical hospital in reaching out to their communities (AAMC, 2012b). Teaching hospitals also have a special function as the NIH provides billions of dollars in research funding each year, most recently $2.2 billion in 2005 (American Hospital Association, 2009),

Academic medicine, when looked at a more critical stance, is questioned as they have been increasingly involved with profit-generating activities and associating with industry. The federal government and question why should they subsidize GME via Medicare and other federal subsidies to medical schools and teaching hospitals when medical services performed by medical residents are billed and become profit to these institutions (Ghadebo & Reinhardt, 2001; Newhouse & Wilensky, 2001). The idea of medical research is questioned as either an operation cost for the society or intellectual capital infrastructure to benefit the health care system on which medical schools and teaching hospitals benefit more individually than contributing to society as a whole (Klein, 2012).

However much like colleges and universities today, the debate between public good and private good of medical schools and medical education of physicians is difficult to tease out. Sorting these individual (private) and social (public) benefits of higher education provides to be a contentious topic particularly when economics and allocation of resources are involved (Bowen & Servelle, 1972). Like universities in the 21st century, medical schools along with their teaching hospitals, have a larger role in profit generation and translating knowledge into profitable product generation. Still it has a foundational role and mission to educate students and conduct research and provide service (Clark, 1998). Part of this debate is due to the same reason that funding and resources allocated to HEIs has dwindled considerably from public sources, therefore leading these entities to seek funding elsewhere.

It is important to show that even though new initiatives for funding for medical residencies are emerging on a federal policy level, it is not easy to see if they will lead to

actual changes or provide the result desired. Implementing policies is not straightforward as the macro and micro level structures that exist which affect the degree of how it will be enacted at the state and eventual institutional level (Goldrick-Rab & Shaw, 2007). This is because different types of institutions behave in different ways in how they pursue their goals, focus their priorities, and spend their revenues, whether for their intended purposes or not (Leslie, Slaughter, Taylor, & Zhang, 2012). Further, tracking the true effects of the Balanced Budget Act of 1997 is not answered here, as other influences particularly at the local and state level are not equal and the interrelationships are complex (Gornitzka, Kyvik, & Stensaker, 2002) and measuring them will lead to challenges (Doyle, 2007). It is too early to tell the changes in policy that are occurring regarding funding of medical residency funding will actually have an impact on the outcome.

Today, by looking at the current number of residency positions available through ACGME and AOA, the number of GME spots increased even after the passing of the BBA in 1997, and understanding where the funding has come from is an important step. The next section of this literature review focuses on financing of medical residencies and the theoretical framework in order to do this study.

Medical School Finance and Theoretical Framework

Even though medical residencies and the creation of physicians are important to the advancement of society and meet the nation's healthcare needs, revenue sources and institutional priorities seem to have markedly shifted in the past few decades with medical schools pursuing alternative sources of funding to make up for the loss of public

funding sources. Higher education policy research focuses on this issue, that for HEIs, even if a part of their missions and goals focus on the public good, what convinces them to pursue this avenue rather than the activities that garner profit, prestige, and more lucrative pursuits? This section seeks to understand the background of how medical residencies have been funded in the past, the shifts that have occurred recently due to the limit of medical residency positions and funding from the government due to policies, and how medical schools have adapted to these changes by diversifying their funding sources and depending more on external sources of revenue. Finally, by using the theory of academic capitalism, I will provide a framework to understand the changes in how medical residency funding has changed in the past 10 years.

Background on Graduate Medical Education Funding

Federal funding and priority for both graduate medical education and medical research emerged during the mid-20th century as a means to strengthen the United States' role in knowledge, technology, and educated manpower. Initially, medical research funding was given priority in the early 1940's with the expansion of the NIH at the same time, which provides the majority of its available research grants to medical schools to do medical research, and NSF in the early 1950's, which the NSF provides research grants primarily to universities to study non-medical research (Starr, 1982). Due to this new source of funding by the government to conduct research, medical schools soon expanded and focused on medical research, both basic science and clinical, but would limit the scale of expansion of GME until later.

The increased funding for GME occurred around the same time as federal research funding exponentially grew, but on a smaller scale, with smaller pockets of federal funding available for residency programs, particularly in focusing on programs in primary care (Ludmerer, 2015). Generally, even today, medical education has had a harder time than medical research to gain funding for its purposes. Whereas medical research funding gained popularity, federal bills to increase the number of physicians by providing grants and scholarships to medical schools and residencies never gained traction in the mid-1950s and beyond (Starr, 1982).

Within the next few decades, the federal government would take a larger role in funding GME. During the 1970s, medical schools and training hospitals gained more funding to increase enrollments to increase the supply of physicians projected to be needed in the future (Starr, 1982). This lead to the Health Manpower Act in 1971 that gave “capitation grants” with funding per student and bonuses with increased enrollment. Between 1965-1980, the number of university-based medical schools rose from 88 to 124 and doubled the number of medical school graduates (Stephan, 2012).

The largest source of funding for GME and medical residencies came through the implementation of Medicare in 1965. Medicare is a federal health insurance program provided for individuals who are 65 years or older, people with disabilities, and those with end stage renal disease (Medicare, n.d.). Even though Medicare is widely known for its insurance purposes, Medicare also provides a large proportion funding of medical residencies around the United States.

Funding for medical residency training by Medicare began at the same time Medicare was implemented in 1965 (AAMC, 2011). This provided medical schools with

a new source of funding which generally had lax regulations for reimbursement at the beginning. The federal government had an indirect role to regulate hospitals and gave more incentive for hospitals to be involved with pay-for-service tactics. Medicare initially paid teaching hospitals of as expenses were incurred for patients and resident training. Through the implementation of this plan, Medical schools began to be flush with funding for medical residencies in the 1970's. Through federal funding and other sources, the rise of medical school and teaching hospital affiliations grew in the 1980's, and increased the numbers of medical education directors, residency programs and creation of large university medical centers (Stevens, 1989). Within a ten year period of 1972-1982, medical school revenues went from $2.2 billion to $8.2 billion, with rough estimates of $65 million per school.

However in the 1990s, this free flow of revenue would halt as the funding model would change and soon revenue generation for medical schools would come less from Medicare and the funding for residencies by Medicare would be insufficient to cover the total costs of training resident physicians. The major change that drove the limits of federal funding from Medicare was due to the implementation of the Balanced Budget Act of 1997. The Balanced Budget Act's purpose was in attempts to reduce spending on national health care between 1998 and 2002. Ultimately Medicare was cut $127 billion dollars. One part of this cut was to halt the growth in the number of available residency positions funded by Medicare and the other cut was reimbursements made on Medicare patients who used teaching hospitals to get care. This effective capping of Medicare GME spots in the late 1990's limited the number of physicians able to be trained.

However, this provided Congress new power and control over the supply of physicians by the funding provided by Medicare to fund residencies.

The Balanced Budget Act of 1997 initially had a minimal effect regarding the number of medical residency positions available to teaching hospitals that would be paid for by the federal government but has had far reaching effects since it was enacted. Since 1997, medical schools have either been newly built or expanded their enrollments, yet the number of residency positions that Medicare provides has remained constant. Although bills such as the Resident Physician Shortage Reduction Act and the Training Tomorrow's Doctors Today Act were introduced in 2013, neither bill passed the House of Representatives. In 2010, Medicare funded $9.5 billion to help train 100,000 residency positions (Dower, 2012; Iglehart, 2013).

The irony of budget cuts for Medicare and medical residency positions and funding was the rise of research funding for medical research. As the capping of medical residency funding occurred, soon afterward, between 1998-2003, the NIH budget doubled from $13.6 billion to $27.1 billion, which was justified as fostering more research discoveries and increase research workforce development (Smith, 2006). This disconnect between medical education and medical research shows the priorities that legislators have placed on both these areas and supports the idea of academic capitalism to be discussed later in this chapter.

How Have Medical Schools Adapted in the Meantime?

Adaptation is key to survival, and medical schools soon had to find alternative sources of funding to make up for the loss from Medicare, especially as the demand for

medical residency positions increased. Medical education funding is complex, and differs based on medical schools and residency programs. Alternative sources of funding have come from research funding, industry support, federal funding/Medicare, state funding, and hospital revenues.

Research: Clinical and Profit-Generating

One way that medical residencies are funded is through research funding. Bok (2003) states that higher education institutions have three ingredients that can help grow and make an institution prosperous: highly trained specialists, expert knowledge, and scientific advances which can create valuable new products or life-saving treatments and cures. Medical schools have the opportunity to do all. The Bayh-Dole Act of 1980 gave colleges and universities the increased opportunity to use their research and turn to profit. Medical schools took advantage of the ability to work and receive corporate funding. One example is pharmaceutical companies willing to invest money for biomedical researchers, particularly those in the applied sciences to create products and turn a profit from selling these products (Stephan, 2012).

Delineating the proportion of funding that goes to medical residencies is complex as funding can be transferrable or justified in medical education training. Biomedical research or federal science research grant can contribute to medical residency, but it is hard to differentiate if it goes to basic science faculty, who work with biomedical masters and doctoral students, and/or clinical science faculty, who work with medical students, residents, and fellows (Office of Program Policy Analysis & Government Accountability (OPPAGA), 2008).

What adds to the complexity is the nature of faculty roles in a medical school and teaching hospitals. Although a majority of medical school faculty bring in some form of research funding, approximately 22% of faculty do research that is unfunded. From the 22% of faculty who do unfunded research, almost 70% are physicians are in clinical practice, contrary to basic science faculty in medical schools who are dependent on grants to pay for their salaries (Zinner & Campbell, 2009). These physicians who are doing unfunded research, must be using other internal revenues to support this, as a survey found an average of 7.3 hours were spent per week on research. This is akin to what universities are doing to bear the cost of scientific research, using internal university funding in order to support the research enterprise (Ehrenberg, Rizzo, & Jakubson, 2003).

Industry Support

Another means of funding is through industry. Industries, particularly in the biomedical and pharmaceutical sector, entice medical schools and teaching hospitals to accept industry support through various means. Recently, the ability of pharmaceutical companies has been limited to affecting biomedical researchers more than actual medical education staff and students due to recent laws and rules limiting perks and benefits provided to medical school faculty, and criticism from medical organizations (AAMC, 2008; AMA Council on Ethical and Judicial Affairs, 2008), However, financial contributions still exist through funding of educational programs (Relman, 2008). Even medical residency programs are paid for by private funding from corporations or pharmaceutical companies on a limited basis (Advisory Board Company, 2013). Yet the

intersection between industry funding medical residency education has not been studied on a deeper level currently.

Federal Funding/Medicare

Medicare is still the main provider of funding GME and medical residencies. In 2011, The Centers for Medicare & Medicaid Services contributed $9.5 billion to train 110,000 residents at 1,110 teaching hospitals (Health Affairs, 2012). Direct versus indirect Medicare payments have helped subsidize the cost of GME in the U.S. but on a limited scale and decreasing per year. This funding is intended to cover resident salaries, teaching expenses, and indirect hospital costs, but this is through a complex allocation formula. The difference between direct ($3 billion) and indirect ($6.5 billion) is the direct payments include resident, faculty and staff salaries. The indirect payments are from Medicare diagnoses for costs that come from being in a teaching hospital (Schwartz, 2012). Not all costs are covered through Medicare, and Kelly, Tibbles, Barnett, and Schwartzstein (2012) argue that it affects the quality and competitiveness of these educational residency programs as other incidental costs are not covered.

Additional costs that accrue include: recruitment, resources for residents, professional development meetings and events, and trainee support that can easily add up per resident. Estimates by the ACGME looked at all non-salary costs of resident training. The average annual cost per resident on these “other costs” was $4,439, with a range from $1,500 to $9,417 by program (Kelly, Tibbles, Barnett, & Schwartzstein, 2012.

Today, the federal government is hesitant to fund medical education and

scientific research as budget deficits have limited or cut funding in both of these areas (Salsberg & Grover, 2006). However, the government and society still fully expects higher education organizations to address broad societal issues which in this case includes maintaining an adequate supply of physicians for the future trained in quality residency programs (Clark, 2002). There is concern from many groups and conflicting views of whether or not Medicare GME funding should increase, as Institute of Medicine (2014) claims that the current funding levels are sufficient, whereas the Council on Graduate Medical Education (2014) argues it is not adequate and funding should increase.

Policy debates hotly contest GME funding by Medicare. These issues include: (1) Where should the funding be allocated to, whether directly to residents, or indirectly to health care providers, medical schools, outpatient clinic, or teaching hospitals. (2) If GME funding allocation should vary between teaching hospitals as some institutions and/or states include factors such as faculty teaching costs, and some do not. There is debate if this should be aligned better on a national level. (3) Finally, whether or not the federal government should have such a huge role for even paying for GME, or it should be turned to the states to deal with the issue (Anderson, Greenberg, and Wynn, 2001; Rich et al., 2002).

State Funding

States have increased their contribution to medical residency funding, but in a limited manner though particular programs and specific initiatives. Further, this funding has not been guaranteed long-term, and is dependent on state priorities at the time.

Some states provide funding in different ways with no single formula funding similar between states (OPPAGA, 2008). What is also distinct about state funding for medical residency programs is that both private and public medical schools can receive funding, which is unlike funding for colleges and universities that many states primarily fund their public state institutions through state appropriations (OPPAGA, 2008).

Some states do fund some medical residency programs, particularly if there is a need within the state to meet physician supply and demand in certain specialties. As policy and priorities intersect, most of these state funded medical residency programs focus on family medicine, primary care, rural medicine, or address particular needs of the state. One example of how a state funds medical residencies is Texas providing formula funding per resident to support the costs of faculty and resident supervision. Yet the state contribution only comprises three percent of the estimated cost to train a physician. Texas provides additional funding for family medicine to help cover nine percent of training a family medicine resident as primary care is a need and priority for the state (Texas Higher Education Coordinating Board, 2014).

There is evidence that where a medical graduate does their residency predicts whether or not they will stay in the state to practice, regardless of where they went to medical school (Burfield, Hough, & Marder, 1986; Dorner, Burr & Tucker, 1991). States believe keeping medical school graduates within their state to do their residency helps keep their investment in place. The concern arises if a student goes to medical school in-state using state resources but then as a graduate leaves to do residency out-of-state. This risks the physician to stay after residency to practice out-of-state, with the

state losing out on all the money, time, and energy they have invested in a medical student's education.

Hospital Revenues

Teaching hospitals are able to cover residency program costs not covered by Medicare and increasingly have been doing so using hospital revenues charged to patients. Hospitals can cover costs by using other revenue streams to cross-subsidize Medicare GME funds, using clinical program profits, or charge higher fees to payers. Kennedy, Johnston, and Arnold (2007) emphasize that there are three missions within clinical departments: research, clinical care, and education and teaching of medical students, residents, and fellows. Because then functions occur within a single department, which funds-flow allocation alignments are nearly impossible to separate. Using hospital revenues to fund medical residency education is justified as medical residents provide care for patients, which is both a service to the hospital, and a learning opportunity for the resident, while being supervised by an attending faculty member.

Multiple Funding Sources Comes with Caveats

Towards the end of the 20th century, medical schools and teaching hospitals have encountered multiple burdens much more than nonteaching hospitals, which include having a larger proportion of Medicare and Medicaid patients, residency programs which are costly to run, and the higher complexity of medical cases which require more time and money to treat (Stevens, 1989).

Funding from these other sources, affiliated hospitals, medical schools, health centers, and not discussed here, foundations, are often hidden and implicit subsidies to residency programs (Rich et al., 2002). Some of the funding from the NSF, NIH, and other federal agencies do indirectly help pay for residency costs as clinical faculty may be doing clinical trials with medical residents in their education and professional development. Yet this can have deleterious effects such as inadequate support of resident workload, faculty teaching effort, educational infrastructure, and other teaching costs. Therefore, it is important to look at the effects of these sources and how they interplay in the relationship between a medical school, its teaching hospital(s), industry, and the government.

The Complex Interrelationship between a Medical School, Teaching Hospital, Industry, and the Government

There exists an interrelationship between the university, the workforce, and its environment which impact how faculty and universities behave (Slaughter & Leslie, 1997). A distinct difference between faculty in traditional colleges and universities to those faculty in medical schools are if medical faculty work in a clinical setting or academic teaching center such as a hospital, they are able to charge fees for services they render. Some of the care may be educational in nature as these medical "attendings" (clinical faculty) supervise residents and medical students. This is the diffuse, ambiguous nature of medical education. Clinical researchers in academic medicine, those that particularly work in a medical school or teaching, increasingly use multiple relationships with industry, as they believe it is integral and benefits in substantial and tangible ways (Zinner & Campbell, 2009).

The United States is very market-like oriented in how they see higher education, which has lead to innovative, entrepreneurial, academic programs and research foci (Dill & Sporn, 1995). Like biology and the other basic sciences, medicine also has increasingly shifted their involvement with technology and the advancement of medicine through biomedical devices and new pharmaceuticals development. This has lead to medical schools becoming highly specialized. The specialization has occurred through new partnerships and innovative ways to create research through specialized research centers that create collaborations and potential to market their findings through patents and product generation. This goes beyond the teaching function of these departments. The highly specialized natures of these medical departments leads to confederations of departments existing with a medical school, in a certain extent, multi-product firms which are extremely complex, with multiple goals and objectives (Cohn, Rhine, & Santos, 1989). These departments are in pursuit of their own interests, resources, and entrepreneurial opportunities (Clark, 2002).

Possibly more so than any other discipline or type of higher education institution, a university-industry-government partnership exists within medical schools. Industrial relationships are typically with pharmaceutical or technology companies, which provide funding and resources. Government partnerships include grants and close partnerships with the National Institutes of Health and to a limited extent, the National Science Foundation. This all intertwines with political coalitions, which follows a competitiveness mindset that focuses on privatization and commodification of science and technology, which includes medicine (Slaughter & Rhoades, 1996). This creates a similar situation like the STEM fields as to be a both an institution to benefit society and taxpayers,

creation of strategic alliances of funding are needed. This is in order to grow and build the organization's knowledge generation, service opportunities, and in turn charge for it to generate new revenue and be productive (Sutz, 1997). The benefit to society is the public good of these activities, both preparing and training people for the workforce, and the knowledge and revenue generation is the private good. This has lead to a conflict and contradiction of colleges and universities in pursuit of public goods that benefit society or private goods that benefit the individual and in this case, the individual institution. Pursuing one priority, leads to undercutting of the other priority leading to a precarious balancing act within the institution (Labaree, 1997; Slaughter & Rhoades, 2004)

Teaching hospitals, which are a large part of medical residencies, have an interesting function, much like non-teaching hospitals, which may or may not be for-profit. Stevens (1989) argues that hospitals in general have multiple functions which include profit-generation, service to the public, and advancing human science and technology, which can easily lead to conflict between mission and money. Hospitals exist as public and private entities, as "both necessary social organizations and icons of American science, wealth and technological achievement" (p. 4). This argument aligns with Weisbrod et al.'s (2008) views on the tensions between mission and money from a university's standpoint. However the connection between market-like behaviors seems stronger with hospitals than universities and medical schools. This is due to the way that hospitals can charge for their services and focus on other initiatives beyond teaching and research, creating false non-profits. Hospitals can easily mask their pursuits for pecuniary rather than altruistic objectives, and pursue strategic avenues either for

profits, power, or prestige, while justifying that their behaviors are focused on their service mission (Weisbrod, 1988; 2000). For medical schools, this is less clear as the function the education mission also has to be considered in the mission of these institutions.

Medical Schools are Increasingly Resource Dependent

Looking at the trends in revenue for medical schools is particularly striking. Particularly looking at changes in medical school revenue by source between fiscal year 1977 to fiscal year 2014, by using data from an annual survey by LCME and AAMC about medical school finances, the trend has shifted that medical schools are more dependent on alternative sources of revenue beyond federal, state, local, and parent university support in three decades that this survey has been conducted (AAMC, 2015a).

Medical school revenues are derived from different sources and has changed throughout the years. When looking at revenue sources as a percentage of total revenue for medical schools with full LCME accreditation (Table 1 & 2, see below), medical service revenue is increasingly a larger source of revenue for medical schools (AAMC, 2015a). Tuition and fees have always comprised a relatively small share of revenue. What is shown clearly in the figure is a marked difference between 1977 and 2014 on the state, local, and parent university contribution to a medical school's revenue. In 1977, these sources comprised 29.67% of total revenue, but in 2014, only 6.34% of total revenue, almost a five-fold decrease. In contrast, the revenue from hospital services was 20.44% in 1977 to 58.03% in 2014. Clearly, medical schools are

depending upon other sources of funding, primarily through the services they provide and charge. This mirrors the decline in college and universities, in a similar effect that state appropriations comprises a much lesser percentage of revenue for those institutions and other sources of funding for colleges makes up for the lack of public funding (Archibald & Feldman, 2010).

Table 1

Revenue Sources as a Percentage of Total Revenue for Medical Schools with Full LCME Accreditation in 1977 and 2014

	Year: 1977	% of total	Year: 2014	% of total
Federal Research (in millions)	927	23.50%	16,137	15.37%
Tuition & Fees (in millions)	194	4.92%	4,007	3.82%
Other Federal (in millions)	337	8.54%	2,653	2.53%
Medical Service (in millions)	806	20.44%	60,942	58.03%
State, Local, Parent University (in millions)	1,170	29.67%	6,662	6.34%
Other Income (in millions)	510	12.93%	14,611	13.91%
Total (in millions)	3944		105012	

Source: AAMC, 2014

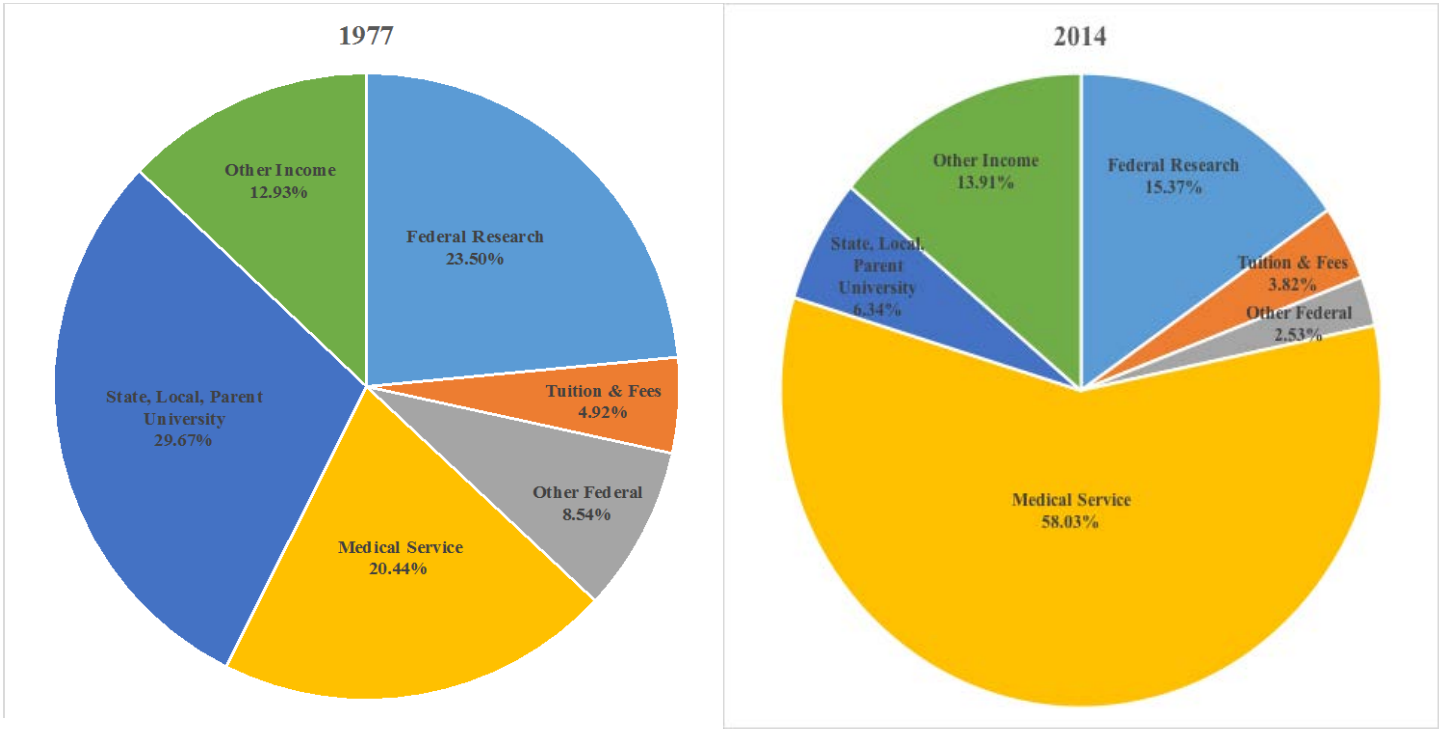

Figure 1. Visual representations of revenue sources as a percentage of total revenue for medical schools with full LCME accreditation in 1977 and 2014.

Table 2

Revenue Sources of U.S. MD-Granting Medical Schools with Full LCME Accreditation by Type and Year (1977-2014) in Millions

Year	Federal Research	Other Federal	State, Local, Parent Support	Tuition and Fees	Medical Service	Other Income
1977	927	337	1,170	194	806	510
1978	1,008	332	1,320	232	813	639
1979	1,128	375	1,499	270	962	722
1980	1,264	432	1,639	314	1,245	751
1981	1,415	458	1,847	347	1,432	837
1982	1,516	406	1,957	415	1,921	946
1983	1,635	382	2,090	483	2,424	1,145
1984	1,782	366	2,271	548	2,741	1,310
1985	2,024	381	2,477	589	3,020	1,536
1986	2,294	406	2,628	635	3,447	1,618

(table continues)

Table 2 (*cont*.).

Year	Federal Research	Other Federal	State, Local, Parent Support	Tuition and Fees	Medical Service	Other Income
1987	2,474	499	2,774	677	4,241	1,827
1988	2,865	440	2,950	721	5,044	2,052
1989	3,287	863	3,157	767	6,617	2,440
1990	3,868	996	3,360	816	7,484	2,801
1991	4,056	610	3,537	876	8,867	3,074
1992	4,472	689	3,500	955	10,155	3,361
1993	4,817	741	3,627	1,048	11,226	3,731
1994	4,582	752	3,716	1,130	12,799	3,920
1995	5,475	800	3,897	1,213	13,874	4,209
1996	5,800	825	3,983	1,301	15,481	4,577
1997	6,252	865	4,003	1,375	17,417	4,948
1998	6,801	861	4,220	1,443	18,331	5,368
1999	7,489	883	4,432	1,479	19,576	5,918
2000	8,209	1,015	4,734	1,550	20,787	6,684
2001	9,399	1,167	4,975	1,613	22,206	7,172
2002	10,826	1,308	5,143	1,717	25,517	8,088
2003	12,375	1,496	5,149	1,857	27,336	8,609
2004	13,759	1,574	5,128	2,005	29,768	9,307
2005	14,454	1,666	5,355	2,114	31,987	9,895
2006	15,022	1,728	5,285	2,372	35,153	10,147
2007	14,986	1,836	5,451	2,552	38,289	10,889
2008	15,108	1,975	6,161	2,711	40,245	11,571
2009	15,560	1,924	6,285	2,914	43,298	12,422
2010	17,389	2,288	5,985	3,139	46,174	12,286
2011	18,735	2,554	6,034	3,363	49,011	12,916
2012	17,710	2,528	6,082	3,568	52,884	13,027
2013	17,006	2,681	6,379	3,790	56,535	14,221
2014	16,137	2,653	6,662	4,007	60,942	14,611

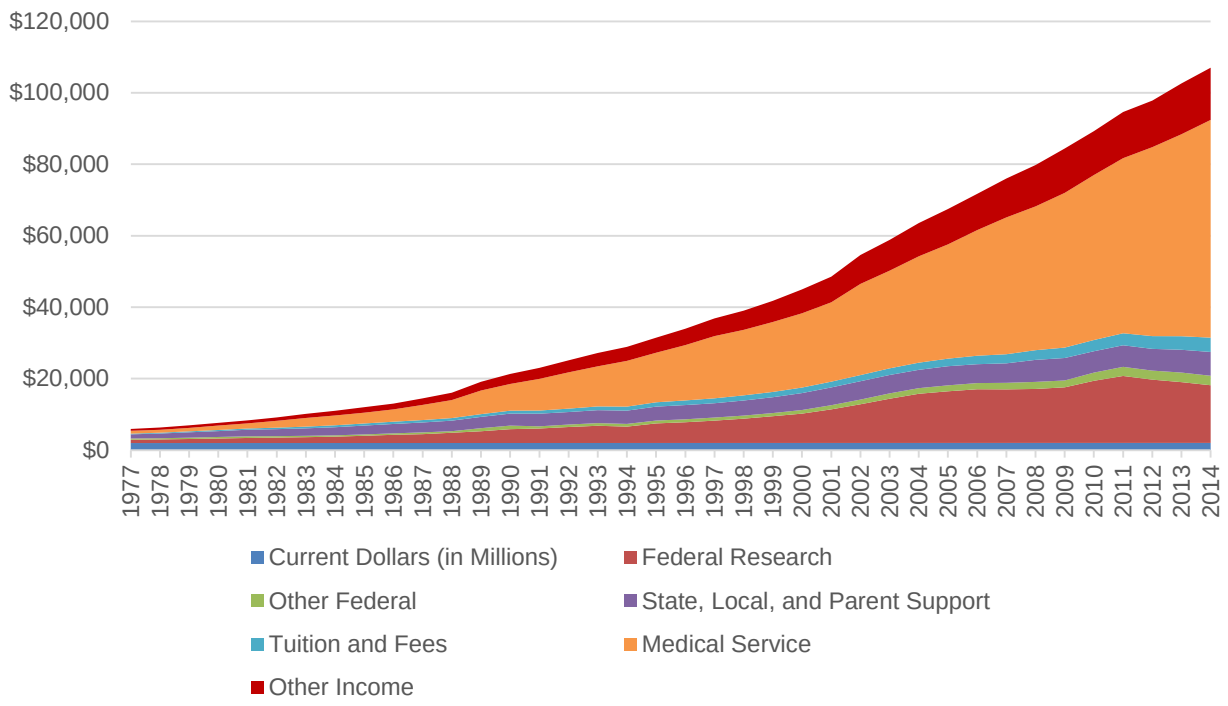

Figure 2. Revenue by source of AAMC medical schools with full accreditation (FY 1977-2014) in millions.

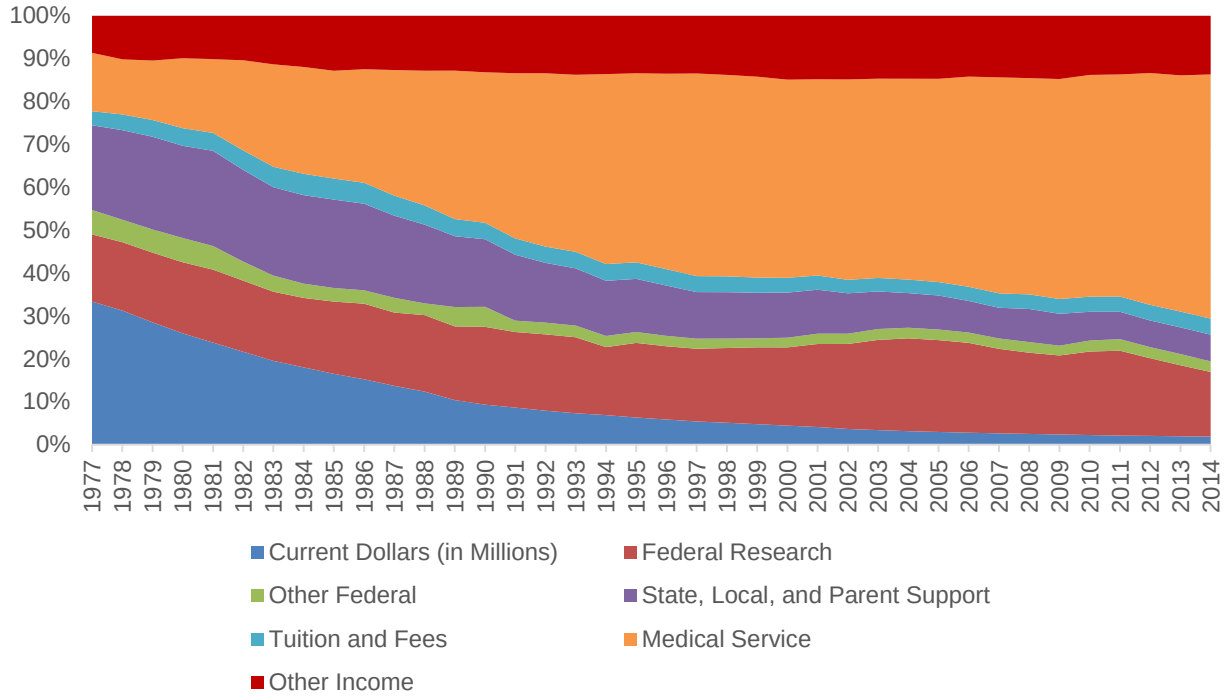

Figure 3. Revenue by source as a percentage of total revenue of AAMC medical schools with full accreditation (FY 1977-2014) in millions

Today, medical schools can no longer only focus on training physicians, pursue basic science research, and provide patient care. There is an increasing focus on knowledge and technology production and profit maximizing activities. This idea of using education to drive commercial initiatives is not new as traditional higher education institutions have used patent licenses, online education, and other “products” to drive behaviors and purpose toward profit making ventures at an unprecedented size and scope (Bok, 2003). However, unlike traditional higher education institutions, medical schools have a unique revenue source from which they can derive expense, which are for medical services, which traditional colleges and universities without a medical school cannot gather.

Like traditional universities competing for research funding and other resources, medical schools follow the same pattern of being resource dependent. Even more so than traditional universities that pay a base salary to faculty, some medical schools expect their faculty to raise their own salaries from the monies gained from being awarded national research grants (Stephan, 2012). Not only do these research grants cover the principal investigator, it is expected that it covers everyone within his or her direction, staff, all lab equipment and other needs. So even though it is expected that both traditional university faculty and medical school faculty will pursue external resources, the stakes are higher for medical school faculty to invest their energies to winning these rewards, to survive and maintain their job at the medical school. Of course, the institution benefits greatly from the funding even as it may be an individual effort of survival, as each additional grant adds to the resources that the institution has ultimate access to and authority over due to indirect costs.

Cross-subsidization. Income for higher education institutions can be derived from different sources which can include sources such as payments from services rendered, like in the case of medical schools, payments from hospital services, but this makes the allocating resources and managing finances more complex. The complex dynamics of this system creates differentiation, which further allows for greater complexity (Etzkowitz & Leydesdorff, 1997). Institutions need to be flexible in how they manage and respond to opportunities and difficulties. If not, the university's sense of purpose may get lost in revenue generation (Weisbrod et al., 2008).

When institutions encounter an imbalance between environmental demand and limited institutional capacity, they look toward diversifying their funding bases, particularly as these other sources of funding prove to be more flexible and valuable (Clark, 1998; Froelich, 1999). Like traditional HEIs, cross-subsidization is occurring as the “hard money” from government entities is becoming increasingly scarce and HEIs are pursuing other avenues of funding. HEIs are seeking alternative sources of funding, known as “soft money” and in higher percentages, depending upon this more to fund and cross-subsidize all areas of the institution (Clark, 1986; Weisbrod et al., 2010). This diversified funding increases the streams of income that come into the institution with the ability of being able to use it in more ways. This is justified by other sources of revenue “supporting the academic mission” of the medical school (Jones & Sanderson, 1996).

To explain this phenomenon, medical schools, like traditional colleges and universities, are responding to changes in their environments by diversification of funding (Clark, 2002; Hearn, 2003; Johnstone, 2002). The vast change seen in the

funding shows a cycle as the more successful in an institution can find alternative funding, the proportion of the income from the institution itself decreases, therefore more pressure to focus on alternative funding sources intensifies, creating a cycle (Clark, 1998).

Multiple studies on this topic looking at the trends that have occurred in HEIs have shown the increase on the reliance of diverse funding sources. The increased cost of conducting scientific research has lead to the growth over the years of internal institutional funds being used to pay for research activities, at the cost of the teaching function of institutions (Ehrenberg et al., 2003). A study of the relationship between revenues and expenditures at research extensive institutions showed that there is a tight relationship between the revenues and expenditures for public institutions, which typically use tuition for instructional purposes but not for private research institutions, that may use tuition to pay for research activities. A cross-subsidization occurs with instructional revenues paying for research expenditures that occurs at these types of institutions (Leslie et al., 2012). Further, a study conducted by Barringer (2016) of public higher education institutions found that these types of institutions altered their revenue streams and revenue profiles between 1986 and 2010 in order to adapt to their changing environments. This change happened over time, which supports the notion that medical schools have done the same thing in approximately the same time period.

Medical Schools as Quasi-markets and Market-Like Behavior

Medical schools, like traditional colleges and universities, could be considered a quasi-market, as competition occurs for resources particularly within the institution itself

by individual medical departments. Quasi-markets are primarily driven by policy and external stakeholders, in this case, medical residency funding that is controlled by the federal government. Quasi-markets are shaped by policy (Slaughter & Rhoades, 2004) and since the federal government has considerable control over a very important aspect of residencies, the funding; medical schools fit the model of a quasi-market.

The concept of quasi-markets explains the theory for how for-profit organizations behave in pursuit of maximal resource allocation (Pfeffer & Salancik, 1978). The argument of higher education as a quasi-market was introduced as the creation of human capital, leading to both public and private benefits, making higher education unlike a true market (Leslie & Johnson, 1974). Another perspective to the idea of quasi-markets in higher education was competition for governmental resources, financial aid, teaching support, and research funding, is based on selectivity, efficiency and outcomes, which has been affecting higher education organizations on a more frequent basis (Glennerster, 1991). Also the rise of government grants has led to the rise of universities competing for these limited resources (Williams, 1991; 1992). Soon, the concept of quasi-markets took hold and was applied throughout higher education (Froelich, 1999).

The idea of markets within higher education have different foci and priorities, which include the competition for students, education emphases, research funding, and academic professionals which adds to the layer of complexity and understanding in these types of organizations as multi-product firms (Dill, 1997). For quasi-markets in traditional colleges and universities, programs with potential for research funding and resources like the sciences and engineering are favored more than the humanities

(Taylor, Cantwell, & Slaughter, 2013). In this case of medical schools, programs and departments which have the potential to bringing in higher external revenues are favored, particularly those that can generate higher hospital revenues and research funding from the NIH. Further, NIH funding also has profound effects of the finances of a medical school as Larson, Ghaffarzadegan, and Diaz (2012) have noticed in how even a modest increase or decrease in NIH funding has dramatic effects on the performance of medical schools.

Since 1994, the BBA has increased competition for residency positions, by creating a policy regulation which stifled the growth of residency positions. These regulations were intended to alter the conduct of behavior of medical schools, by controlling the number of medical residency positions. Particularly for all of higher education, regulating and influencing market behavior has led to price regulation of academic programs, research services, enrollment management, degree program production, and maintaining quality programs (Dill, 1997). As discussed above, the Balanced Budget Act of 1997, did indeed attempt to control medical residencies in this manner.

This leads to an HEI to prioritize on certain programs and departments, at the detriment to others, which are seen as less important due to their lack of competition and ability to gain resources, regardless of the need present and societal pressures to grow. One example is medical schools that focus on primary care and rural medicine. Considering primary care specialties, they are viewed as a benefit that medical schools do to help create physicians for society. As with other medical specialties, there is some opportunity for medical schools to compete for the available federal and state monies

that focus on these areas, but it is limited in number and much smaller in dollar amounts. Yet it should be questioned if areas such as primary care are true priorities for medical schools today as they bring in less research dollars and much less likely to generate technologies and pharmaceuticals that can be turned into a profit unlike some of the other lucrative specialty departments of medical schools. There is little research to show if the medical school does benefit from a financial standpoint from engaging in these types of activities focusing on primary care.

Current research is conflicted in how much investment a medical school puts on primary care and its payoff. There is some support for how particular medical school characteristics influence whether or not their medical school graduates will enter into primary care or not, yet findings suggest that medical school characteristics play little role in specialty choice, and begins when students matriculated into medical school (Senf et al., 1994). However, when a study on how much a medical school received in overall NIH research funding and percentage of students entering family medicine was studied, there was a negative correlation between NIH funding and students entering into primary care (Brode, Petterson, & Bazemore, 2013).

Particular departments within a medical school/teaching hospital may be acting as powerful entities and influencers within the institution for the limited resources that is present for medical residency funding. In this case, medical departments, particularly ones that can generate lucrative contracts and render costly services, generate revenue more than those who may be focusing on teaching and service initiatives. Funding can have a powerful influence on how resources are allocated internally. If funding is derived from the core institutional budget and undifferentiated, allocation of the budget

can be done by prioritizing institutional initiatives. However, if funding comes from outside sources, this can cause a shift, as incentives are provided by the institution to increase this external income and focus is placed on the external market and the resources it is willing to provide on certain agendas they care about (Porter, 1980). This seems to be happening with medical departments within a medical school. Although some may be favored by the institution, powerful departments that are able to gain grant funding, create products to be sold and turned into profit, and do research that increases the prestige of the institution are prioritized instead.

For this study, quasi-markets are dependent on sector, level, and control, therefore medical schools are a select group of institutions, outside of traditional higher education institutions, that have distinct missions, foci, and priorities. Yet, even as medical schools are in its distinct category of higher education institution, two main kinds are present, university-affiliated, and independent non-university affiliated medical schools. For this study, independent non-university affiliated MD-Granting medical schools will be studied. First, they are independent, unaffiliated institutions. These institutions have one mission, vision, and goal that only encompass one very particular area of higher education and no other disciplines. With medical schools affiliated with a parent university, even as they may be their own college or school, may have influence from the university in what they do and pursue. Second, these types of medical schools operate on limited finances as an independent institution. This leads the unlikeliness of the parent university's income and revenues cross-subsidizing medical education expenses. Finally, due to the institutional foci between MD and DO institutions can be different, only MD-Granting institutions are studied.

Theoretical Framework

This study explores tensions between “mission” and “money” (Weisbrod et al., 2008). As noted previously, the traditional mission of medical schools is the training of physicians and the provision of low-price health care to traditionally underserved populations. Federal policy has limited increases in GME support since the late 1990s; however, leaving medical schools to pursue other sources of revenue even if these activities distract or detract from their traditional focus (Weisbrod, 1998). In contrast, NIH funding established by Congress has steadily increased, believing the focus on clinical medical research is important to the advancement of science and medicine in the U.S. (Moy et al. 2000). Through these means, academic capitalism has led to increased stratification, as most NIH funding is concentrated in elite schools and this advantage has been accumulating ever since (Taylor, 2015). Institutions focusing on medical education are left behind as research pursuits advantages institutions due to the priorities placed by the nation on this initiative, not instruction or medical education.

The theoretical framework to be used in this study is academic capitalism (Slaughter & Rhoades, 2004). In its classic iteration, academic capitalism explores the ways in which declining direct government support – understood as state appropriations to subsidize undergraduate education – has prompted administrators and faculty members to seek new sources of revenue (Slaughter & Leslie, 1997). This formulation is in some ways analogous to graduate medical education, which also has faced declining direct government support since the late 1990s as a result of the BBA of 1997.

The theory of academic capitalism posits that, as direct government support declines, higher education institutions will create strategic partnerships with external

entities, yielding new circuits of knowledge between the university, industry, and government (Slaughter & Cantwell, 2012; Slaughter & Rhoades, 2004). Because of their close links with government, these competitions do not yield markets (Marginson, 2013), but rather quasi-markets in which the preferences of policymakers shape competitive advantage (Taylor, Cantwell, & Slaughter, 2013). Also, external market forces do not have control of how institutions allocate their institutional resources internally (Leslie & Johnson, 1974). Academic capitalism focuses on competition and institutions orienting themselves based on certain agendas and incentives, leading to market-like behaviors (Slaughter & Taylor, 2015). This leads to institutions to be strategic in aligning themselves to be the in the best position to have access to limited resources and increase revenues. Although not explicitly stated, this leads to what Mettler (2011) calls the “submerged state” as institutions that behave and act in a certain manner, gain resources that are provided by the government, veiled as policies tied to federal funding. Although on the surface it looks like the market is restraining institutional resources, in reality, it has heavy influence by the government (Taylor, 2015).

The push for more residency positions and funding toward GME has particularly increased within the past 10 years due to the predicted shortage of physicians by the implementation of varying federal acts providing widespread healthcare. However, this is in flux based on the partisan influence of the federal government and how much of a role the federal government wants to have in providing healthcare access. Although medical schools aggressively pursue external funding, the government, due to funding the majority of residency programs, has the upper hand in deciding the fate of residency

positions with the policies they have put in place. In other words, the “marketization” of university-based medical schools – meaning the growing emphasis on fee-for-service treatments rather than traditional mission fulfillment – could reflect the policy environment (e.g., federal support for GME and medical research) rather than inevitable economic processes.

Academic capitalism has enticed higher education institutions to pursue revenue generating and prestige-maximizing activities such as research, and focus less service to the public and away from its mission (Jaeger & Thornton, 2005; Mirowski & Sent, 2002). This has lead to institutions to focus on activities that garner benefits and prestige upon them, such as research activity and revenue generation, and in turn reward those within the institution that pursue these avenues (Leslie et al., 2012). This is not just happening within universities, but also in professional schools and the affiliations they hold and contracts they have.

This research aims to look at this problem from a novel approach using the narrative of academic capitalism. GME funding and the availability of medical residency positions can be explored through current revenue sources that medical schools have such as federal research funding, Medicare graduate medical education funding, hospital revenues, and other funding sources. Seventy years before, Weber (1946) alluded to institutes of medicine as state capitalist enterprises, which cannot be managed without high amounts of support from the government. Although a considerable portion of support from the government has decreased for medical schools today, governmental subsidies still comprise a large part of revenue of medical schools to use.

Mechanic, Coleman, and Dobson (1998) found that the high cost of teaching hospitals and the rise of managed care and competitive markets may be compromising graduate medical education and the academic mission of teaching hospitals. Further, managed care may be affecting the ability for academic medical centers and medical schools to win NIH grants (Hellerstein, 2008). Although funded research projects are key to the medical school research enterprise, unsponsored research funding, whether faculty supported or institutionally supported, can be used to explore new areas of potential research that can be further developed to be ready for external funding.

Further, even though academic capital is focused on faculty (Slaughter & Rhoades, 1997), I argue that medical residents also contribute to this commodity for medical schools. Through their daily activities of being educated in a specific specialty, they also serve patients which ultimately benefits the individual resident, the university hospital/clinic they work, the medical school, and then eventually society. Within universities, graduate students, postdocs, and technicians are crucial in the research findings generation, which leads to the faculty member applying for more grant funding and the further creation research outputs. This creates a cycle that the reliance of current research being done by workers, not the individual faculty member, is then turned to apply for more research funding, increasing the reliance of external research findings in universities (Cantwell, 2015; Cantwell & Taylor, 2015).

Residencies pose an entity between the federal government, industry, and the institution. Due to Medicare limiting residency positions, it goes contrary to one of the critical missions by the federal government, which is health. Due to the limit in residency funding and positions, industry and other areas have stepped in to cover and increase

residency positions. This shows the complex interplay between the market, the state, and the academy, much like traditional universities are today (Slaughter & Rhoades, 1997).

This research seeks to understand whether or not the claims of marketization of higher education, particularly medical residency funding, has merit and in what ways. Higher education's purpose, in this case, education of medical residents, is questioned as alternative revenue sources seem to generate revenue for additional positions beyond those provided by the government. Yet the societal impact of this alternative investment is not considered on a larger scope of the creation of human capital and how it coexists alongside academic capitalism (Taylor, Slaughter, & Rosinger, 2015). This takes looking at how funding sources have changed and by what mechanisms funds, both public and private (Williams, 1995). The next section will focus on the methods using for this analysis.

CHAPTER 3

METHODS

The primary goal of this study is to analyze organizational finances of non-university based independent medical schools in the United States to understand the trends of how medical residencies have been funded in the past 10 years (2004-2013). This chapter provides the methods used to conduct the analyses and has three main sections, (1) the datasets chosen for analysis, (2) the variables selected, and (3) the statistical analysis and models.

Research Questions

- RQ1: What is the general variation in sources of financial support over time at university-based medical schools in the past 10 years (2004-2013)?
- RQ2: Has the number of residency positions increased over the past 10 years (2004-2013) even as Medicare-funded residency positions have remained relatively constant?
- RQ3: What university and medical school characteristics have predicted variation in the number of residency spots at university-based medical schools over time?

Sample

Only independent non-university affiliated public and private not-for-profit MD-Granting medical schools was studied. The problem with using all medical schools located in the United States is that complex finances that are not easily extractable by college/school if medical schools are affiliated with a parent university or system. Moreover, this would be an inadequate test of the increased role of distinctiveness of independent medical schools (Clark, 1995). Upon a search in IPEDS, the majority of

U.S. medical schools are affiliated with a parent university and report to IPEDS in this manner. To tease out revenues and expenses for just the medical school unit was impossible to do unless use of another data source is present. Plus, cross-subsidies exist as units are not siloed financially and likely as medicine is a costly venture, other areas of the university may help fund the medical school. Today, undergraduate teaching makes up a substantial portion of a university, and it subsidizes other areas of the university through its tuition generation and ability to be cost-efficient. Research and knowledge production is increasingly a larger priority for universities, therefore funding shifts from undergraduate programs toward graduate and professional schools within a larger university setting has been occurring (Clark, 1995b). This is unlike graduate and professional education, which solely focuses on research and knowledge production, and with smaller class sizes, specialized faculty, making it more of an expensive area of higher education.

The reasoning behind the choice of this sample of 32 institutions is the confounding of main institutional data with medical institutional data. The institutions were selected by doing a search through IPEDS, using Carnegie classification, and selecting institutions classified as medical schools. IPEDS automatically removed all medical schools with a university affiliation and provided a list of 46 institutions. Twelve of these institutions are DO-granting therefore removed, which left with a total a 34 independent non-university affiliated MD-granting medical schools. Although this sample greatly decreased the number of medical schools studied, it still provided a usable analysis because of time constraints present as the institutions selected were

very carefully chosen. The table provides the general information about each institution which includes IPEDS ID number, location, year established and public/private control.

Table 3

List of Independent Non-University Affiliated MD Medical Schools in the United States

	IPEDS ID	Institution Name	City	State	Est.	Control
1	188580	Albany Medical College	Albany	NY	1838	Private
2	223223	Baylor College of Medicine	Houston	TX	1900	Private
3	231970	Eastern Virginia Medical School	Norfolk	VA	1973	Public
4	193405	Icahn School of Medicine at Mount Sinai	New York	NY	1963	Private
5	117636	Loma Linda University	Loma Linda	CA	1909	Private
6	159373	Louisiana State University Health Sciences Center-New Orleans	New Orleans	LA	1931	Public
7	435000	Louisiana State University Health Sciences Center-Shreveport	Shreveport	LA	1969	Public
8	173957	Mayo Medical School	Rochester	MN	1972	Private
9	239169	Medical College of Wisconsin	Milwaukee	WI	1912	Private
10	218335	Medical University of South Carolina	Charleston	SC	1823	Public
11	220792	Meharry Medical College	Nashville	TN	1876	Private
12	140562	Morehouse School of Medicine	Atlanta	GA	1975	Private
13	193830	New York Medical College	Valhalla	NY	1858	Private
14	204477	Northeast Ohio Medical University	Rootstown	OH	1973	Public
15	209490	Oregon Health & Science University	Portland	OR	1887	Public
16	214616	Pennsylvania State University-College of Medicine	Hershey	PA	1963	Public
17	145558	Rosalind Franklin University of Medicine and Science	North Chicago	IL	1912	Private
18	148511	Rush University	Chicago	IL	1837	Private
19	196255	SUNY Downstate Medical Center	Brooklyn	NY	1858	Public
20	229337	Texas Tech University Health Sciences Center	Lubbock	TX	1969	Public
21	229300	The University of Texas Health Science Center at Houston	Houston	TX	1972	Public
22	228644	The University of Texas Health Science Center at San Antonio	San Antonio	TX	1959	Public

(table continues)

Table 3 (*cont*.)

	IPEDS ID	Institution Name	City	State	Est.	Control
23	228653	The University of Texas Medical Branch	Galveston	TX	1891	Public
24	216366	Thomas Jefferson University	Philadelphia	PA	1824	Private
25	106263	University of Arkansas for Medical Sciences	Little Rock	AR	1879	Public
26	110699	University of California-San Francisco	San Francisco	CA	1864	Public
27	163259	University of Maryland-Baltimore	Baltimore	MD	1807	Public
28	166708	University of Massachusetts Medical School Worcester	Worcester	MA	1962	Public
29	176026	University of Mississippi Medical Center	Jackson	MS	1903	Public
30	181428	University of Nebraska Medical Center	Omaha	NE	1881	Public
31	207342	University of Oklahoma-Health Sciences Center	Oklahoma City	OK	1900	Public
32	228635	University of Texas Southwestern Medical Center	Dallas	TX	1943	Public
33	196307	Upstate Medical University	Syracuse	NY	1834	Public
34	190424	Weill Cornell Medical College	New York	NY	1898	Private

Datasets Used

The datasets used in this analysis was from the National Center of Education Statistics Integrated Postsecondary Education Data System (NCES IPEDS), National Science Foundation (NSF), National Institutes of Health (NIH), Centers for Medicare and Medicaid Services Cost Reports (CMS), the National Resident Matching Program (NRMP), and American Association of Medical Colleges (AAMC). These datasets provided information important to study the effects of funding on medical residency training positions.

The proposed research used no restricted datasets and all data was available publically on federal or medical organizational websites. Some of the AAMC data was acquired through direct communication with the medical organization as it previously

was accessible online but due to the limited number of years of data published online. AAMC's policy was to provide this data free of charge if at one point, the data was accessible to the public.

The datasets and variables to be used and their relevance are as follows.

NCES IPEDS

The NCES IPEDS Finance datasets provided revenues specific to what the medical college receives or through teaching hospitals affiliated with medical schools. Particular variables to be used are tuition and fees, total hospital revenues, federal and state appropriations, and endowment. The IPEDS Finance data, which has data available from 1987 to current, provides a comprehensive collection of finance data such as revenues, expenditures, and other funding sources. This dataset provided various streams of funding, tuition and fees, federal and state appropriations, hospital revenues, and other revenues aside from R&D federal funding which can be analyzed for this project.

NSF HERD and NIH R&D

The National Science Foundation Higher Education Research and Development (NSF HERD) Survey and National Institutes of Health Federal Funds for Research and Development (NIH R&D) survey provided research and development funding data, which can be broken down by type and agency source. The NSF HERD data provided all federal agency funding sources except for NIH. Therefore, the NIH R&D data was used to provide R&D funding from the NIH.

The HERD data are a survey that provides information on research and development funding categorized by field of research and source of funds at institutions that expended at least $150,000 in a fiscal year (National Science Foundation, 2014). This data set has been in place since 2010. Before this, the National Science Foundation (NSF) Survey of Research and Development Expenditures at Universities and Colleges (Academic R&D Expenditures Survey) was in place between fiscal year 1972-2009 (National Science Foundation, n.d.). Both datasets are able to be integrated seamlessly, expect for minor changes which definitions are provided by NSF and will be noted if any variables used in this analysis are affected by any minor changes throughout the years.

NIH Federal Funds for R&D and NIH Federal Funds for Health R&D, similar to the NSF data, provided funding amounts for research and development to medical schools based on the number of awards, total funding, year, and funding mechanism (National Institutes of Health, 2015). The NIH Federal Funds for R&D Awards by Location and Organization data will gathered using “Group by System and/or Main Campus” query to gather institutional specific data (National Institutes of Health, n.d.).

Both datasets provide variables of total funding, field of research, types of research and expenses, and source of funding. This NSF data set and the NIH R&D data sets (NIH Federal Funds for R&D and NIH Federal Funds for Health R&D) will be able to analyze the funding that a medical school receives per year.

Centers for Medicare and Medicaid Services Hospital Cost Reports

Centers for Medicare and Medicaid Services (CMS) Hospital Cost Reports

provide Medicare GME Direct and Indirect Medical Education (DGME and IME) funding by hospitals and/or teaching facilities, the number of residents, and the per-resident amount the hospital receives for each medical resident, excluding podiatric and dental residents. Hospital Form 2552-96 and Hospital Form 2552-10 contains data starting 1995 to present (Centers for Medicare and Medicaid Services, 2015) and will be used in this study. All data from the CMS is publically available for download from their website.

National Residency Matching Program (NRMP)

National Resident Matching Program (NRMP) are programs used by residency programs to match fourth year medical students to residencies they will enter upon graduating. The NRMP is the program that most allopathic residency programs use to match applicants. This NRMP data will provide the total number of residency positions per year and the types of residency positions available by specialty.

American Association of Medical Colleges

AAMC data will be used to provide medical school matriculants and graduates data by institution and by year to analyze general population trends of students entering medical school and graduating medical school. AAMC collects data for all allopathic medical schools (AAMC, n.d.b), These particular data will provide the number of matriculants and number of graduates by year to study the demographic change of student enrollments in the past fifteen/twenty years. Any data that is not currently provided on their websites will be requested at the time of data analysis or has been requested previously and already in possession.

Table 4 summarizes all variables used for this study, the grouping it has been designated, whether financial or demographic, the variable names, definitions, and source of variable. All variable definitions were directly obtained by the source of the data.

The variables used reflect the both academic capitalism and distinctiveness of these colleges. The financial control variables such as tuition and fees, revenue, research funding, appropriations, Medicare GME funding, are used to study the effects of revenue differences over the years and to argue that the external revenues have had a substantial effect on the priorities of medical school behaviors. Further, demographic variables such as institutional control (public or private), year institution founded, number of medical student matriculants, medical school graduates, and total available medical residency positions will help show the changing function of medical schools in 10 years and how they have emerged as a distinct entity of higher education institution and will answer Research Questions 1 and 2. The independent variable for this study is the total number residencies within a particular medical school which is studied to help show that particular finances of an institution are ultimately tied to the number of medical residencies that are available for a medical school.

Table 4

Variables Used in this Study

Variable Group	Variable Name	Variable Definition	Variable Source
Financial	Tuition and Fees	Public - GASB 34/35 - Tuition and fees are revenues from all tuition and fees assessed against students (net of refunds and discounts & allowances) for educational purposes. Private - FASB - The amount of tuition and educational fees, net of any allowances applied in the general purpose financial statements. Included in this amount are fees for continuing education programs, conferences, and seminars.	IPEDS
Financial	Sales and services of hospitals/Hospital Revenue Total	Public - GASB 34/35 - Sales and services of hospitals, after deducting patient contractual allowances include operating revenues (net of patient contractual allowances) for a hospital operated by the institution and clinics associated with training. It excludes clinics that are part of a student health services program that should be reported elsewhere. Private - FASB - Revenues from hospitals includes revenues and gains of hospitals operated as a component of a reporting institution of higher education. Independent operations includes revenues associated with operations independent of the primary missions of the institution, such as revenues associated with major federally funded research and development centers. All other revenues not reported in the above categories (tuition and fees through sales and services of auxiliary enterprises) are included here.	IPEDS
Financial	Total Higher Education R&D Expenditures for S&E	R&D expenditures in science and engineering (S&E) fields from current operating funds that are separately budgeted and accounted for. For purposes of this survey, R&D includes expenditures for organized research as defined by 2 CFR 220 (OMB Circular A-21) and expenditures from other accounts that are only used for research. Includes: Sponsored research (including federal and nonfederal sponsors), University research (institutional funds that are separately budgeted for individual R&D projects), Other accounts funded by the institution that are only used for research, Recovered and unrecovered indirect costs, Equipment purchased from R&D project accounts, R&D funds passed through to a subrecipient organization, educational or other., Clinical trials, Phases I, II, or III Research training grants funding work on organized research projects	NSF HERD Academic R&D

Financial	Federally Financed Higher Education R&D Expenditures for S&E	R&D expenditures in S&E fields, including direct and recovered indirect costs, funded by all agencies of the Federal government.	NSF HERD Academic R&D
Financial	State/Local Govt Financed Higher Education R&D Expenditures for S&E	R&D expenditures financed by any state, county, municipality, or other local government entity in the United States, including state health agencies. It also includes state funds that support R&D at agricultural and other experiment stations. Public institutions are instructed to report state appropriations restricted for R&D activities here rather than in Institutional funds.	NSF HERD Academic R&D
Financial	Business Financed Higher Education R&D Expenditures for S&E	R&D expenditures financed by any domestic or foreign for-profit organization. Funds received from a company's nonprofit foundation are included under nonprofit financed R&D expenditures.	NSF HERD Academic R&D
Financial	Institutionally Financed Higher Education R&D Expenditures for S&E	R&D expenditures financed by university funds from unrestricted sources that are separately budgeted for organized research. It also includes committed cost sharing and unrecovered indirect costs. Unrecovered indirect costs are defined as the difference between the recovered indirect costs and the amount that could have been recovered according to the institution's negotiated rate for all externally funded R&D.	NSF HERD Academic R&D
Financial	Other Higher Education R&D Expenditures for S&E	R&D expenditures financed by all other sources, such as funds from foreign governments.	NSF HERD Academic R&D
Financial	DGME Direct Medical Education Funding	DGME costs are for the direct cost of training residents including residents' salaries and benefits, teaching physicians' salaries and benefits, accreditation fees, support staff costs, space costs etc. (Frankenbach, 2014)	CMS Hospital Cost Reports
Financial	IME Direct Medical Education Funding	IME costs are for the incremental patient care cost related to training residents including severity of illness not reflected in DRG assignment, and inefficiencies in care associated with training residents. (Frankenbach, 2014)	CMS Hospital Cost Reports
Demographic	Number of Total Residents Matched	The total number of medical residents matched to a particular residency program which are rolled up from specialty/program to institution level	NRMP Resident Registration Program
Demographic	Number of Matriculants to Medical School	The number of entering medical students in the academic year	AAMC
Demographic	Number of Medical School Graduates	The number of graduating medical students in the academic year	AAMC

Statistical Analysis and Models

For this project, a fixed effects panel analysis will be run through STATA 14 to analyze the changes of funding to medical schools within the past 10 years to answer Research Question 3. A fixed-effects panel analysis is appropriate for this study as variables can be observed across time and one can control for particular variables that may confound the results. Academic capitalism posits that changes in institutional profiles and behaviors has lead to predictable differences which can be studied over time and in this case, this distinctive type of institution, the independent, non-affiliated MD-granting medical school.

Using this analysis is contingent upon the results of a Hausman specification test. Panel analysis is useful to looking at universities as it can control for individual heterogeneity, which is common in higher education research (Zhang, 2010).

Using panel data instead of time-series/cross-sectional studies has multiple benefits. Baltagi (2008) provides the benefits of using panel data as follows: (1) The ability to control for individual heterogeneity of time-invariant variables, (2) removal of biases from aggregation of firms or individuals, and (3) the ability to study the dynamics of adjustment. Particularly for studying higher education institutions, panel analysis is appealing for these statistical and conceptual reasons (Zhang, 2010).

Ten years is used for two reasons: (1) IPEDS data prior to this would provide difficult as variables and reporting has been inconsistent prior to 1990 and (2) the effects of the Balanced Budget Act and subsequent federal policy changes can be studied and provide a more comprehensive picture of what trends have occurred even in the midst of funding changes.

Statistical Model

Research Questions 1 and 2 will use descriptive statistics in order to answer the questions. Research Question 3 will be answered using fixed effects model. This to analyze the impact of variables over time and it is assumed that time-invariant variables are not correlated with other variables. The Hausman specification test will be able to better provide the justification of using this fixed effects model. Three models were provided to look at Research Question 3.

Model 1 specifically looks at five main sources of revenue: tuition, hospital revenue, total higher education research and development funding, and direct and indirect graduate medical education from Medicare.

Model 1:

$$RP1_{it} = \beta_0 + \beta_1 T_{it} + \beta_2 HOSP_{it} + \beta_3 HERD_{it} + \beta_4 DGME_{it} + \beta_5 IME_{it} + \alpha_i + u_{it}$$

$RP1_{it}$ is the total number residencies within a particular medical school. T_{it} represents the total tuition revenues each institution generates. $HOSP_{it}$ is the total hospital revenues derived from patient care. $HERD_{it}$ is the total funding an institution receives as a component of higher education research and development. $DGME_{it}$ is the total direct GME direct medical education funding the institution has received in total, IME_{it} is the total indirect medical education funding from Medicare it receives.

Model 2 further disaggregated higher education research and development (HERD) into its specific sources of revenue: federal, state and local, business, institutional and other. Definitions of these specific sources of revenue are provided in Table 4.

Model 2:

$$RP2_{it} = \beta_0 + \beta_1 T_{it} + \beta_2 HOSP_{it} + \beta_3 FHERD_{it} + \beta_4 STLOHERD_{it} + \beta_5 BUSIHERD_{it} + \beta_6 INSTHERD_{it} + \beta_7 OTHERHERD_{it} + \beta_8 DGME_{it} + \beta_9 IME_{it} + \alpha_i + u_{it}$$

$RP1_{it}$ is the total number residencies within a particular medical school. T_{it} represents the total tuition revenues each institution generates. $HOSP_{it}$ is the total hospital revenues derived from patient care. $FEDHERD_{it}$ is the total federal funding an institution receives as a component of higher education research and development. $DGME_{it}$ is the total direct GME direct medical education funding the institution has received in total, IME_{it} is the total indirect medical education funding from Medicare it receives.

Model 3 is similar to model 1 but separates public MD-granting medical schools and private MD-granting medical schools and analyses were run separately.

Model 3:

$$RP3PRI_{it} = \beta_0 + \beta_1 T_{it} + \beta_2 HOSP_{it} + \beta_3 HERD_{it} + \beta_4 DGME_{it} + \beta_5 IME_{it} + \alpha_i + u_{it}$$

$$RP4PUB_{it} = \beta_0 + \beta_1 T_{it} + \beta_2 HOSP_{it} + \beta_3 HERD_{it} + \beta_4 DGME_{it} + \beta_5 IME_{it} + \alpha_i + u_{it}$$

As shown in Chapter 4, the profile of private and public institutions differ slightly on certain revenues and private medical schools are more reliant on tuition funding than public medical schools.

By studying medical schools using these three research questions, one can see how current conditions that exist and organizational characteristics predict the current state of medical residencies, revenue profiles of medical schools, and how they intersect to show the relationship between the training of physicians and medical school finances.

CHAPTER 4

RESULTS

This chapter discusses the findings of the three research questions of this study that look at the intersection between the academic mission and money of medical schools.

- RQ1: What is the general variation in sources of financial support over time at non-university-based independent medical schools in the past 10 years?
- RQ2: Has the number of residency positions increased over the past 10 years even as Medicare-funded residency positions have remained relatively constant?
- RQ3: What university and medical school characteristics have predicted variation in the number of residency spots at university-based medical schools over time?

The overall data set was created using the multiple sources of data provided publically which includes IPEDS, NSF HERD, CMS Medicare, AAMC, and NRMP. The time of analysis was limited to years 2004-2013, a ten-year period. Ten years was chosen due to the changing nature of the IPEDS finance data in the early 2000. All data are analyzed by the academic year method, for example, the data will show up as 2013 for the academic year 2012-2013. All financial values are adjusted to inflation in 2013 dollars. The Consumer Price Index by the U.S. Bureau of Labor Statistics provided these yearly value adjustments. The multiplier was used for the initial financial values, then all values were multiplied by Full Time Student Equivalent (FTE). Finally, all values were divided by 1,000 to provide interpretable results, so all output findings will be based on $1000 per FTE.

Description of Sample

First the IPEDS finance data was analyzed. A few medical schools encountered

an issue that although these institutions had a separate IPEDS ID number, they did not report any financial funding under their particular IPEDS ID. The institutions that were removed include the University of Mississippi Medical Center and Pennsylvania State University-College of Medicine. Instead, both institutions currently report their financial data as a part of the main university. Therefore, the final sample for this study was reduced from 34 to 32. Some general information about these institutions are provided in Table 5 which provides institutional characteristics of the medical schools in the study sample. Regional categories were created by sorting the states in the regions provided by the US Census Bureau (2016).

Table 5

*Institutional Characteristics of Medical School Sample (*N = *43)*

Institutional Characteristics		Total
Sector	Public	19
	Private	13
Region	Midwest	6
	Northeast	8
	South	15
	West	3
State	Texas	6
	New York	6
	Illinois	2
	California	2
	Louisiana	2
	All Others	1 Each

In general, there are more MD private institutions (19) than MD public institutions (13). The states for which the majority of my institutional sample are located include: Texas (6), New York (6), Illinois (2), California (2), and Louisiana (2). All other states in sample had only one institution each. Even looking at the demographic location of this sample is interesting as the majority of independent, non-affiliated MD medical schools in the United States are located in Texas and New York. Although not a focus of this study, looking at the procedures and policies of how medical schools are founded and established, the governance type of the states (governing, coordinating, or planning/regulatory/service agencies) and specific characteristics of university affiliated MD-Granting medical schools would provide some perspective on why this is the case.

For all the values with Research Questions 1 and 2, a total average was provided and values separated by the control of the institution (public or private). This is due to two reasons. Medical schools which are private are more tuition driven and typically will not receive large sums of state funding (Gil, Park, & Daniels, 2015). Separating the descriptive statistics will provide a more complete picture of the funding sources that each type and control of medical school.

The focus of the results is how revenues and specifically different types of revenues have influenced how medical schools use various types of funding and whether or not any are used in the creation of medical residency positions. Medical schools in a traditional sense has a large focus on educating and training of physicians, but also pursue other activities such as research and service, analogous to traditional colleges and universities. However due to competitive pressures from both within and outside of higher education, medical schools are also enticed to pursue activities that

maximize prestige and profit maximization such as applied research and marketable goods such as patents and pharmaceuticals. By first looking at the changes of specific revenue sources within the years studied (2004-2013) can show how shifts have occurred on a national scale but also within the sample studied. Further, as public and private medical schools have slightly different revenue sources, they will be studied separately to look for differences.

Analysis of Tuition

Prior to delving into the research questions, an analysis of the changes in tuition charged for undergraduate medical education should be discussed. The rationale for this is that the argument is alternative sources of funding are making up for the lack of public sources (Andolsek et al., 2013). Tuition is a valid outside funding source to explore as the AAMC (2013) has found that tuition has risen exponentially in the most recent decade. This is also when Medicare funding has remained relatively stable for medical residencies (Ighehart, 2013). There is some component that those who benefit from the education, in this case, medical students, should bear more costs in their training, especially when public sources of medical education has been declining in recent years.

The following data on tuition is adjusted for inflation and shown in 2013 dollars. Data are provided by residency status (in-state and out-of-state) and by sector (private and public). First data for all MD-granting medical schools are provided, then data specific to independent, non-university affiliated medical schools are provided to compare and contrast the two types of institutions. For this specific analysis, there are a

total of 138 MD-granting medical schools with 53 being private medical schools and 85 being public institutions.

Table 6 and Figure 4 shows the trend between 2004-2013 on average tuition rates for all MD-Granting medical schools in the United States separated by in-state and out of state. Data shows that the rates of in-state medical school tuition (26.8%) has risen relatively faster than for out-of-state residents (20.7%) between 2004-2008. Even more markedly different is the 10 year change of tuition for in-state students (62.6%) and out-of-state students (49.8%). This somewhat reflects the trends for rising tuition costs for in-state students overall as state appropriations and other sources of public funding have declined and students are bearing unmet costs through increased tuition (Archibald & Feldman, 2010).

Table 6

*The 10 Year Trend in Average Tuition for all MD Medical Schools in the United States, Separated by In-State and Out-of-State Tuition Rates (*n = *138)*

Year	In-State	Out of State	Overall
2004	$22,707	$32,946	$27,698
2005	$24,120	$35,075	$29,439
2006	$25,422	$36,201	$30,677
2007	$26,948	$37,792	$32,236
2008	$28,796	$39,762	$34,167
2009	$30,275	$41,413	$35,731
2010	$31,819	$43,224	$37,410
2011	$33,587	$45,330	$39,364
2012	$35,334	$47,610	$41,375
2013	$36,911	$49,358	$43,039
5 Year Change (2004-2008)	26.82%	20.69%	23.36%
10 Year Change (2004-2013)	62.55%	49.82%	55.39%

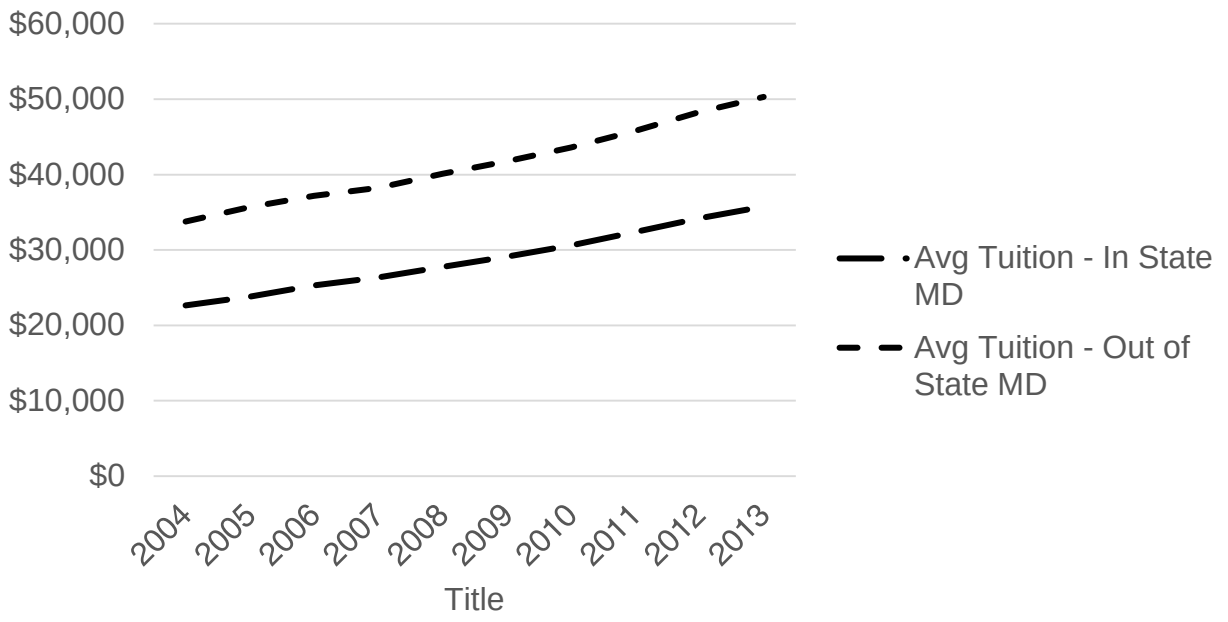

Figure 4. The 10 year trend in average tuition for all MD medical schools in the United States, separated by in-state and out-of-state tuition rates.

For the differences between private and public institutions, public institutions are increasingly charging more for tuition as tuition has increased 17.2% for private MD-granting medical schools versus 22.87% for public MD-granting medical schools. Data are provided in Table 7 and Figure 5. Again, the 10 year change is more marked, as private MD-granting medical schools have increased tuition by 41.9% but for public MD-granting medical schools have increased by 62.1%. Again, as mentioned above by in-state and out-of-state status, due to the decline in public revenue sources, medical schools have increased tuition more so in public institutions than privates.

Table 7

The 10 Year Trend in Average Tuition for all MD Medical Schools in the United States, Separated by Private v. Public Institutions

Year	MD Private Avg	MD Public Avg
2004	$33,525	$24,796
2005	$34,494	$26,694
2006	$35,948	$28,151
2007	$37,359	$28,999
2008	$39,279	$30,468
2009	$40,899	$31,920
2010	$42,481	$33,693
2011	$44,046	$35,905
2012	$45,680	$38,418
2013	$47,555	$40,200
5 Year Change (2004-2008)	17.16%	22.87%
10 Year Change (2004-2013)	41.85%	62.12%

Private n= 53; Public n = 85

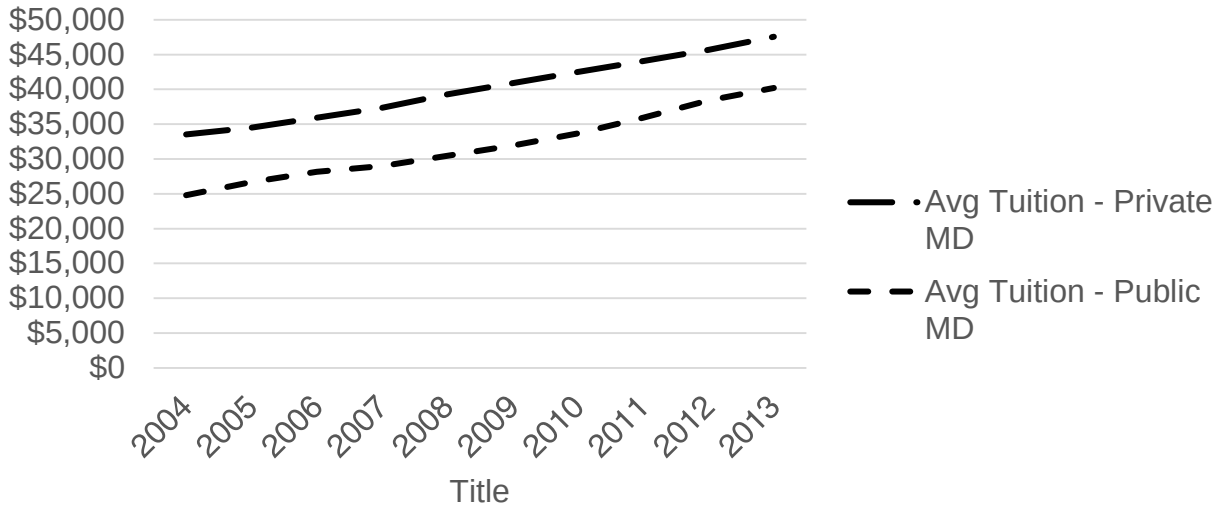

Figure 5. The average tuition differences for all MD medical schools in the United States between 2004-2013.

When intersecting both type of institution (private and public) and residency status (in-state and out-of-state) provides another perspective that focuses on

differences. These are shown in Tables 8 and 9 and Figure 6. Overall, private MD-granting medical schools generally charge similar tuition rates for both in-state and out-of-state students. For public medical schools, in-state students are generally charged less, especially when state subsidies on undergraduate medical education are provided. Public out-of-state students are charged similarly to private in-state and out-of-state students and can be shown in Figure 6.

Table 8

The 10 Year Trend in Average Tuition for MD Medical Schools in the United States, Separated by Control (Private v. Public) and In-State and Out-of-State Tuition Rates

MD Average Tuition	Private		Public	
Year	In-State	Out-of-State	In-State	Out-of-State
2004	$40,607	$42,080	$19,808	$41,350
2005	$40,420	$41,869	$20,603	$43,079
2006	$40,853	$42,224	$21,568	$43,490
2007	$41,300	$42,650	$21,994	$43,168
2008	$41,859	$43,140	$22,377	$43,555
2009	$43,772	$45,049	$23,761	$45,561
2010	$44,710	$46,058	$25,071	$46,919
2011	$45,089	$46,144	$26,038	$48,331
2012	$45,761	$46,939	$27,573	$50,389
2013	$46,975	$48,134	$28,685	$51,715

Private n= 53; Public n = 85

Table 9

The Average Tuition Differences (Increase/Decrease) by Year for MD Medical Schools in the United States, Separated by Control (Private v. Public) and In-State and Out-of-State Tuition Rates

MD Avg Tuition Change	Private (*n* = 53)		Public (*n* = 85)	
Year to Year	In-State	Out-of-State	In-State	Out-of-State
2004-2005	-0.46%	-0.50%	4.02%	4.18%
2005-2006	1.07%	0.85%	4.68%	0.95%
2006-2007	1.09%	1.01%	1.97%	-0.74%
2007 - 2008	1.36%	1.15%	1.74%	0.90%
2008 - 2009	4.57%	4.42%	6.19%	4.60%
2009 - 2010	2.14%	2.24%	5.51%	2.98%
2010 - 2011	0.85%	0.19%	3.85%	3.01%
2011 - 2012	1.49%	1.72%	5.90%	4.26%
2012 - 2013	2.65%	2.55%	4.03%	2.63%
5 Year Change (2004-2008)	3.08%	2.52%	12.97%	5.33%
10 Year Change (2004-2013)	15.68%	14.39%	44.82%	25.07%

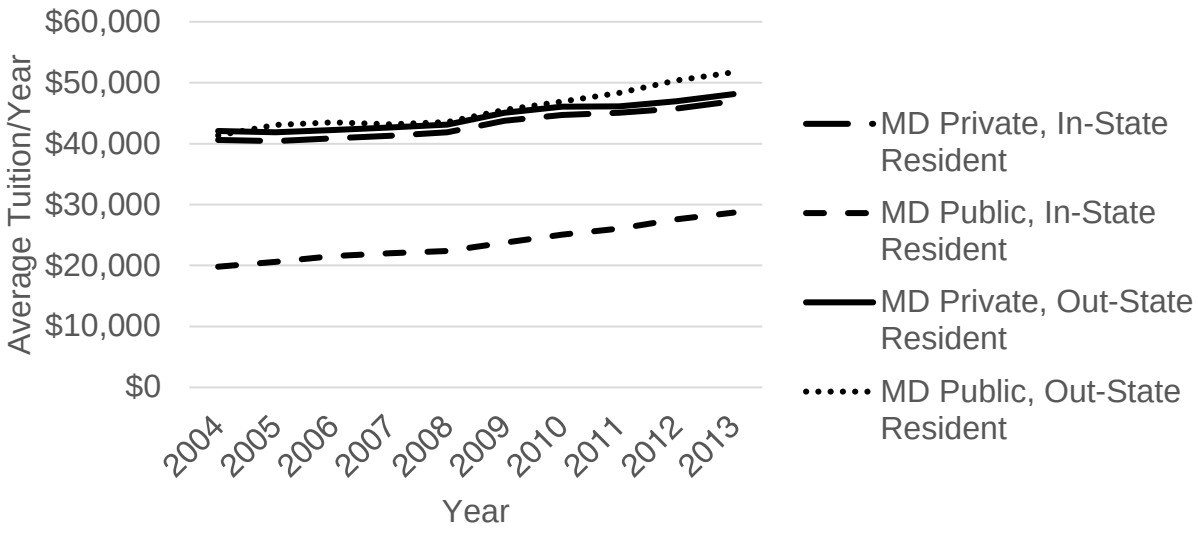

Figure 6. The average tuition differences for all medical schools in the United States, only MD institutions, but separated by control (private and public) and tuition (in-state resident or out-of-state resident.

Finally an in-depth analysis of average tuition rates for the sample in this study is conducted to show the similarities and differences from national tuition rates for all MD-granting medical schools in the United States to independent, non-university affiliated MD-Granting medical schools in the United States.

Table 10

*Average Tuition Rates by Control (Private and Public) by Residency Status (In-State/Out-of-State) for Sample (*N = *32)*

Private MD Tuition	In-state	Out-of-State	Average
2003-04	$30,151	$31,547	$30,849
2004-05	$31,111	$32,513	$31,812
2005-06	$32,079	$33,438	$32,758
2006-07	$33,234	$34,665	$33,950
2007-08	$35,311	$36,745	$36,028
2008-09	$36,476	$37,916	$37,196
2009-10	$38,433	$39,873	$39,153
2010-11	$40,808	$41,381	$41,094
2011-12	$41,974	$43,442	$42,708
2012-13	$43,850	$45,308	$44,579
5 Year Change (2004-2008)	17.1%	16.5%	16.8%
10 Year Change (2004-2013)	45.4%	43.6%	44.5%
Public MD Tuition	**In-state**	**Out-of-State**	**Average**
2003-04	$14,986	$30,367	$22,677
2004-05	$16,082	$32,666	$24,374
2005-06	$17,271	$34,495	$25,883
2006-07	$17,685	$35,331	$26,508
2007-08	$18,533	$36,868	$27,700
2008-09	$19,685	$38,787	$29,236
2009-10	$21,222	$39,671	$30,446
2010-11	$22,696	$42,478	$32,587
2011-12	$24,503	$45,285	$34,894
2012-13	$25,937	$47,081	$36,509
5 Year Change (2004-2008)	23.7%	21.4%	22.2%
10 Year Change (2004-2013)	73.1%	55.0%	61.0%

Table 10 shows the differences of tuition rates by control and residency status. Overall, similarities exist for this sample of medical schools and all medical schools in the United States. However, one should take into consideration that a large sample of the medical schools in this study are located in New York and Texas. Texas tuition rates for medical schools, have generally been in the bottom quartile of all medical schools. Although out of the scope of the study, analysis of how much subsidies a state provides for undergraduate medical education is worthy of exploration in the future.

Next as the analysis of tuition rates have been analyzed, the specific research questions and results are discussed.

Research Question 1

RQ1: What is the general variation in sources of financial support over time at non-university-based independent medical schools in the past 10 years?

For Research Question 1, as all the data is shown here adjusted for inflation and per FTE, generally the rise in tuition, higher education research and development funding, direct and indirect medical education have increased but only by incremental amounts and this can be seen in tables . However, hospital revenues have increased substantially in the past 10 years.

However, when looking at the share of total (percentage) that each of these sources of revenue have, shows a different picture. The share of hospital revenues have taken a substantial amount of the total when compared to HE R&D. This reflects the nature of research and development, as for medical schools, the federal government has provided the majority of funding for medical schools and that has decreased in the past 10 years. Field conditions have changed in the past ten years and

as Slaughter & Leslie (1997) suggest, organizational characteristics have changed accordingly.

Table 11

Mean Characteristics of Financial Support (in Millions): All MD Medical Schools in Sample

Year	Tuition	Hospital Revenue	HE R&D	DGME	IME
2004	$18.1	$150.6	$105.6	$15.9	$37.7
2005	$19.0	$166.8	$100.9	$15.9	$37.5
2006	$18.3	$165.7	$98.6	$15.5	$35.8
2007	$19.3	$176.3	$94.9	$15.0	$34.8
2008	$19.6	$175.5	$95.1	$14.4	$34.3
2009	$20.6	$206.5	$97.6	$13.4	$33.0
2010	$21.6	$214.2	$96.8	$12.3	$31.3
2011	$22.2	$202.0	$96.6	$12.2	$30.1
2012	$22.9	$223.1	$91.5	$12.0	$30.1
2013	$23.9	$230.2	$91.4	$12.5	$31.0

Values in Millions

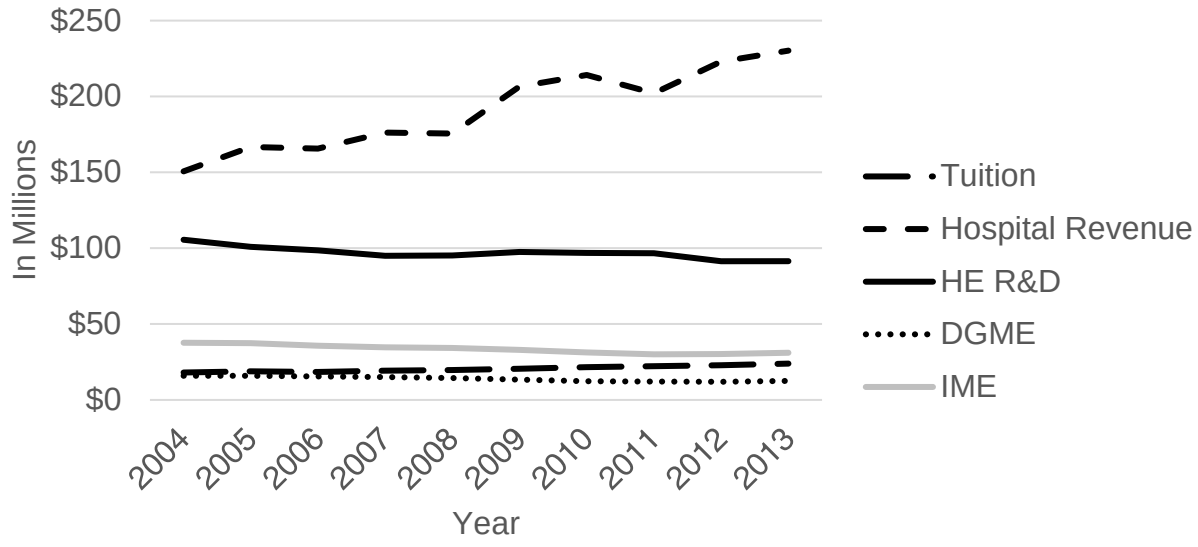

Figure 7. The general pattern of revenues for medical schools (all MD medical schools in sample) in a ten-year period. Values are adjusted to inflation (2013 dollars), normalized to FTE and in millions.

Table 12

Percentage share of financial support – All MD medical schools in sample

Year	Tuition (%Tot)	Hospital Revenue (%Tot)	HE R&D (%Tot)	DGME (%Tot)	IME (%Tot)
2004	5.51%	45.94%	32.20%	4.85%	11.49%
2005	5.57%	49.04%	29.68%	4.68%	11.03%
2006	5.49%	49.63%	29.52%	4.64%	10.73%
2007	5.68%	51.81%	27.89%	4.41%	10.21%
2008	5.78%	51.79%	28.07%	4.24%	10.12%
2009	5.54%	55.64%	26.30%	3.61%	8.91%
2010	5.74%	56.94%	25.74%	3.27%	8.32%
2011	6.11%	55.64%	26.61%	3.36%	8.28%
2012	6.04%	58.77%	24.09%	3.15%	7.94%
2013	6.15%	59.16%	23.50%	3.21%	7.98%

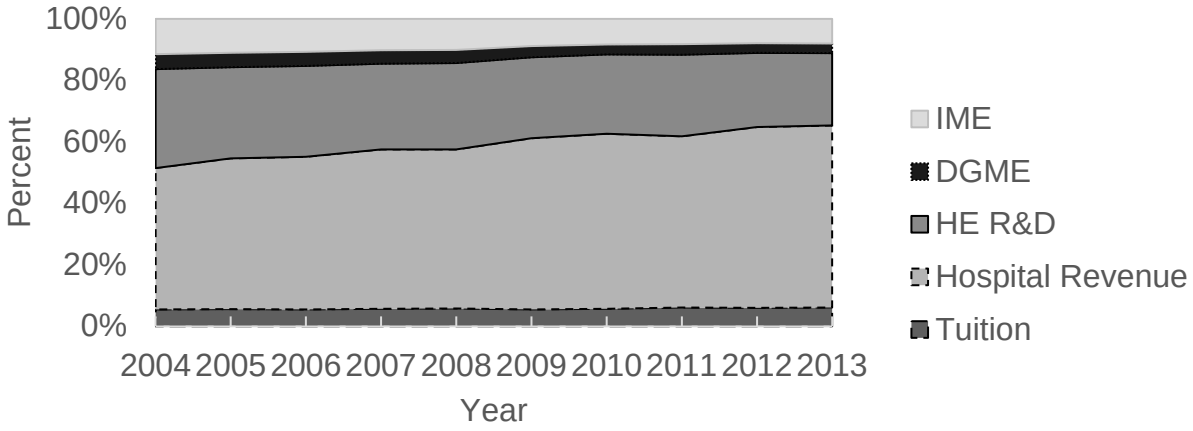

Figure 8. The general pattern of revenues for all MD medical schools in sample in a ten-year period shown by percentage share of total. Values are adjusted to inflation (2013 dollars), normalized to FTE (full time student equivalent) and in millions.

Table 12 and Figure 8 particularly shows the percentage share of these five sources and how they have changed in ten years. The most change that has occurred in 10 years is the increase of hospital revenue which is taking up the share in the decline of HE R&D revenues. Specifically the changes in the percentage share of revenues, not total dollars, include increases in tuition (.64%), hospital revenues (13.22%), and declines in HE R&D (-8.7%), direct GME (-1.64%), and indirect GME (3.51%). One should consider the differences between Table 11 and 12, as absolute dollars have increased per year in all sources of revenue, but the share percentages in where revenues are derived are shifting. This shows us a case of costs are rising rapidly, but revenue sources have shifted in varying directions. Due to the decline in direct government support, there is an increase of alternative sources of revenue taking over a share of the total, which is reflective of changes that are happening in traditional colleges and universities (Slaughter & Leslie, 1997).

From this sample, it reflects the changes that have been noted by the AAMC in how the share of medical school revenues have shifted in the past decade (AAMC, 2015a). Medical schools are indeed becoming more resource dependent due to the decline in public sources of funding (Archibald & Feldman, 2010).This is somewhat analogous to funding within traditional universities as public sources of revenue are declining and alternative private sources of funding are making up for the decline (Clark, 1986; Weisbrod et al., 2008).

A further analysis of HE R&D funding by source (table 13 and14) shows a particular decline in federal HE R&D funds as a total, even as state and local HE R&D, business HE R&D, and other HE R&D have remained relatively stable. Institutional HE

R&D for the medical schools in the sample have increased slightly. This means that institutions are investing more toward their research and development funds. Upon delving in what constitutes “institutional higher education R&D funding” from the IPEDS definition, these funds are derived from unrestricted funding budgeted for organized research which includes cost sharing and indirect costs that are unrecovered. This unrecovered rate are the costs that are incurred doing externally funded R&D but not recovered (IPEDS, n.d.). How these unrecovered costs are paid for would be generally hard to estimate where are they truly coming from, but could be from student tuition, contracts, licenses, etc.

Table 13

Mean Characteristics of Higher Education R&D (in Millions): All MD Medical Schools in Sample

Year	Federal HERD	State & Local HERD	Business HERD	Institutional HERD	Other HERD
2004	$72.8	$4.6	$6.5	$10.8	$10.9
2005	$70.0	$4.0	$5.6	$11.0	$10.3
2006	$68.4	$2.8	$4.9	$11.4	$11.1
2007	$63.6	$2.7	$5.3	$11.9	$11.4
2008	$62.2	$2.8	$5.3	$13.0	$11.9
2009	$62.6	$2.8	$5.3	$14.5	$12.4
2010	$65.0	$3.3	$4.7	$12.8	$11.1
2011	$64.9	$3.6	$4.2	$13.6	$10.3
2012	$57.9	$3.5	$4.2	$15.5	$10.3
2013	$56.9	$3.3	$4.2	$16.7	$10.3

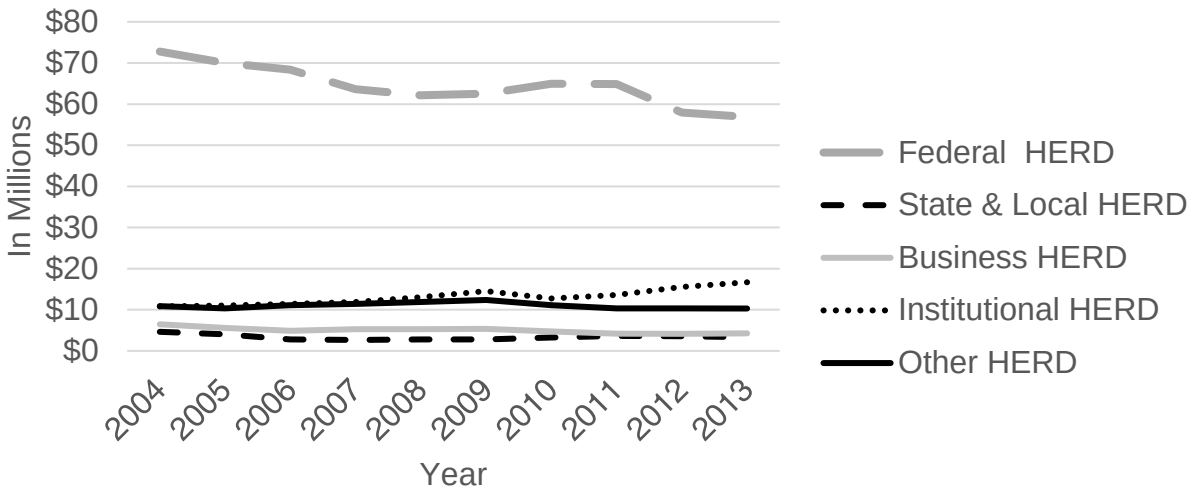

Figure 9. Higher education R&D (in millions) by type – All MD medical schools in sample

Table 14

The Percentage Share of Total Changes of HE R&D between 2004-2013 for all MD Medical Schools in Sample

Year	Federal (%Tot)	State & Local (%Tot)	Business (%Tot)	Institutional (%Tot)	Other (%Tot)
2004	67.3%	4.7%	6.2%	12.5%	9.3%
2005	68.1%	3.7%	5.9%	13.3%	9.0%
2006	68.8%	2.8%	5.8%	13.3%	9.3%
2007	65.8%	2.8%	5.9%	15.2%	10.4%
2008	63.3%	2.7%	5.8%	17.1%	11.1%
2009	62.4%	2.8%	5.6%	18.2%	10.9%
2010	65.6%	4.8%	5.1%	14.6%	9.9%
2011	66.6%	5.3%	4.7%	14.4%	9.0%
2012	63.6%	4.8%	4.7%	17.3%	9.6%
2013	63.2%	4.4%	4.6%	17.5%	10.3%

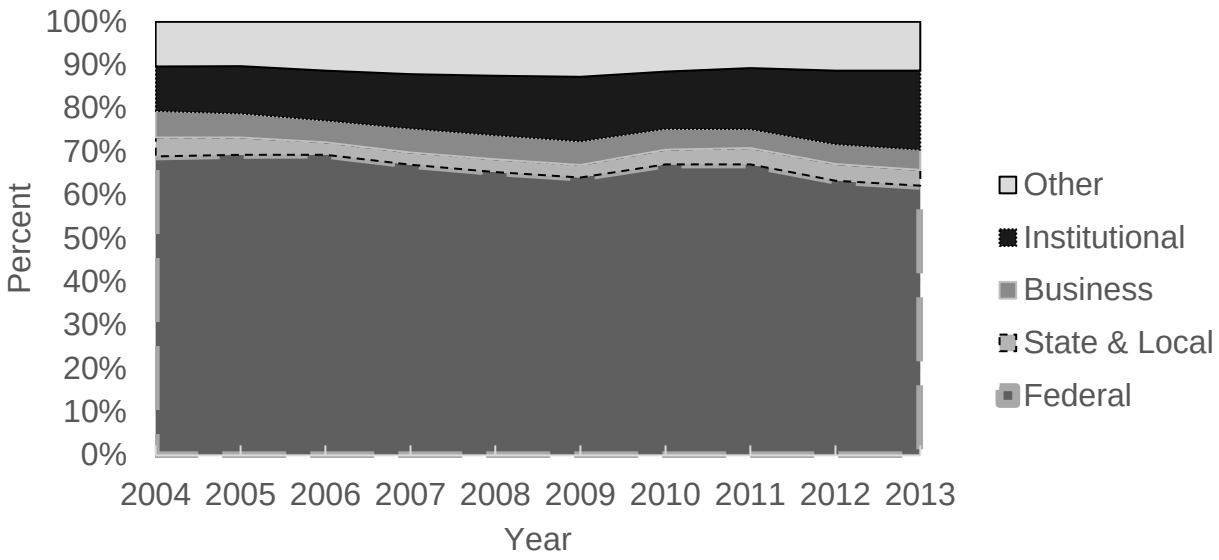

Figure 10. The general pattern of the different types of higher education research and development funds for medical schools in a ten-year period by percentage share. Values are adjusted to inflation (2013 dollars), normalized to FTE (full time student equivalent) and in millions.

Finally, an analysis of federal funding which is derived from graduate medical education costs which are provided by Medicare are shown in the figure 15 below. This shows that GME funding has declined in the past 10 years. Although Medicare has stated that they have maintained relatively stable funding toward graduate medical education (Ighehart, 2013), this shows that as a whole for the medical schools in my sample that it has declined. Although the focus of this dissertation is on independent, non-university based medical schools, this may suggest that the share of the funding may be going towards affiliated university-based medical schools. This is shows further stratification that occurs between institutions which is analogous to what occurs between research institutions in the U.S. (Slaughter & Taylor, 2015). Or this may be perhaps that organizational segmentation is occurring within independent, non-university affiliated medical schools realizing that direct and indirect medical education

funding is less valued than others. This organizational segmentation exists for traditional colleges and universities valuing particular sources of revenues more than others (Rosinger et al., 2016; Taylor et al., 2013).

Table 15

Mean Characteristics of Direct and Indirect Graduate Medical Education Funding (in Millions): All MD Medical Schools In Sample

Year	DGME	IME	DGME/IME
2004	$15.9	$37.7	$53.6
2005	$15.9	$37.5	$53.4
2006	$15.5	$35.8	$51.3
2007	$15.0	$34.8	$49.8
2008	$14.4	$34.3	$48.7
2009	$13.4	$33.0	$46.4
2010	$12.3	$31.3	$43.6
2011	$12.2	$30.1	$42.3
2012	$12.0	$30.1	$42.1
2013	$12.5	$31.0	$43.5

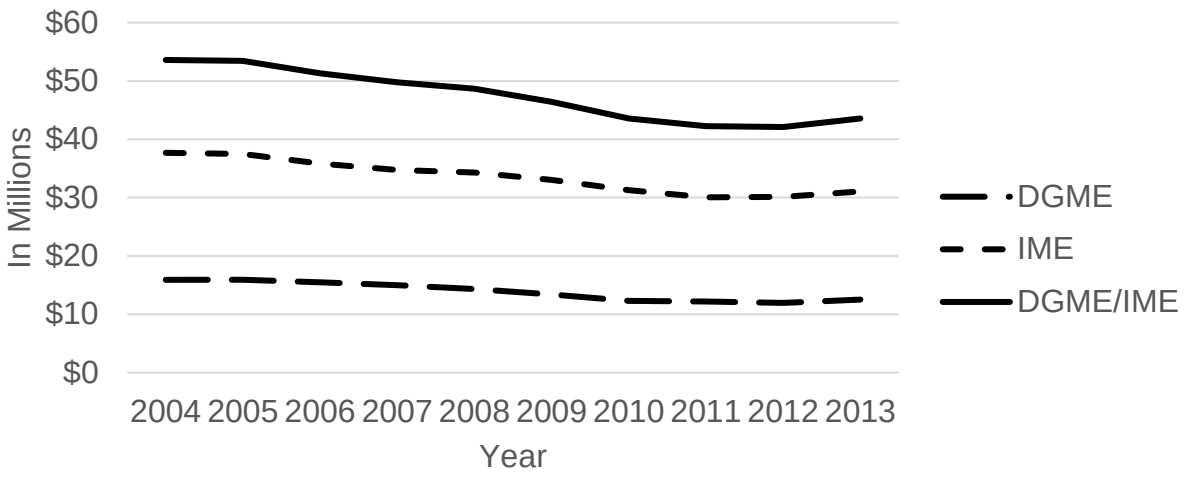

Figure 11. The general pattern of funding of direct graduate medical education, indirect medical education, and the sum of direct graduate medical education and indirect medical education for medical schools in a ten-year period. Values are adjusted to inflation (2013 dollars), normalized to FTE (full time student equivalent) and in millions.

Next a specific analysis by private/public MD-granting independent, non-university medical schools are provided to show the specific differences by private MD-granting institutions and public MD-granting institutions.

Private MD-Granting Medical School Revenues

For private medical school revenues, these types of medical schools have seen an increasing reliance on hospital revenues, particularly in the past five years going from approximately 40% of the total to 50% of the total (Table 17, Figure 12). Particularly looking at the decline of higher education R&D dollars, overall it seems to be a change of approximately 8% between 2004-2013, but delving closer into the various types of HE R&D, a unique profile emerges. As the decline of federal R&D funding has occurred, the institutional R&D has taken its place (Table 19; Figure 15). Institutions are having to invest their own R&D funding to make up for the decline in public funding that comes from the federal government for R&D. Also a theory could be at play here which the costs of doing R&D may have increased, but the federal government is not able to pay actual costs of doing R&D research; therefore institutional R&D is having more of a role in funding higher education R&D.

Table 16

Mean Characteristics of Financial Support (in Millions): All Private MD Medical Schools in Sample

Year	Tuition	Hospital Revenue	HE R&D	DGME	IME
2004	$26.4	$149.1	$120.7	$31.4	$72.9
2005	$26.2	$149.7	$113.2	$31.2	$72.2
2006	$24.2	$135.6	$112.7	$30.6	$69.9
2007	$25.8	$152.3	$104.7	$29.4	$67.5
2008	$25.3	$145.8	$96.5	$28.1	$66.9
2009	$26.6	$194.9	$97.9	$26.0	$63.0
2010	$27.4	$206.2	$96.3	$23.5	$59.6
2011	$27.9	$205.3	$97.1	$23.1	$57.0
2012	$28.7	$200.0	$90.7	$22.3	$56.2
2013	$30.2	$205.5	$93.5	$23.8	$59.2

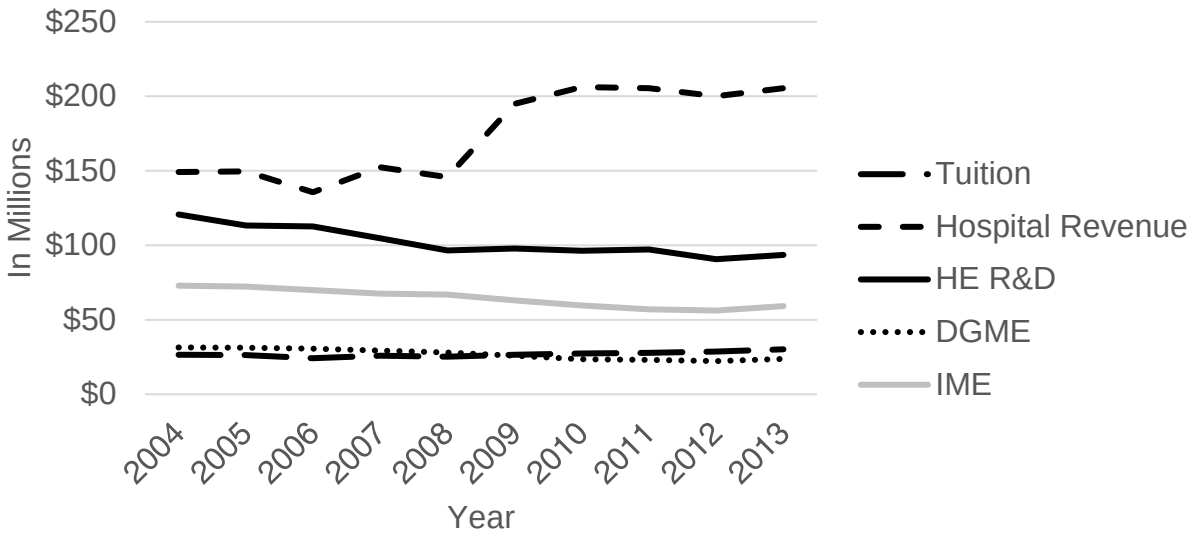

Figure 12. The general pattern of revenues for medical schools (all private MD medical schools in sample) in a ten-year period. Values are adjusted to inflation (2013 dollars), normalized to FTE and in millions.

Table 17

Percentage Share of Financial Support: All Private MD Medical Schools in Sample

Year	Tuition (%Tot)	Hospital Revenue (%Tot)	HE R&D (%Tot)	DGME (%Tot)	IME (%Tot)
2004	6.60%	37.22%	30.13%	7.85%	18.20%
2005	6.68%	38.13%	28.84%	7.95%	18.40%
2006	6.49%	36.36%	30.21%	8.19%	18.74%
2007	6.80%	40.10%	27.58%	7.74%	17.78%
2008	6.99%	40.20%	26.60%	7.75%	18.46%
2009	6.51%	47.73%	23.97%	6.36%	15.43%
2010	6.64%	49.91%	23.32%	5.69%	14.43%
2011	6.79%	50.03%	23.66%	5.64%	13.88%
2012	7.21%	50.27%	22.79%	5.60%	14.13%
2013	7.33%	49.87%	22.68%	5.77%	14.36%

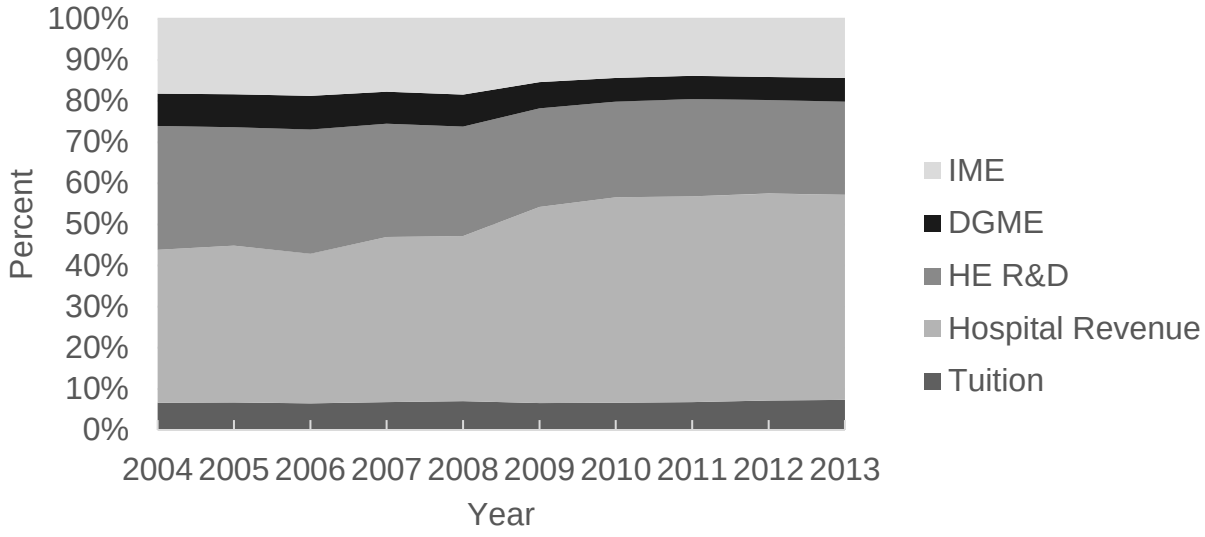

Figure 13. The general pattern of the different types of higher education research and development funds for private MD-granting medical schools in a ten-year period by percentage share. Values are adjusted to inflation (2013 dollars), normalized to FTE (full time student equivalent) and in millions.

Table 18

Mean Characteristics of Higher Education R&D (in Millions): All Private MD Medical Schools in Sample

Year	Federal HERD	State & Local HERD	Business HERD	Institutional HERD	Other HERD
2004	$89.7	$2.0	$8.6	$10.5	$9.8
2005	$85.1	$1.7	$6.5	$10.5	$9.5
2006	$83.3	$1.5	$5.2	$11.5	$11.2
2007	$75.3	$1.5	$5.3	$11.9	$10.7
2008	$69.7	$1.0	$4.6	$11.0	$10.0
2009	$69.3	$1.3	$4.3	$12.1	$11.0
2010	$70.4	$1.3	$4.5	$10.5	$9.6
2011	$68.3	$1.9	$4.0	$14.1	$8.8
2012	$59.9	$2.2	$4.1	$16.0	$8.4
2013	$60.7	$1.7	$4.7	$18.3	$8.2

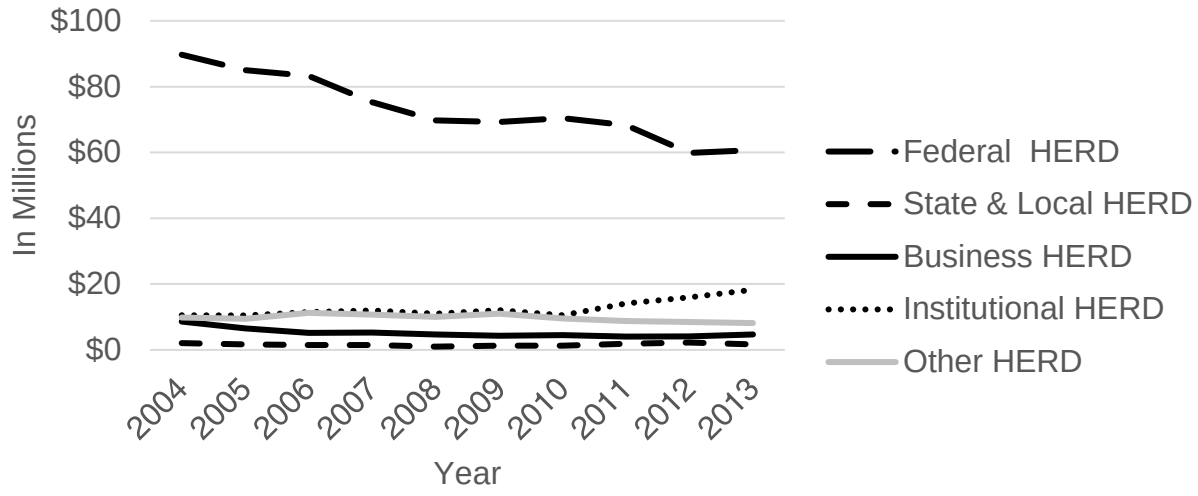

Figure 14. Mean characteristics of higher education R&D (in millions) – All private MD medical schools in sample

Table 19

Percentage Share of Total Changes of Higher Education R&D between 2004-2013 for All Private MD Medical Schools in Sample

Year	Federal (%Tot)	State & Local (%Tot)	Business (%Tot)	Institutional (%Tot)	Other (%Tot)
2004	76.8%	1.5%	6.8%	8.4%	6.5%
2005	78.2%	1.5%	6.4%	8.3%	5.6%
2006	77.1%	1.5%	6.3%	9.2%	5.9%
2007	72.8%	1.5%	6.1%	12.6%	6.9%
2008	73.2%	1.1%	5.3%	12.3%	8.1%
2009	70.7%	1.8%	5.1%	13.6%	8.7%
2010	74.6%	1.5%	6.0%	9.9%	8.0%
2011	74.1%	1.6%	5.4%	11.5%	7.4%
2012	71.1%	1.9%	5.8%	14.0%	7.2%
2013	71.3%	1.3%	5.7%	13.6%	8.0%

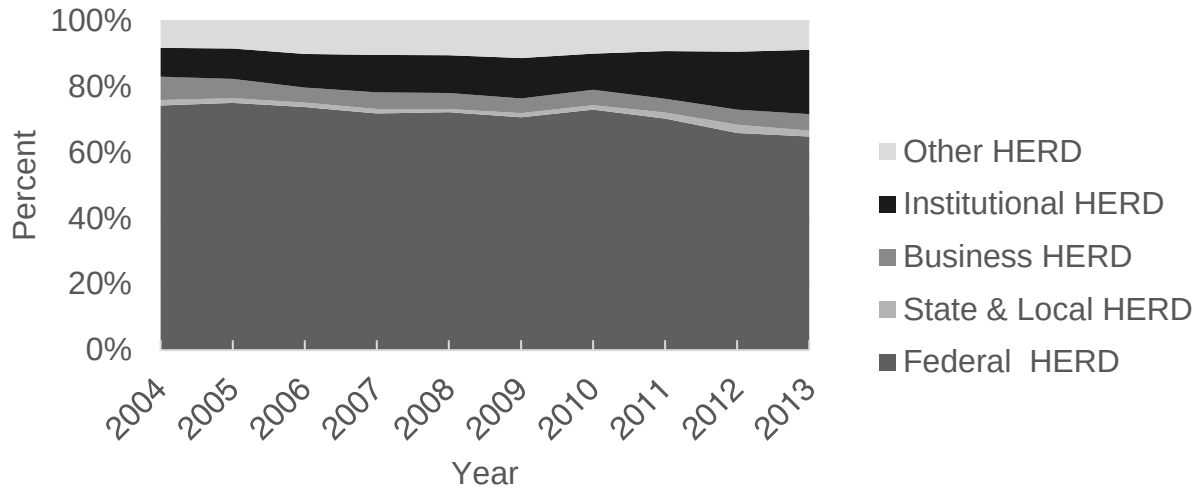

Figure 15. The general pattern of the different types of higher education research and development funds for private MD-granting medical schools in a ten-year period by percentage share. Values are adjusted to inflation (2013 dollars), normalized to FTE (full time student equivalent) and in millions.

Table 20

Mean Characteristics of Direct and Indirect Graduate Medical Education Funding (in Millions): All MD Private Medical Schools in Sample

Year	DGME	IME	DGME/IME
2004	$31.4	$72.9	$104.3
2005	$31.2	$72.2	$103.4
2006	$30.6	$69.9	$100.5
2007	$29.4	$67.5	$96.9
2008	$28.1	$66.9	$95.0
2009	$26.0	$63.0	$89.0
2010	$23.5	$59.6	$83.1
2011	$23.1	$57.0	$80.1
2012	$22.3	$56.2	$78.5
2013	$23.8	$59.2	$82.9

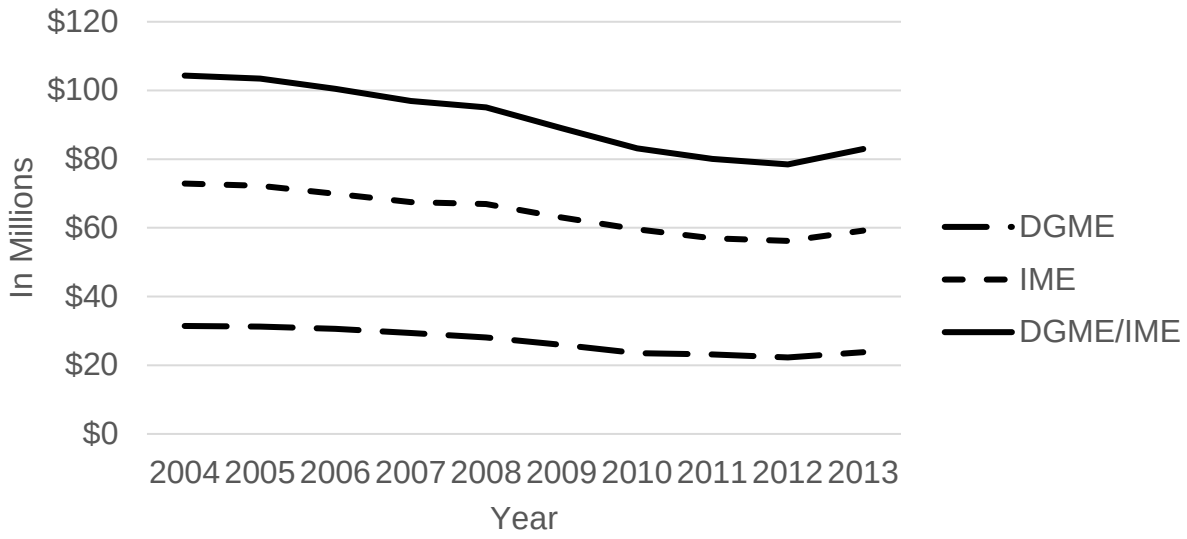

Figure 16. The general pattern of funding of direct graduate medical education, indirect medical education, and the sum of direct graduate medical education and indirect medical education for private MD-granting medical schools in a ten-year period. Values are adjusted to inflation (2013 dollars), normalized to FTE (full time student equivalent) and in millions.

Finally, funding from Medicare on direct GME and IME has shown to have a decline from $104.3 million to $82.9 million. Considering the decline in federal funding, shows alternative sources of revenue are likely needed to make up for this loss (Slaughter & Leslie, 1997). This finding of the decline in DGME and IME funding for private institutions is a concern, with considering where is this loss of funding going to be replaced with as competitive pressures limit funding opportunities?

Public MD-Granting Medical School Revenues

For public MD-granting medical schools, similarities exist with private MD-granting medical schools that hospital revenues are making up for a larger share of the total revenue and approximately equal by percentage (12.5% more between 2004 and 2013 for private MD institutions; 11.6% for public MD institutions). However, the difference between public institutions relying more on hospital revenues is much higher as it seems that private medical schools have a larger share of funding in DGME and IME funding that public medical schools do not have. Although the demographics for the average number of residencies is addressed in Research Question 2, there is not a large difference in the average number of residencies by private (176.8) and public (187.9) schools. However this discrepancy in DGME and IME funding could be explained by the FTE of medical school classes which public medical schools may have higher enrollments than private medical schools.

Table 21

Mean Characteristics of Financial Support (in Millions): All Public MD Medical Schools in Sample

Year	Tuition	Hospital Revenue	HE R&D	DGME	IME
2004	$12.3	$151.7	$95.2	$5.3	$13.6
2005	$14.0	$178.5	$92.6	$5.5	$13.8
2006	$14.3	$186.3	$88.9	$5.2	$12.5
2007	$14.9	$192.7	$88.1	$5.2	$12.3
2008	$15.7	$195.9	$94.2	$4.9	$12.0
2009	$16.5	$214.4	$97.4	$4.8	$12.5
2010	$17.6	$219.6	$97.1	$4.6	$11.9
2011	$18.3	$199.8	$96.3	$4.7	$11.6
2012	$19.0	$239.0	$92.0	$4.9	$12.3
2013	$19.7	$247.1	$90.1	$4.8	$11.8

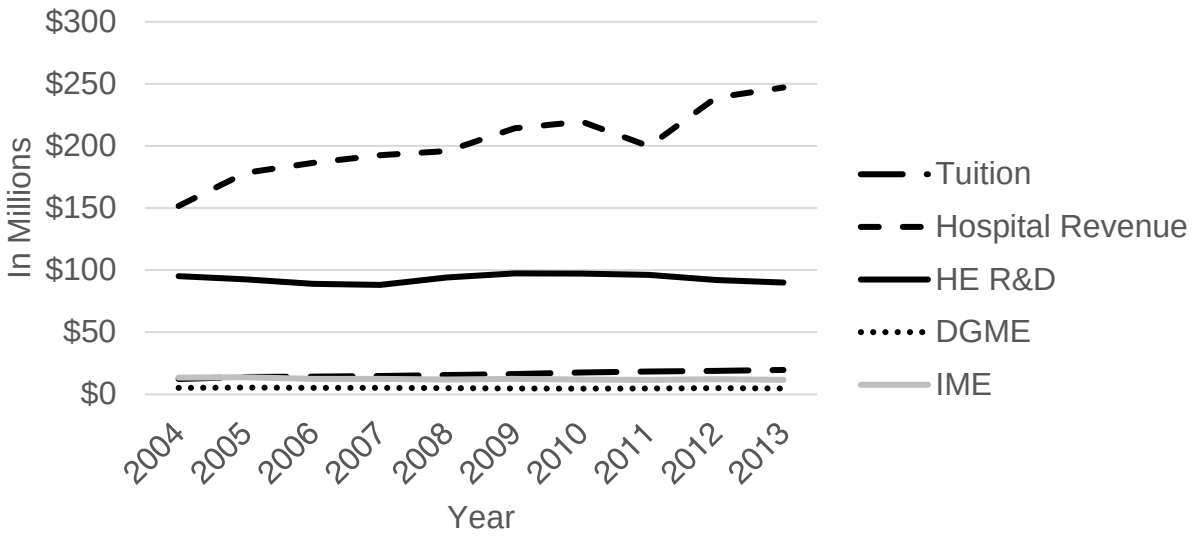

Figure 17. The general pattern of revenues for medical schools (all public MD medical schools in sample) in a ten-year period. Values are adjusted to inflation (2013 dollars), normalized to FTE and in millions.

Table 22

Percentage Share of Financial Support: All Public MD Medical Schools in Sample

Year	Tuition (%Tot)	Hospital Revenue (%Tot)	HE R&D (%Tot)	DGME (%Tot)	IME (%Tot)
2004	4.44%	54.54%	34.23%	1.90%	4.89%
2005	4.60%	58.66%	30.42%	1.79%	4.52%
2006	4.66%	60.66%	28.94%	1.68%	4.07%
2007	4.75%	61.52%	28.14%	1.65%	3.94%
2008	4.85%	60.70%	29.20%	1.53%	3.71%
2009	4.76%	62.03%	28.19%	1.39%	3.63%
2010	5.01%	62.60%	27.68%	1.31%	3.40%
2011	5.53%	60.40%	29.13%	1.43%	3.52%
2012	5.18%	65.07%	25.06%	1.33%	3.36%
2013	5.26%	66.18%	24.11%	1.29%	3.16%

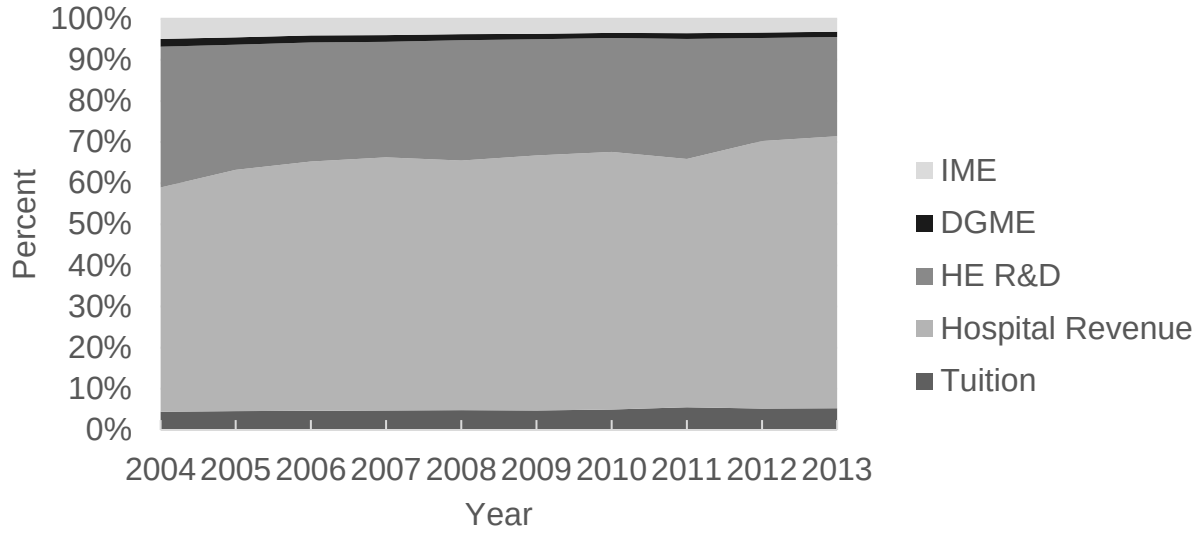

Figure 18. The general pattern of the different types of higher education research and development funds for public MD medical schools in a ten-year period by percentage share. Values are adjusted to inflation (2013 dollars), normalized to FTE (full time student equivalent) and in millions.

Table 23

Mean Characteristics of Higher Education R&D (in Millions): All Public MD Medical Schools in Sample

Year	Federal HERD	State & Local HERD	Business HERD	Institutional HERD	Other HERD
2004	$61.2	$6.4	$5.0	$11.0	$11.6
2005	$59.6	$5.6	$5.0	$11.4	$10.9
2006	$58.1	$3.7	$4.7	$11.3	$11.0
2007	$55.6	$3.5	$5.2	$11.9	$11.9
2008	$57.0	$4.0	$5.7	$14.4	$13.1
2009	$58.0	$3.9	$6.0	$16.2	$13.3
2010	$61.2	$4.6	$4.8	$14.3	$12.2
2011	$62.5	$4.9	$4.3	$13.3	$11.4
2012	$56.6	$4.4	$4.2	$15.2	$11.6
2013	$54.3	$4.4	$4.0	$15.6	$11.8

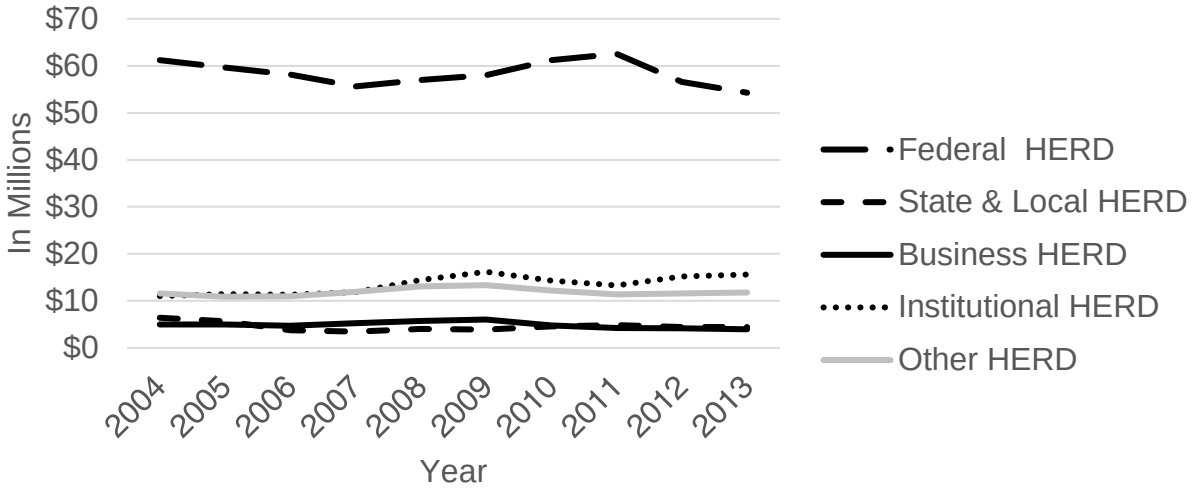

Figure 19. Mean characteristics of higher education R&D (in millions) – All public MD medical schools in sample

Table 24

Percentage Share of Total Changes of Higher Education R&D between 2004-2013 for All Public MD Medical Schools in Sample

Year	Federal (%Tot)	State & Local (%Tot)	Business (%Tot)	Institutional (%Tot)	Other (%Tot)
2004	61.1%	6.8%	5.8%	15.2%	11.1%
2005	61.7%	5.1%	5.6%	16.5%	11.2%
2006	63.4%	3.7%	5.4%	16.0%	11.5%
2007	61.3%	3.6%	5.7%	16.8%	12.6%
2008	57.2%	3.7%	6.1%	20.1%	12.9%
2009	57.3%	3.5%	5.8%	21.1%	12.3%
2010	60.1%	6.9%	4.6%	17.4%	11.1%
2011	62.0%	7.6%	4.2%	16.1%	10.1%
2012	59.0%	6.5%	4.1%	19.3%	11.1%
2013	58.2%	6.2%	3.9%	19.9%	11.7%

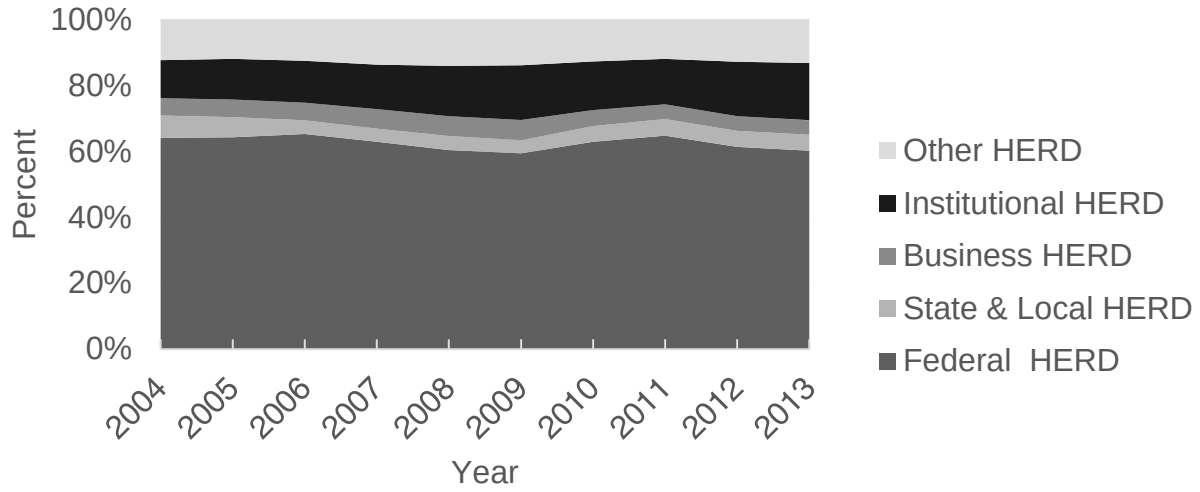

Figure 20. The general pattern of the different types of higher education research and development funds for public MD-granting medical schools in a ten-year period by percentage share. Values are adjusted to inflation (2013 dollars), normalized to FTE (full time student equivalent) and in millions.

One particularly interesting difference which makes sense knowing the type of institution is the share of state and local R&D provided to institutions by type. Private medical schools receive only a small share of state and local R&D (1.1-1.9%) versus public medical schools (3.5-7.6%) during 2004-2013. Yet, private medical schools get this lack of funding from the state and local R&D from the federal government making up a larger percentage of the R&D total.

Table 25

Mean characteristics of direct and indirect graduate medical education funding (in millions) – All public MD medical schools in sample

Year	DGME	IME	DGME/IME
2004	$5.3	$13.6	$18.9
2005	$5.5	$13.8	$19.2
2006	$5.2	$12.5	$17.7
2007	$5.2	$12.3	$17.5
2008	$4.9	$12.0	$16.9
2009	$4.8	$12.5	$17.3
2010	$4.6	$11.9	$16.5
2011	$4.7	$11.6	$16.4
2012	$4.9	$12.3	$17.2
2013	$4.8	$11.8	$16.6

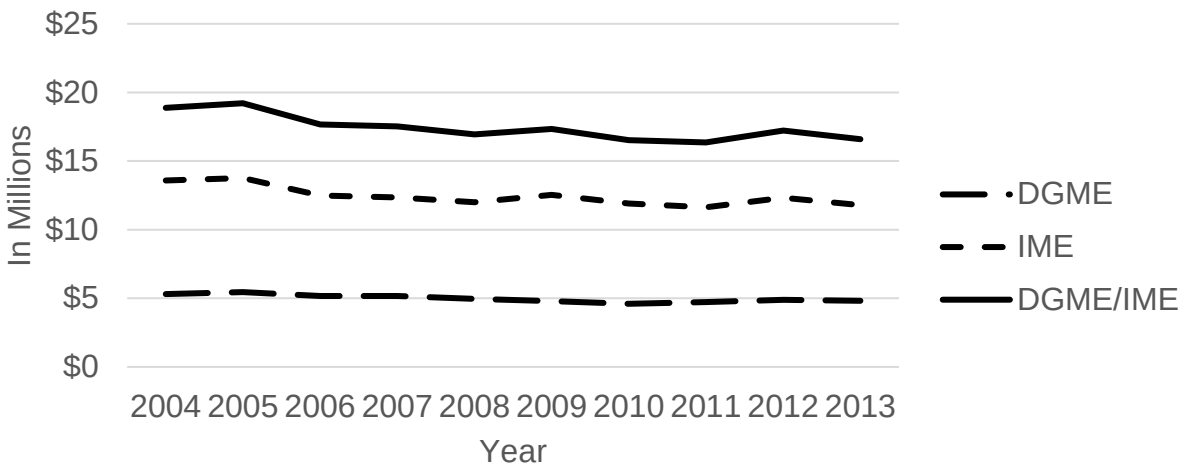

Figure 21. The general pattern of funding of direct graduate medical education, indirect medical education, and the sum of direct graduate medical education and indirect medical education for private MD-Granting medical schools in a ten-year period. Values are adjusted to inflation (2013 dollars), normalized to FTE (full time student equivalent) and in millions.

Finally, the funding of direct graduate medical education and indirect medical education is particularly interesting when comparing private and public medical schools. Earlier this was discussed but on average private medical schools received approximately $80.1 to $104.3 million versus public medical schools receiving only $16.4 to $18.9 million. However, this discrepancy could be explained as the raw DGME and IME values were divided by FTE. Table 29 shows that for the study sample, public medical schools enroll almost double FTE enrollments (3,200) versus private medical school classes (1,813). Therefore, descriptives here provide some insights in the data and funding, but Research Question 3, a specific model was analyzed which split the analysis by private and public institution. This will help bring to light if that these differences in funding by private and public medical schools do make differences in the number of medical residencies available.

Research Question 2

RQ2: Has the number of residency positions increased over the past 10 years even as Medicare-funded residency positions have remained relatively constant?

The number of residency positions funded by Medicare has remained the same for residency programs and teaching hospitals since the Medicare residency caps were put into place due to the Balanced Budget Act of 1997 by Congress (Dower, 2012; Ighehart, 2013). The number of residencies funded by Medicare has remained the same, except for rare exceptions that occur when hospitals close, if hospital systems share FTE residents, and other special circumstances, which shift and reallocate those free spots to existing open hospitals.

Table 26 shows the total number of medical residency positions available and Table 27 shows the average number of medical residency positions available per medical school. Currently MD institutions are provided, as the American Osteopathic Association which houses osteopathic medical school data is unable to provide the number of residency positions per medical school at this time. Overall, as a whole, both private and public medical school residency positions have increased in the past 10 years.

Table 28 provides the number values of residency positions available, with the difference after each year, and the percent difference. Further, the five year and ten year change are also provided. During 2004-2008, a five year period, there were a total of 358 more residency positions which was an increase of 8.04 percent. Within ten years (2004-2013), 1,330 more residency positions were available between this time period, which was a 29.97 percent increase from 2004-2013. This shows that there is a substantial increase in the number of residency positions within the past ten years, but

markedly so within the last five years. Therefore, medical schools are increasing the number of residency positions even as Medicare-funded residencies have remained constant which shows medical schools are indeed increasing residency spots even as no extra funding is coming from the federal government.

Table 26

Total Number of Medical Residency Positions

	Private	Public	Grand Total
2004	1612	2616	4228
2005	1634	2686	4320
2006	1697	2787	4484
2007	1662	2846	4508
2008	1668	2904	4572
2009	1727	2915	4642
2010	1766	3056	4822
2011	1809	3177	4986
2012	1845	3289	5134
2013	1945	3571	5516

Table 27

Average Number of Medical Residency Spots (per Institution)

	Private	Public	Grand Avg
2004	146.5	137.7	140.9
2005	148.5	141.4	144.0
2006	154.3	146.7	149.5

(table continues)

Table 27 (*cont*.)

	Private	Public	Grand Avg
2007	151.1	149.8	150.3
2008	151.6	152.8	152.4
2009	157.0	153.4	154.7
2010	160.5	160.8	160.7
2011	164.5	167.2	166.2
2012	167.7	173.1	171.1
2013	176.8	187.9	183.9

Table 28

Total Number of Residencies, Difference from Previous Year, and Percent Increase

Year	Total Number of Residencies	Difference (from Previous Year)	Percent Increase
2004	4228		
2005	4320	92	2.18%
2006	4484	164	3.80%
2007	4508	24	0.54%
2008	4572	64	1.42%
2009	4642	70	1.53%
2010	4822	180	3.88%
2011	4986	164	3.40%
2012	5134	148	2.97%
2013	5516	382	7.44%
5 Year	2004-2008	344	8.14%
10 Year	2004-2013	1288	30.46%

The next question to be considered with all these disparate enrollment figures is looking at whether the number in the increase of medical residency positions keeping pace with the number of students entering medical school and the number of medical school graduates? Table 29 provides the total number of medical student enrolled per year, table 30 provides the average number of medical students enrolled per institution. Tables 31 and 32 provide the total number of medical school graduates per year and the average number of medical school graduates per institution.

Comparing national values of increases in medical school enrollments, as total enrollments between 2002-2014 have increased by 23% (AAMC 2013c), for the sample of independent MD-granting, non-university affiliated medical schools, the increase is much more modest at 11.6% between 2004-2013.

Table 29

Total Number of Medical Students Enrolled

	Private	Public	Grand Total
2004	1691	2801	4492
2005	1697	2830	4527
2006	1739	2934	4673
2007	1775	3011	4786
2008	1802	3037	4839
2009	1796	3074	4870
2010	1811	3109	4920
2011	1818	3138	4956
2012	1816	3177	4993
2013	1813	3200	5013

Table 30

Average Number of Medical Students Enrolled (per Institution)

	Private	Public	Average
2004	153.7	147.4	150.6
2005	154.3	148.9	151.6
2006	158.1	154.4	156.3
2007	161.4	158.5	159.9
2008	163.8	159.8	161.8
2009	163.3	161.8	162.5
2010	164.6	163.6	164.1
2011	165.3	165.2	165.2
2012	165.1	167.2	166.2
2013	164.8	168.4	166.6

Table 31

Total Number of Medical Students Graduated

	Private	Public	Total
2004	1610	2734	4344
2005	1625	2748	4373
2006	1625	2761	4386
2007	1619	2797	4416
2008	1688	2780	4468
2009	1682	2843	4525
2010	1691	2910	4601
2011	1745	2947	4692
2012	1756	2993	4749
2013	1784	3115	4899

Table 32

Average Number of Medical Students Graduated (per Institution)

	Private	Public	Average
2004	146.4	143.9	145.1
2005	147.7	144.6	146.2
2006	147.7	145.3	146.5
2007	147.2	147.2	147.2
2008	153.5	146.3	149.9
2009	152.9	149.6	151.3
2010	153.7	153.2	153.4
2011	158.6	155.1	156.9
2012	159.6	157.5	158.6
2013	162.2	163.9	163.1

By taking the number of medical school enrollments, the number of medical school graduates and the number of medical school residency positions available, Figure 5 provides the trend of the three measures, and shows the trend between 2004 and 2013. Around 2010, the number of residency positions exceeded the number of enrollment in medical school. This is a positive finding as concern exists whether or not there are enough residency positions available for students graduating from medical schools. However, there are some caveats as (1) although the number of graduates is lower than the number of medical residency positions available, this should be taken with caution as medical school graduates will not just choose residency within this particular sample of institutions. (2) Students who graduate from other medical schools not in the sample choose residencies within this sample of institutions. (3) There are

crosses that occur as DO medical school graduates choose to do MD sponsored residencies and vice versa. (4) Finally, considerations of foreign/international medical school graduates doing U.S. residencies are not considered in this analysis.

Table 33

Incoming Medical Student Class Enrollment (First Year), Number of Medical School Graduates, and the Number of Medical Residencies Available per Year

Year	MD Enrollment	MD Graduates	Residency Positions
2004	4492	3201	4228
2005	4527	3261	4320
2006	4673	3386	4484
2007	4786	3485	4508
2008	4839	3522	4572
2009	4870	3576	4642
2010	4920	3623	4822
2011	4956	3680	4986
2012	4993	3861	5134
2013	5013	3887	5516
5 Year Change (2004-2008)	7.7%	10.0%	8.1%
10 Year Change (2004-2013)	11.6%	21.4%	30.5%

Note. Values are totaled for each medical school in the sample.

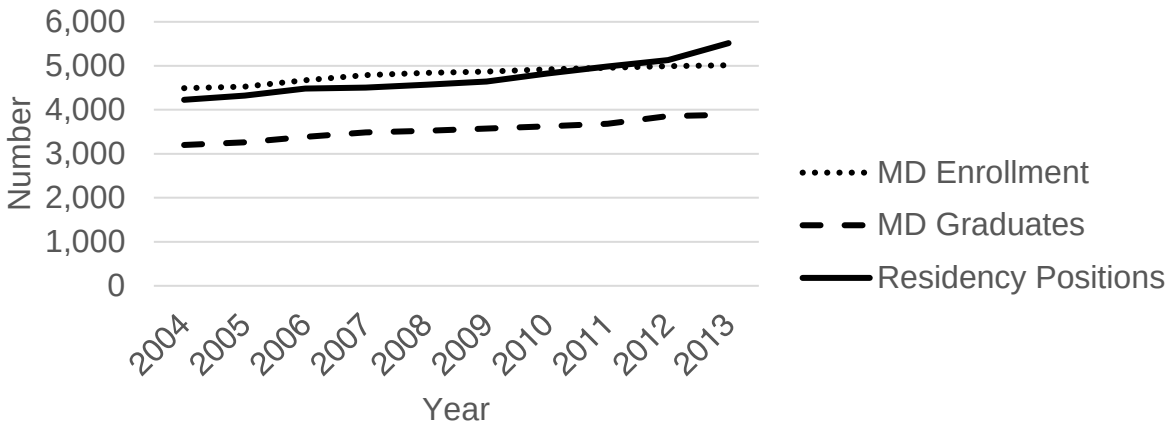

Figure 22. The trend of incoming medical student class enrollment (first year), number of medical school graduates, and the number of medical residencies available per year. Values are totaled for each medical school in the sample.

Overall, Research Question 2 shows that the number of residency positions has increased during a 10 year time period. Further, medical school enrollment, medical school graduates, and the number of available medical residency positions have increased, even as the number of Medicare funding has led to a set number of medical residency positions and medical schools fulfilling the demand through some other mechanism. Therefore as the increase of enrollments, graduates, and residency positions have indeed increased, one should explore if medical school finances have increased accordingly or may be funded by an alternative funding mechanisms which was conducted within Research Question 3.

Research Question 3

RQ3: What university and medical school characteristics have predicted variation in the number of residency spots at university-based medical schools over time?

For Research Question 3, prior to analyses, the data was tested for serial correlation (autocorrelation) between the variables. Serial correlation occurs in panel

data analyses when the error terms repeat and carry over to subsequent time periods. In other words, this is correlation over time. In order to test this, a Woolridge test for serial correlation was conducted as this is the method used for panel analyses (Wooldridge, 2002). The statistical test was conducted by using the STATA command xtserial (Drukker, 2003). The results of this tests suggests my dataset has serial correlation $F(1,31) = 16.829$, $Prob>F = .0003$.

Next, the test for heteroscedasticity was conducted which tests how the dependent variable's variances are unequal across the measure of independent variables. The estimate of the independent variables and the dependent variable will be unbiased, but caution will be needed as the standard errors calculated and results of the hypothesis tests could be wrong, creating type II errors. To test for this, a Modified Wald test for groupwise heteroscedasticity was used using the STATA command xttest3 (Baum, 2001). Results: χ^2 (32) = 7150.73. Prob χ^2 = .0000 therefore the test found that heteroscedasticity is present in my dataset.

There are multiple ways to control for serial correlation and/or heteroscedasticity. Running a panel analysis using heteroscedasticity-robust standard errors corrects for heteroscedasticity but not serial correlation. To correct for both, using Driscoll and Kraay standard errors was appropriate (Hoechle, 2007). This program estimates pooled ordinary least-squares regression and fixed-effects regression models and also takes into account cross-sectional dependence for small balanced panel data sets. Driscoll and Kraay standard errors provide serial correlation and heteroscedasticity-consistent robust standard errors (Driscoll & Kraay, 1998). Also they are robust to cross sectional

and temporal dependence that exists in this sample. Table 12 shows the differences in regression model specifics and the differences in standard errors and significance.

There were three models for Research Question 3 that were tested. Model 1 took five main sources of revenue: tuition, hospital services revenue, total higher education research and development funding (HE R&D), direct graduate medical education funding, and indirect graduate medical education funding. DGME and IME are federal funding sources provided by Medicare.

Model 1

For Model 1, results have found that for every $1000 per FTE increase in tuition revenue, approximately two residency positions are created ($p<0.01$). Also the value of hospital revenue was present as for every $16,474 per FTE increase in hospital service revenue, approximately one residency position is created ($p<0.01$). However, caution should be taken with the meaning of the significance of hospital service revenue generating medical school residency positions. One needs to consider the nature of revenues and expenditures increase relative to one another. Assuming that hospitals behave as non-profit entities, the slack funding that may be generated from revenues is likely to return to making up for rising expenditure for hospital care costs, rather than be used for alternative forms like the creation of new residency positions. Research suggests that the high cost of teaching hospitals and the rise of managed care and market competition seems to compromise graduate medical education and the academic mission of teaching hospitals (Mechanic, Coleman, and Dobson, 1998).

Table 34

Fixed Effects Panel Analysis using Driscoll-Kraay Standard Errors for Model 1: Main Sources of Revenue

Variables	Number of Residencies
Tuition	2.047***
	(-0.563)
Hospital Revenue	0.0607***
	(-0.0122)
Higher Ed R&D	-0.0323
	(-0.0955)
DME Total	0.0523
	(-0.285)
IME Total	-0.158
	(-0.131)
Constant	109.2***
	(-6.069)
Number of Observations	320
Number of Groups	32

*** p<0.01, ** p<0.05, * p<0.1, Standard errors in parentheses

Model 2

Model 2 took the same five main sources of revenue, tuition, hospital services revenue, total higher education research and development funding (HE R&D), direct graduate medical education funding, and indirect graduate medical education funding. The total R&D was split into its specific sources of R&D: federal, state and local, business, institutional, and other. For model 2, results indicate that for every $1000 per

FTE increase in tuition revenue, approximately two residency positions are created ($p<0.05$), which was approximately the same result given in Model 1. Also the value of hospital revenue was present as for every $26,738 per FTE increase in hospital service revenue, approximately one residency position is created ($p<0.01$). Even though no significant effects were found in the Total HE R&D, by splitting up the values into more specific funding sources provided some more insight into the effects of research funding on medical residency positions. For every $1,279 increase per FTE of state and local HE R&D, one residency position is created ($p<0.05$). Also for every $1,453 increase in institutional HE R&D, lead to one more residency position ($p<0.01$). Within these results, as mentioned above, unless hospital revenues slack dollars are highly available, which in this case is not, the available revenue will likely not go towards residency positions. Further, in Table 36, shows the percent distribution of higher education research funding by type and looking specifically at state and local higher education R&D, of the total, state and local R&D funding only makes up on average less than 5% of the total. Again, statistical significance may exist, but whether or not it would make a meaningful significance in the increase in the number of medical residency positions is unlikely.

Table 35

Fixed Effects Panel Analysis using Driscoll-Kraay Standard Errors for Model 2: Main Sources of Revenue with Expansion of Higher Education R&D

Variables	Number of Residencies
Tuition	2.046**
	(-0.647)
Hospital Revenue	0.0374***
	(-0.00557)
Federal Higher Ed R&D	-0.245
	(-0.119)
State & Local Higher Ed R&D	0.782**
	(-0.324)
Business Higher Ed R&D	-0.434
	(-0.522)
Institutional Higher Ed R&D	0.688***
	(-0.167)
Other Higher Ed R&D	0.437
	(-0.334)
DME Total	0.524
	(-0.295)
IME Total	-0.216
	(-0.113)
Constant	107.4***
	(-9.989)
Number of Observations	320
Number of Groups	32

*** p<0.01, ** p<0.05, * p<0.1, Standard errors in parentheses

Table 36

Percent Distribution of Higher Education R&D Funding by Type

Private MD	Federal	State & Local	Business	Institutional	Other
2004	73.2%	1.4%	5.3%	9.8%	10.3%
2005	73.2%	1.4%	5.2%	10.3%	9.9%
2006	71.0%	1.3%	4.9%	11.7%	11.1%
2007	69.1%	1.4%	5.2%	12.7%	11.6%
2008	69.5%	1.1%	5.0%	12.6%	11.8%
2009	68.4%	1.5%	4.7%	13.1%	12.4%
2010	71.6%	1.4%	5.1%	11.5%	10.5%
2011	69.4%	2.0%	4.5%	14.4%	9.7%
2012	64.3%	2.8%	5.0%	18.2%	9.8%
2013	62.6%	2.3%	5.3%	20.5%	9.3%
Public MD					
2004	61.4%	6.0%	6.1%	13.9%	12.6%
2005	61.7%	5.5%	6.0%	14.4%	12.3%
2006	62.1%	4.7%	5.3%	15.3%	12.7%
2007	59.8%	4.2%	5.8%	15.9%	14.3%
2008	57.9%	4.4%	6.0%	17.5%	14.3%
2009	56.8%	4.1%	6.6%	18.0%	14.5%
2010	60.9%	5.3%	4.9%	15.7%	13.2%
2011	62.5%	5.8%	4.4%	14.8%	12.4%
2012	58.9%	5.4%	4.6%	17.5%	13.6%
2013	57.9%	5.5%	4.4%	18.4%	13.8%

(table continues)

Table 36 (*cont*.)

Private MD	Federal	State & Local	Business	Institutional	Other
MD (Pu&Pr)					
2004	64.9%	4.6%	5.9%	12.7%	11.9%
2005	65.0%	4.3%	5.8%	13.2%	11.6%
2006	64.7%	3.7%	5.2%	14.2%	12.2%
2007	62.4%	3.4%	5.7%	15.0%	13.6%
2008	61.0%	3.5%	5.7%	16.1%	13.6%
2009	59.9%	3.4%	6.1%	16.7%	13.9%
2010	63.8%	4.2%	5.0%	14.5%	12.5%
2011	64.4%	4.8%	4.4%	14.7%	11.7%
2012	60.3%	4.7%	4.7%	17.7%	12.6%
2013	59.2%	4.6%	4.6%	19.0%	12.5%

Model 3

Finally for Model 3, the Model 1 was repeated yet run separately by sector of institution to see if there is a difference between public and private independent non-institutionally affiliated M.D. medical schools on the number of residencies and funding sources. As seen in my descriptive analysis of tuition, the increase of tuition revenues between 2004-2013 showing a much higher rate of increase for public medical schools, than privates, therefore may show a different profile and differences by the sector of institution.

Table 37

Fixed Effects Panel Analysis using Driscoll-Kraay Standard Errors for Model 3: Main Sources of Revenues Separated by Sector of Institution (Public v. Private)

	Number of Residencies	
	Publics	Privates
Tuition	2.730***	0.628
	(-0.484)	(-0.8)
Hospital Revenue	0.0572***	0.0685**
	(-0.0144)	(-0.0256)
Higher Ed R&D	0.00543	-0.137
	(-0.106)	(-0.0776)
DME Total	-3.343***	0.575**
	(-0.914)	(-0.244)
IME Total	0.531	-0.364***
	(-0.349)	(-0.0977)
Constant	110.8	145.4
	(-7.214)	(-17.89)
Number of Observations	190	130
Number of Groups	19	13

*** p<0.01, ** p<0.05, * p<0.1, Standard errors in parentheses

Results are shown above in Table 37. For public institutions, every $1,000 per FTE increase in tuition leads to 2.73 increase in residency positions (p<0.01). However, there is no effect for private medical schools. This leads to the inference that public medical schools may be more dependent on tuition revenues on funding medical residency positions than private institutions, even though private medical schools rely more on tuition as a major source of their total revenue. Likely, tuition dollars paid by

UGME students at private schools will likely be used to pay for its intended activities of undergraduate medical education. Public medical schools may actually be have the ability to funnel resources to GME and other areas whereas private medical schools need to use this tuition revenue toward more strategic activities. Some reasons may be public institutions also have a source of funding through state appropriations that are provided for medical education whereas privates do not. This is similar to what research universities do with their tuition revenues, with particular differences between public and private universities (Leslie et al., 2012).

Next looking at hospital service revenues for public and private medical schools yields similar results as in Model 1. For every $17,482 per FTE in hospital revenue for public institutions ($p<0.01$) and $14,599 per FTE in hospital revenue for private institutions ($p<0.05$) lead to an increase of one medical residency position. This is alignment with Model 1's finding of an $16,474 per FTE increase in hospital service revenue, approximately one residency position is created ($p<0.01$). Although a significant difference was found, the findings here should be taken with caution as hospital operating expenditures increase as much as they generate revenues and assuming teaching hospitals follow their stance as "not-for-profit". Therefore, the available funding from hospital revenues is unlikely to go toward medical residency positions unless a substantial share of the total hospital revenues is very high so the medical school can use these funds toward education. Instead, smaller amounts of excess hospital service revenues will likely go toward providing medical care to patients and relevant other expenditures.

CHAPTER 5

CONCLUSION

The training of future physicians is an important multi-stage process that involves multiple years of higher education, from undergraduate education, medical school, residency and fellowship training. This accumulates to at least 11 years of post-high school education for an individual to become a licensed physician to practice in the United States. However, there is concern by society, policymakers, and current physician leaders about the future supply of physicians for the future due to the rise of the aging population, the increase of retiring physicians, and the growth of demand in health care services in the United States. Influence on widespread national health care may shift dramatically in the upcoming years as majority partisan influences in the federal government will change nationally and attempt to affect current policies. This was particularly evident 20 years ago, as a similar shift occurred. The Balanced Budget Act of 1997 essentially froze the number of medical residency positions and has virtually remained unchanged till now (Salsberg et al., 2008).

Medical schools have tried to address the possible future physician shortage. Many interventions and increases in enrollment of medical students and establishments of new medical schools have occurred in the past decade, but has residency positions kept up with this growth. Much of the concern that exists today is the lack in the number and funding of medical residency positions and where do the growing number of medical graduates attend residency.

The purpose of this study was to take a preliminary look at the past ten years (2004-2013) and see if the current projections of the physician supply truly reflect the

changes that medical schools have implemented in increasing medical school enrollment, medical school graduates, and medical residency positions. Further, as medical residencies are often touted, the majority of positions are funded by Medicare, a public source of funding from the federal government, but an analysis of medical school finances, both from public and private sources was analyzed to see if other sources of funding are making up for the lack in number and financing of medical residency positions by Medicare. Particularly the number of medical school residency positions, the percentage share in change that has occurred between public and private streams of funding and what is truly funding medical schools was analyzed during the years 2004-2013.

This study used two conceptual frameworks, first, Burton Clark's (1998) concept of the distinctive college and, second, academic capitalism (Slaughter & Leslie, 1997). In the first case, the argument presents itself that independent, non-university affiliated MD-granting medical schools are a distinctive type of higher education institution. Medical schools of this type are specific in their missions, visions, and goals and do not need to consider the larger influences of disparate disciplines beyond medicine as traditional colleges and universities do. These types of institutions have little focus on undergraduate teaching and other pressures that traditional colleges and universities face. A tension exists between higher education institutions overall as want to be acknowledged as distinctive unique entities, but competitive pressures, incentivizes institutions to act more likeminded and same. There is a tension between the mission that medicals schools purport to have versus the money and competition that exists (Weisbrod et al., 2010). This drives institutions like those chosen for my sample to be

very distinctive yet to be competitive and relevant in an academic capitalist environment. This leads medical schools to behave in certain ways not only in the larger context of higher education, but also within their own select group of medical schools.

As such, medical schools are indeed professional schools. However, defining a professional school, especially medical schools, can be difficult to classify as they provide post-undergraduate training, and sometimes affiliated with a parent university or a part of a large academic medical center. Another distinctive nature of medical schools is the intensive nature of the research enterprise, the focus of medical research funding forming a basis of how basic faculty are paid which leads to heavy reliance of market forces and competitive pressures. Further, medical schools provide a unique contribution to society as they help create medical professionals, a very important part of any society with concerns of the health of its citizens. However, similarities also exist with traditional colleges and universities as medical schools have similar structures of academia and the creation of human capital has to coexist with the realities of academic capitalism that exists today (Taylor et al., 2015).

Overall the findings considered whether medical schools are distinctive but has become less over time, analogous to the shift of traditional colleges and universities. Is the behavior that medical schools oriented toward similar to all of higher education, or do medical schools still remain unique in the midst of similar pressures and competitive forces that exist in higher education today? The second argument is the balance between institutional distinction versus institutional diversity. Should there be a standardized type of medical school? Higher education has shifted and evolved throughout history to reflect the changes of the nation and the needs of the populace

(Geiger, 2000; Morphew, 2002). It looks like medical schools are still distinct entities in higher education and behave very similar to traditional colleges and universities but have unique functions that they are able to deviate their behavior in slightly different ways.

It is difficult to tease out how closely medical schools behave in the context of academic capitalism. As academic capitalism posits, institutions increasingly are oriented toward the academic market enterprise in the pursuit of research and alternative resources and funding (Slaughter & Rhoades, 2004). The relationships between a medical school, teaching hospital, industry, and the government however are very complex (Cohn, Rhine, & Santos, 1989). Also, the distinction between these various groups as public or private entities, with pecuniary or altruistic objectives, in their true functions can be hard to separate. Both types are needed to function and survive in today's competitive higher education environment (Weisbrod et al., 2008). Medical schools, like universities are needing to maintain the balance of human capital generation in an academic capitalist environment (Taylor et al., 2015).

Further, the focus of medical school finances prioritizes less on public sources such as state subsidies, as in the case of medical schools is mainly funded through federal funding and research monies, to private and internal sources of funding such as medical school tuition and hospital patient care revenues. This is due to the "hollowing out" of the state as both federal (for medical school residency funding) and state (for state appropriations) have steadily declined in recent years (Harloe & Perry, 2009). Therefore, this study also looks to both the function of academic capitalism from the standpoint of medical schools, assuming they are different from traditional colleges and

universities but questioning the future of remaining distinctive due to the competitive pressures of revenue maximization.

The dataset used for this study used data publically available from both public federal datasets such as IPEDS, NSF HERD, CMS Medicare, and private organizational data from AAMC, and NRMP which focus on medical school data. For the first two research questions, descriptive statistics were provided to show a profile of finances and medical residency positions during a 10 year time period of 2004-2013. Research question three was answered using a fixed effect panel analysis with the number of medical residency positions as the dependent variable, and independent variables being different sources of main revenues that medical schools in my sample generate.

Three research questions were used to guide the study and the following provides a summary of the findings.

Research question one looked at the general variation in sources of financial support over time at non-university-based independent medical schools in the past 10 years. In summary, in the time period studied, the share of higher education research and development funding (HE R&D) has declined by 8.7% along with GME funding, both direct and indirect funding. The share of tuition has increased slightly by less than a percentage point (.64%) but not enough to make a large impact. However, between 2004 and 2013, the share of hospital service revenues making up a total percentage share of medical school revenue in this sample has increased by 13.22%.

The rise of hospital revenues has steadily increased whereas the other means of financial support have remained relatively steady or decreased. Particularly between the years of 2008 and 2009, hospital revenues increased by 31.6 million dollars (17.7

percent increase) which can be found in Table 11 and Figure 7. Although there was a slight decline in hospital revenue in 2011 (-5.7%), this type of support has steadily increased overall. In the years between 2004-2008, hospital revenues as total have increased by 16.5% and within a ten-year time period by 52.9%.

Multiple explanations can be explored in the fluctuations that have occurred within this time period for some of these variables. For hospital patient care revenues, one needs to consider that health care expenditures have always been on the rise which leads hospitals to charge more for patient care. Also, how much insurance companies and particularly how Medicare reimburses hospitals may be less than the billing rate of the provider as there are maximum caps on particular treatments and services rendered. Specifically, for medical schools and teaching hospitals, the nature of teaching lends itself to medical students, residents, and attending physicians to spend more time on patients and patients generally come in with more severe, chronic costly diseases and likeliness that patients will come from lower socioeconomic backgrounds and needing indigent care.

One explanation in the fluxuation in hospital revenues could be due to the Great Recession. In 2008, health care spending was slowed due to the recession (Mitka, 2010). But the alternative effects of the recession included people who lost their jobs, their steady income, and employer provided insurance. Due to the effects of the recession, the federal government had to intervene. This meant that in 2008, Medicaid had to increase their spending by 8.4% and Medicare by 8.6% (Hartman, Martin, Nuccio, & Catlin, 2010; Young, Garfield, Clemans-Cope, Lawton, & Holahan, 2013). There was also a rise of Medicare patient hospital admissions and hospital spending for

those who get Medicare benefits (Young et al., 2013). As medical schools and teaching hospitals serve disproportionately this population, the increase in hospital revenues 2009 makes sense.

Another explanation is also due to another federal act, the American Recovery and Reinvestment Act (ARRA) of 2009, with the Department of Health and Human Services (HHS) receiving approximately $167 billion dollars for the next 10 years toward programs that provided funding to hospitals that serve underserved, uninsured, and low income populations (Department of Health and Human Services, 2009). As medical school teaching hospitals disproportionately serve this population, the windfall from this federal act would indeed have effects on medical schools. This is somewhat analogous to ARRA funding provided in the form of federal R&D grants to universities. The funding in this context follows the quasi-market model for which funding will usually go to the universities with the best resources and status in place (Taylor & Cantwell, 2016). In this case, medical schools are an example of higher education institutions which are primed by federal policies to get this HHS-designated ARRA funding.

The national policy which runs analogous to this trend is the implementation of the Affordable Care Act (ACA) in 2010 which can explain the rise in hospital revenues in 2012. For all non-profit hospitals, revenues grew by 5.1% which was reported by the Moody's Investors Service (Kutscher, 2014). This further provided health care insurance to those who previously did not have it. However, the ACA was implemented in stages in the subsequent years, for which the data in this study do not encompass (2004-2013). Therefore, it is too early to tell whether or not the implementation of ACA had an effect of the rise of hospital revenues.

For the future, the increasing revenues from hospitals are in flux, as more health care systems have negative operating margins, which is in part due to the rising expenses of salary, benefits and retirement costs of employees, and supply costs to treat patients (Kutscher, 2014). Medical schools and teaching hospitals are particularly effected by trying to break even on finances. Also, teaching hospitals are often classified in the Disproportionate Share Hospital (DSH) programs, which these hospitals treat more indigent and low income patients. Funding cuts are expected due to the Affordable Care Act, which focuses on efficiency and outcomes, but also could change due to differences in federal support for the ACA. This would further decrease revenues even in the midst of increasing patient loads and rising costs in health care (Korn, 2015). Further, due to the uncertain future and existence of the Affordable Care Act at the time of this study, time and policy changes can further shift the rise of hospital revenues.

This rise of hospital revenues is important to note as all the public sources of funding, Higher Education R&D, DGME, IME, have all decreased in share, and tuition and hospital revenue, all institutionally raised and private sources, have all increased in share. Yet, expenditures for both tuition and hospital revenue complement one another. The cost of health care is rising in the U.S. and revenues can increase due to the increase in services rendered. Yet, due to the interplay between revenues of services rendered and expenditures to do those services, the likeliness of slack revenue intended for other purposes like the funding funneled toward medical residencies is less likely.

However, the argument can be made that although medical school enrollments have increased, so have the costs of tuition charged. This can be seen in analysis of tuition rates based on type of institution (public and private) and residency status of student (in-state and out-of-state). Which leads to ambiguous pockets of revenue intended to be used for undergraduate medical education, but could easily be cross-subsidized and used for other institutional activities. This is analogous to undergraduate education subsidizing graduate education in traditional colleges and universities (Ehrenberg, 2006; Newfield, 2009; Taylor, Cantwell, & Slaughter, 2013). The training of an undergraduate medical student is costly, but one needs to consider the framework and the educational model of the four years of undergraduate medical education. The majority of medical schools in the country focus on the two year classroom then two year clinical experiences model. Particularly for the first two years, medical students spend the majority of their time in lectures and small lab settings learning the basic sciences. For the third year of medical school, students spend time in teaching hospitals and clinics. In the fourth year of medical school, although there are requirements for students to complete rotations and internships, the majority of students spend their time applying, interviewing, and preparing to match in a residency position. In considering the educational model of medical schools, it does make some sense that unlike medical residents who spend the majority of time in the hospitals and clinical settings, that tuition funding could easily be funneled from undergraduate medical education to graduate medical education. This cross-subsidization makes sense and justified by medical school administrators as it is under the auspices of the overall university mission (Weisbrod et al., 2008).

When looking on a detailed level on the types of higher education research and development funds, the federal HE R&D has declined the most. This makes sense as all sources of federal research funding has remained steady or decreased in the past decade (NSF, 2014). Although federal HE R&D funding has steadily decreased, there was a slight increase between 2009-2011($62.6 million to $65.0 million) found in Table 13, Figure 9. As explained above, this can be attributed by the infusion of funding from the American Reinvestment and Recovery Act (ARRA), but in this case, federal research funding. Overall, the decline in federal HE R&D funding has affected all of higher education, not just medical schools. Yet one needs to consider the heavy reliance of public sources of research funding in the medical school enterprise and the slight but increasing use of institutional R&D to make up for the decline in federal HE R&D funding.

Research question two studied whether or not the number of residency positions increased over the past 10 years even as Medicare-funded residency positions have remained relatively constant. Assuming that Medicare funded residencies have remained constant, aside from the rare occurrences of hospitals closing, and exceptions of resident sharing and other circumstances (CMS, 2014), a descriptive analysis has shown that medical residency position have indeed risen between 2004-2013. The first five years (2004-2008) of analysis saw only a modest rise in more medical residency positions of 358 positions, an increase of 8.04 percent. Within a ten year time period (2004-2013), there was a rapid increase by 29.97 percent in medical residency positions, a total of 1,330 more positions.

An analysis of the number of medical students enrolled, total number of medical school graduates, and number of available medical residencies per year show that they all have been steadily increasing in the past ten years. In 2010, the sixth year of the 10 years studied show that the number of medical residency positions have increased over the number of students who were enrolled in medical school. However, caution should be taken as it takes four years for an incoming medical student to graduate from medical school. However, the finding that the number of medical residents is growing is a positive finding.

Another consideration is that migration occurs between programs and states. As this study only looked at a very specific group of medical schools, it assumes that medical school graduates migrate between just this specific type of institutions, an independent, non-university based medical school, which is not generally the case. Findings show that in 2010, more medical residency positions were available than the number of medical school graduates. However, one must also consider those graduates from outside this specific type of institution, those who graduate from a university-affiliated medical school, osteopathic (D.O.) medical school, or international medical graduates who choose to do allopathic medical residencies in the United States. Further, medical school graduates migrate out-of-state to do residencies, particularly for states which have fewer medical residency positions than medical school graduates. Therefore, slight caution and consideration of context should be considered on this finding. Overall, this finding does show that even though the number of Medicare-funded residency positions have remained virtually the same since 1995, states and

medical schools are trying to keep up with demand and the increase in medical school enrollments and graduates.

The final research question addressed what university and medical school characteristics predicted variation in the number of residency spots at university-based medical schools over time. From the analyses done, it seems that tuition is a main driver of the increases in the number of medical residency positions, as approximately two residency positions were created per $1,000 in tuition per FTE funding. Although hospital revenues would also have an impact on the number of medical residency positions, the meaning behind this finding is suspect as the slack available funding is likely to be used toward rising expenditures in patient care and the expensive nature of residents and academic medical centers providing specialized care rather than toward creation of medical residency positions.

Particularly interesting was when institutions were analyzed separately by public and private institutions and how tuition increases are markedly different between private and public medical schools when one ties in the rate of increase of tuition based on public and private MD institutions, with public medical schools' rate of change on average being 61% between 2004-2013 and private medical schools increasing tuition by 44.5%. Specifically, for public MD institutions, in-state tuition has increased by 73.1%, whereas at a lower percentage of 55% tuition increase for out-of-state students. Private schools typically charge the same amount for all students regardless of residency status, but with slight differences, as in-state students' tuition increased 45.4% and for out-of-state students, 43.6%.

The effect of tuition on the number of medical residency positions on private medical MD institutions goes away and the effect only remains for public MD medical schools. This somewhat makes sense as public institutions rely more on public sources of funding whereas, private institutions need to rely more on tuition and other sources of revenue. Particularly for the marked increase for in-state students for public MD schools, this reflect the decline of state subsidies paying for medical education; therefore, tuition increasing at a much higher rate than the other tuition forms for both public out-of-state and private in-state and out-of-state tuition rates. This mirrors the decline of federal sources of funding and alternative forms for funding making up for this loss (Archibald & Feldman, 2010). However, due to the small sample sizes when splitting by sector, caution should be considered on the true veracity and interpretation of this finding.

The findings from analysis found that there are changes in medical residency positions even as the number of medical residency position slots have been limited by the Balanced Budget Act of 1997. Also, the sources and share of different revenue streams of medical schools have shifted from reliance of less public sources to more private sources of revenue, similar to what is happening within traditional colleges and universities (Archibald & Feldman, 2010). Finally, a dependence of tuition funding on the creation of new medical residency positions exists, but particularly at the public medical school level, not private medical school level. Stakeholders and policymakers that provide funding for public medical schools may be pressuring these types of institutions to increase the number of medical residency slots, without actually providing public funding to do so in the midst of declining state budgets and decreased

appropriations. This may be leading public medical schools to use existing, alternative sources of funding like tuition to indeed create more residency positions with no additional funding earmarked by public sources.

Summary of Results

This study examined how medical residency positions have been funded in the past 10 years. The findings that emerged from the study show that the number of medical residency positions have increased even when Medicare provided residency positions have remained steady due to the Balanced Budget Act of 1997. Some of the current research suggests that hospital revenues are mainly what drives and pays for the extra resident spots (Institute of Medicine, 2014). However, in the findings from this study, it shows that tuition revenues, paid for by undergraduate medical students, are instead subsidizing the costs of medical residents. This is analogous to public universities using undergraduate tuition funding to subsidize graduate and professional school students (Newfield, 2009; Taylor, Cantwell, & Slaughter, 2013). Hospital revenues do have a tiny but likely insignificant impact on the number of medical residents based on the revenues they bring.

Next, the findings also suggest that research grant revenues, have no effect on the number of medical residency spots. Perhaps this could also be due to the labor-intensive nature of NIH medical research that institutions argue which requires extensive regulations, equipment, facilities, and infrastructure beyond other types of federal research which may not have as high of an overhead (US Government Accountability Office, 2013).

Or this can be explained as the majority of federal research funding is centralized to a select elite group of institutions, which most are not included in this sample and as these medical schools are categorized as non-university-affiliated independent institutions (National Science Board, 2016). For medical schools, like universities, indirect costs that go directly to the institution varies, but how NIH funds indirect costs differs from NSF and other federal agencies. As medical schools rely primarily on NIH/HHS research funding, the average indirect rate to the institution was 54.5% and ranged from 36.3% to 78% in 2010 (Johnston, Desmond-Hellmann, Hauser, Vermillion, & Mila, 2015). Yet, more research should be considered on how indirect costs based on source of funding should be viewed within medical schools as NIH typically funds a researcher the sum they requested, and provides a separate indirect cost payment directly to the institution which can be negotiated. This contrasts with other sources of federal funding, specifically NSF funding, which the indirect costs are taken directly out of the total grant awarded (Leford, 2014).

Limitations

There were a few limitations in this study. First, finding transparent data on how medical residencies are funded proved quite difficult as Medicare DGME and IME are provided as lump values and not disaggregated into various training costs. Navigating the Centers for Medicare and Medicaid Services was quite difficult and cumbersome and data are not clearly accessible. There are bills and considerations by policymakers to make this data more transparent and easier to understand, but will take time for it to actually be implemented and accessed.

Further, cross-subsidization is likely occurring in medical education, especially at the resident level. Graduate medical education is being paid for by other means, but little is known about this phenomenon. It is difficult to tease out funding between a medical school and teaching hospital even as they may be two different organizations. The intimate nature of both enterprises are inextricably linked to one another. Although hospital revenues seem to be something that could contribute, the findings in this study suggest otherwise. Also, medical schools rely heavily on the research enterprise, more so than traditional colleges and universities as most NIH funding is funneled toward medical schools due to the nature of the research being conducted. Yet one must also consider the costs of doing expensive medical research and how expenditures and revenues are complementary to one another. Medical schools also have a wide profile of outputs which include the creation of knowledge, human capital, innovation in technology, capital investment, etc. (Goldstein, Maier, & Luger, 1995).

However, medical schools, as much as they may purport to be unique entities in higher education, they may be following the academic capitalist framework of competitive pressures to conform to be like other higher education institutions, making them less distinctive than they seem (Taylor, Cantwell, & Slaughter, 2013; Taylor & Morphew, 2010). Like private four year institutions in the United States, medical schools may have a heavy reliance on tuition dollars to help pay for other pursuits in the academic enterprise. For medical schools, tuition intended to be used for undergraduate medical education might be used to pay for residency positions that previously the federal government, the main source of public funding for GME. Medical schools are

trying to find ways to find alternative means of revenue due to the decline in the number and funding available for these positons.

What is quite interesting is that resident salaries and stipends are paid for by the hospital, but teaching/clinical faculty and the program directors of these residency programs salaries are paid for by the medical school. This discrepancy adds to the nebulous nature of how medical residencies are truly funded, and how do medical schools and teaching hospitals clearly delineate roles and responsibilities due to how funding is situated.

The data used in this dataset is unable to truly see how cross-subsidization is occurring, and what exact funds, both in type and source, are being funneled and to where. Even though the assumption lies that due to the high costs, labor-intensiveness, and investment in medical education, that other areas, which have economies of scale of having the flexibility of increasing enrollments and teaching, are subsidizing medical education. Sloan (1998) has found this is the case that medical schools and residency programs are pursuing other forms form of revenue while precariously remaining a non-profit status to pay for teaching costs. This is due to graduate medical education which is constrained by lower student-faculty ratios, the intimate nature of clinical teaching and laboratory hours, and accreditation requirements.

Finally, one of the limitations of studying residency positions that will not be able to be easily influenced is the student choice of where medical school graduates intend to go after residency. Even as more students are inclining toward specialties that pay better with better work hours, providing open positions cannot change behaviors. However, there may be particular factors such as total student debt, prestige of

institution, strength of particular third year medical school clerkships, that may or may not steer medical students into particular specialty choices. More research is needed to study how organizations influence student career choice and through what means.

Implications for Research

Due to the lack of research in this area of how medical residencies are funded and through which particular revenue sources, this study only touches on the surface for what could be studied.

One limitation of this study is the focus on non-university based independent MD-granting medical schools in the United States. Further, only data from the National Medical Residency Program (NRMP) was obtained on the number of medical residencies for each medical school per year. The AOA which maintained the number of osteopathic medical residencies per year was unable to provide data disaggregated by institution. Osteopathic medical schools primarily focus on teaching, and much less on research funding and likely to depend more on tuition and fees than allopathic medical schools.

Expanding this study to include all MD-granting medical schools in the United States could be conducted using the AAMC Annual Financial Survey that medical schools complete each year. This data are more comprehensive and may be able to provide financial data that splits revenues between a parent university and a medical school. This study was only able to study independent, non-university based MD-granting medical schools due to the IPEDS finance reporting which combined an entire

institution's revenue into one profile. Using an alternative data set could provide insights into more detailed finances of medical schools.

Also, focusing on larger variables based on where the medical school and residency is located should be considered as some states do provide funding for medical residencies and heavily subsidizes medical education (starting at the undergraduate medical school level) much more than do some states. This is in the case of Texas medical schools, which consistently every year, tuition and fees is in the bottom quartile of all medical schools (AAMC, 2016). Being able to access a larger data set, with a larger sample of medical schools, and knowing the details of how medical education is funded and valued by state would present unique insights beyond assuming all states generally fund medical education equally which previous research suggests otherwise (Gornitzka et al., 2002).

This research could be further studied to look at the impact between each specialty, as current policy and societal needs focus on the need for more primary care physicians. This study only focused on the nature of all medical residencies as an aggregate. Increasingly, more medical school graduates are pursuing specialties, as the workload and financial compensation are more than are for primary care physicians.

From an organizational standpoint, this could provide unique insights. Assuming medical schools act like quasi-markets, similar to traditional colleges and universities, looking at programs by specialty would provide insight into what areas and medical disciplines are favored by the institution (Taylor et al., 2013). If more information can be studied based on groupings of medical specialties such as primary care (family medicine, pediatrics, and internal medicine), surgical (obstetrics and gynecology,

neurosurgery, general surgery), and other (pathology, radiology), can help better show what is going on between these various areas.

Qualitative research is also needed which looks at how budget decisions are made at the federal, state, and institutional level and why these decisions are made specifically for funding medical residency programs. Further, is this investment in human capital, in this case, a new medical resident is more justified than a new piece of equipment like a magnetic resonance imaging (MRI) or a mass spectrometry machine. Both human capital and equipment are costly investments to a medical school. Medical residents require a lot of investment and a crucial but revolving source of human capital that will eventually graduate and leave.

Further accreditation requirements limit the number of medical residents to one teaching clinical faculty which further limits growth without more expenses and investment accruing upon a residency program. Specialized medical equipment requires maintenance but can easily serve a larger population of patients and stay within the hospital indefinitely. Particularly in an era that accountability is increasingly being emphasized, the ability to justify the use of a piece of equipment can be easily quantified. The value added of a medical resident providing care is a lot harder to measure. Medical schools and teaching hospitals need to consider a careful balance between the investment of human capital, medical residents, versus new equipment needs and acquisitions.

Implications for Policy and Practice

As discussed in a previous section, the majority of research on medical

residencies focuses on medical education of residents or primarily opinion and anecdotally-based on the finances of medical schools and residencies. Stakeholders are definitely concerned as possible solutions through policy changes have been introduced. Even though multiple bills have been introduced to Congress, most recently in 2013, the Resident Physician Shortage Reduction Act and the Training Tomorrow's Doctors Today Act and in 2015, Physician Shortage Reduction Act of 2015, they have all been unable to make it past the initial stages of legislation.

At the state level, field dynamics pressure medical schools even in the midst of a budget shortfall. States have limited higher education funding, where state legislatures must balance where funding should be allocated. Politics play a large role, particularly in the area of state investment in higher education, where agendas and priorities can drive and influence where funding will be allocated (McLendon, Hearn, & Mokher, 2009). In this case, within the higher education context, would be how to balance funneling toward undergraduate students or graduate/professional student programs like medical residency positions. The question arises if states should focus more on one deserving population of students pursuing one form of higher education over another.

However, this is not easy to say that all states should prioritize one group over another. This is incredibly important to look at these findings from a state context in prioritizing where state funding should go. Some states struggle in college completion rates, such as New Mexico, Nevada, and West Virginia where less than 30% of 25-34 year olds obtain a post-secondary education, whereas other states have higher college completion rates like Massachusetts and North Dakota at completion rates above 50% (US Department of Education, 2012).

One also needs to consider physician to citizen ratio by state. In this case, the word “citizen” is used instead of “resident” to not confuse terminology as it is typically referred to as physician-resident ratio. This ratio is important as the higher number of physicians per capita tend to be healthier states, with its citizens having longer life expectancies, lower smoking rates, and less likely are overweight or obese. States with the fewest physicians include Mississippi, Arkansas, Utah, Idaho, and Texas. States with the most physicians are Massachusetts, Maryland, New York, Connecticut, and Maine (AAMC, 2011).

How states respond to this physician-citizen ratio is how they increase the number of medical students enrolled in an allopathic or osteopathic medical school per 100,000 population. Based on the medical school enrollment-citizen ratio, West Virginia, Vermont, Missouri, Pennsylvania, and Nebraska have the highest enrollments by ratio and Oregon, Utah, New Mexico, Washington, and California nave the lowest medical school enrollment to citizen ratio (AAMC, 2011).

The question arises within states on where should they have more flexibility in funneling available higher education funding toward programs like medical residency programs or programs that serve in the access function of entering higher education to increase college degree attainment and graduation rates. As shown in the three different type of metrics by state provided: college attainment rates, physician-citizen ratio, and medical school enrollment-citizen ratio, it is a bit difficult to understand the connections between them all, but incredibly important to maintain a balanced ratio which states have to consider and prioritize.

With this finding from this study that the drivers of medical residency positions are primarily institutionally based, especially tuition, focuses the need of whether or not medical education and the training of physicians is a public good and whether or not the federal government should invest more or less into this venture. Considerations at the institutional level that presidents and chancellors of medical schools should consider are what should be the optimal ratio of revenues from tuition dollars from undergraduate medical students to the number of graduate medical residents? Further should state appropriations funding be further disaggregated towards primary care?

Overall, although the sample used in this study is small, due to insufficient research currently out there on medical residency funding, this does introduce the notion to looking at more alternative ways of how medical residencies are funded. This study only focused on tuition and fees, hospital revenues, higher education research and development funding sources, and Medicare direct and indirect medical education funding. Federal, state, local funding were not used as little is contributed by these areas to medical schools, unlike traditional colleges and universities. Further, state funding is provided in disparate ways, depending upon the state the institution is located and if the state prioritizes primary care or other important initiatives.

Further, this research supports the notion that alternative streams of funding is making up for the lack of public funds that are coming from the federal government in funding medical residencies. This is somewhat in alignment of the decline in public funding, although state funding, for traditional colleges and universities and other revenue sources, such as undergraduate tuition and fees are making up for the decline in public sources (Archibald & Feldman, 2010). However, the call for more funding

toward medical residencies has been discussed for decades with little to no data or analyses to support it.

As the focus on funding medical residencies is now less on federal funding, it places the onus of sustaining these positions on campus administrators, who may or may not find the value of increasing medical residency positions in their medical schools as other competitive pressures and influences also play a role in what they choose to value and pursue for their institutions. However, strong pressures exist to pursue the research mission and the generation of patents, drug manufacturing, and other profit-generating activities rather than education of physicians as they are seen more valuable in the highly competitive arena of medicine, and research and development. As seen in the example of other institutional types in higher education, the public good focus is slowly dissipating, as the tendency toward other pursuits is more valued and other institutions are doing it to get ahead in the higher education enterprise (Slaughter & Rhoades, 2004).

Future Directions

As this study explored how medical residencies are funded only through a limited range of resources, it could be further expanded to look at other alternative sources of funding that may be specific to state or institution that focus on special programs or residency types. This could include special residencies programs that focus on primary care or rural care. Also, partnerships may exist with teaching hospitals and clinical sites which may or may not be directly affiliated with a medical school, but use residents on a shared basis. They could be government or for-profit hospital entities.

Also, there needs to be consideration on the impact of human capital and the generation of physicians considering these findings. Should medical schools be incentivized to increase the health care workforce? Or are there alternatives?

This should be further studied on whether to increase particular types of health care professionals over others. There are alternative health care providers like physician assistants, nurse practitioners, and others that provide high quality health care. A study of healthcare provider utilization within hospitals has found that more physician assistants (PAs) and advance practice nurses (APNs) are increasingly taking larger loads of patients particularly within hospital outpatient departments versus the increasing decline by visits by physicians. Yet, within the teaching hospital setting, more physicians (92%) see patients in an outpatient setting than PAs and APN in a non-teaching hospital (78%) (Hing & Uddin, 2011). One aspect is of the increasing use of alternative health care providers beyond physicians is that they provide similar care but do not require the substantial years of education and post-graduate training like physicians and hospitals can pay these health care providers lower salaries.

Next, particularly looking at differences per state could be an interesting approach to seek differences and effectiveness of funding of medical education. The notion that Texas, California, and New York has a predominance of medical schools, whereas a few states only have one within its borders is particularly salient. Also, one many need to consider the health needs of the population by state as some states have a healthier population than others and may utilize less health care resources than others (McGill, 2016). Further study on the policies, governance of higher education, and other factors that influence medical residency positions and medical schools should

be studied to understand how states have limited or expanded the number of medical school slots or residency positions and whether that has a cumulative effect on physician rates of staying in-state to practice after residency.

Some states, especially Texas, provides very low tuition rates for its in-state residents for undergraduate medical students, as opposed to some states in the U.S., even if they are public institutions. Some public medical schools charge upwards of over $50,000 a year in tuition. Does this ultimately have an effect on specialty choice or whether students stay within state to do residency and ultimately reside in the same state they went to medical school? This could show the investment of subsidies on medical education has or does not have an effect downstream in residency location and practicing state.

Conclusion

Overall, this study looked at finances of medical schools on how medical residencies are funded as typically most research on medical schools focuses on medical education. Yet the interrelationship between medical education and how it is funded is relevant to one another and affects how organizations like medical schools behave. There is tension that does exist between mission and money particularly this issue of balancing the creation of medical residency positions alongside other priorities of a medical school. Medical residencies are funded primarily through federal funding yet little was known on other sources of funding even as medical residency positions and funding has remained relatively stagnant in twenty years; therefore, other funding

sources outside of federal dollars were funding the additional residency positions needed for medical schools.

Further as mentioned earlier, the current publications on this subject are opinion based or only provides numbers which are not consistent. The most interesting finding from the study is the particular emphasis of tuition having a large effect on the increased number of medical residencies, particularly at the public institution level. Perhaps, even though medical education training is known to be costly, economies of scale may as well exist at the undergraduate medical education level that adding an additional undergraduate medical student does not incur added educational costs until this student reaches medical residency. For undergraduate medical education, the majority of a medical student's time is held in classroom and lab settings which additional costs can be minimal whereas the majority of the residency training is clinical and focused more on one-on-one education at that level of training. Medical schools could easily justify this behavior and use of tuition dollars toward GME as undergraduate and graduate medical education still fall under the auspices of the definition of medical education.

Similarities do exist as how traditional colleges and universities are using alternative sources of revenue to make up the decline in public sources of funding. Higher education, like health care, strives to become better in quality. But the increase in quality leads to increase in costs (Archibald & Feldman, 2010). For medical schools, they not only have to deal with striving for quality educational endeavors, but also more technologically and cutting edge health care which is expected by society. Medical schools do have one additional source of revenue, hospital service revenues, but this may increase the number of patients, the revenues of patient care, but ultimately may

not have any effect on adding value to the number and experiences for medical residents.

Within the academic capitalism framework, this makes sense as competition drives how medical schools behave and therefore indirectly forces pressure on medical schools to be less distinctive. Further the conflict between mission and money exists, therefore medical schools also struggle on where they stand in the realm of higher education and their true sense of purpose (Stevens 1989; Weisbrod et al., 2008). Medical schools, although distinct entities from traditional colleges and universities, also compete in their own established field of health care institutions and academic health centers and compete within these specific circles for the limited, albeit more plentiful and varied sources of funding. More consideration should be studied on the different types of medical schools within their own field dynamics, pressures, and expectations placed on them.

More studies, on a detailed level are needed, as only broad sources of funding are studied. Further, this is only a subset of institutions that was studied in this analysis. A broader analysis would provide a richer profile of the current state of medical schools and the impact of different types of funding on how medical residencies are funded. The unique nature of medical schools as distinctive types of institutions should still be further explored as they do suggest that they are, but too early to tell with this research provided here.

This research ultimately provides a small window of the importance of funding of medical residencies and the how the reliance on how they are funded are largely due to private sources of funding such as tuition and fees as opposed to public funding like

federal funding of GME positions as often thought to be assumed to be largely funding medical education. Medical schools, very much like traditional colleges and universities have to balance the educational mission along with the competitive pressures to pursue revenue generating activities and behave accordingly. This tension between mission and money exists within the medical school context and particularly affects the nature of the educating physicians during medical residency and balancing the costs and investment needed to do so. The policy and practical implications are large, as the concern for the future of the medical profession and the supply of physicians is a concern to both society and the federal government.

APPENDIX

CURRENT MEDICAL SPECIALTIES AND SUBSPECIALTIES

Allergy & Immunology

Anesthesiology

Colon and Rectal Surgery

Dermatology

Emergency Medicine

Family Medicine

Internal Medicine

Medical Genetics

Neurological Surgery

Neurology

Nuclear Medicine

Obstetrics and Gynecology

Orthopedic Surgery

Otolaryngology

Pathology-Anatomic and Clinical

Pediatrics

Physical Medicine and Rehabilitation

Plastic Surgery-Integrated

Psychiatry

Radiation Oncology

Radiology-Diagnostic

Surgery-General

Thoracic Surgery-Integrated

Urology

Vascular Surgery-Integrated

Internal Medicine/Pediatrics

REFERENCES

AAMC (2006). *Medicare payments for graduate medical education: What every medical student, resident, and advisor needs to know*. Washington, DC: AAMC.

AAMC (2008). *Industry funding of medical education: Report of an AAMC task force*. Retrieved from: https://services.aamc.org/Publications/showfile.cfm?file=version114.pdf&prd_id=232&prv_id=281&pdf_id=114.

AAMC (2011). *2011 state physician workforce data book: Center for workforce studies.* Washington, DC: AAMC. Retrieved from: https://www.aamc.org/download/263512/data/statedata2011.pdf

AAMC (2012a). *2012 Physician specialty data book*. Washington, DC: AAMC. Retrieved from: https://www.aamc.org/download/313228/data/2012physicianspecialtydatabook.pdf

AAMC (2012b). *Why teaching hospitals are important to all Americans.* Retrieved from: https://www.aamc.org/advocacy/campaigns_and_coalitions/gmefunding/factsheets/253374/teaching-hospitals.html

AAMC (2013). *Survey of resident/fellow stipends and benefits report 2013-2014.* Retrieved from: https://www.aamc.org/download/359792/data/2013stipendsurveyreportfinal.pdf

AAMC (2015a). *Revenue by source, FY1977 through FY2014*. Retrieved from: https://www.aamc.org/data/finance/434230/fig8-9.html

AAMC (2015b). *Results of the 2014 medical school enrollment survey*. Retrieved from: https://members.aamc.org/eweb/upload/Results%20of%20the%202014%20Medical%20School%20Enrollment%20Survey.pdf

AAMC (2015c). *The complexities of physician supply and demand: projections from 2013 to 2025: Final report.* Washington, DC: AAMC. Retrieved from: https://www.aamc.org/download/426242/data/ihsreportdownload.pdf

AAMC (2015d). *2014-2015 Report on medical school faculty salaries.* Washington, DC: AAMC.

AAMC (2016). *Tuition and student fees reports.* Retrieved from: https://services.aamc.org/tsfreports/

AAMC (n.d.a) *What does Medicare have to do with graduate medical education*. Retrieved from: https://www.aamc.org/advocacy/campaigns_and_coalitions/gmefunding/factsheets/253372/medicare-gme.html

AAMC (n.d.b). *Applicants and matriculants data*. Retrieved from: https://www.aamc.org/data/facts/applicantmatriculant/

ACGME (2013). *Accreditation council for graduate medical education: Glossary of terms.* Retrieved from: https://acgme.org/acgmeweb/Portals/0/PFAssets/ProgramRequirements/ab_ACGMEglossary.pdf

Advisory Board Company (2013). *Why medical schools, residency programs can't fill the physician gap.* Retrieved from: http://www.advisory.com/daily-briefing/2012/08/30/why-residency-programs-cant-fill-the-physician-gap

American Board of Physician Specialties (2016). *Why board certification is important.* Retrieved from: http://www.abpsus.org/.

American College of Physicians. (n.d.) *Internal medicine subspecialties*. Retrieved from: https://www.acponline.org/patients_families/about_internal_medicine/subspecialties/

American Hospital Association (2009). *Teaching hospitals: Their impact on patients and the future health care workforce.* Retrieved from: http://www.aha.org/research/reports/tw/twsept2009teaching.pdf

American Medical Association Council on Ethical and Judicial Affairs (2008*). Industry support of professional education in medicine*. Retrieved from: http://www.ama-assn.org/ama1/pub/upload/mm/471/ceja1-2.doc.

American Osteopathic Association (2015). *Accreditation of colleges of osteopathic medicine: COM accreditation standards and procedures.* Retrieved from: http://www.osteopathic.org/inside-aoa/accreditation/predoctoral%20accreditation/Pages/ standards-and-procedures-disclaimer.aspx

American College of Surgeons (n.d.) *What are the surgical specialties?* Retrieved from: https://www.facs.org/education/resources/medical-students/faq/specialties

Anderson, G. F. (1996). What does not explain the variation in the direct costs of graduate medical education. *Academic Medicine, 71*(2), 164-9.

Anderson, G. F., Greenberg, G. D., & Wynn, B. O. (2001). Graduate medical education: the policy debate. *Annual Review of Public Health, 22*(1), 35-47.

Andolsek, K. M., Murphy, G., Nagler, A., Moore, P. R., Schlueter, J., Weinerth, J. L., ... & Dzau, V. J. (2013). Fostering creativity: How the Duke graduate medical education quasi-endowment encourages innovation in GME. *Academic Medicine, 88*(2), 185-191.

Archibald, R. B., & Feldman, D. H. (2010). *Why does college cost so much?.* Oxford, UK: Oxford University Press.

Balanced Budget Act of 1997, 4 U.S.C. Public Law 105-33 §§ 4621-4623. (1997). Retrieved from: https://www.gpo.gov/fdsys/pkg/PLAW-105publ33/pdf/PLAW-105publ33.pdf

Baltagi, B. (2008). *Econometric analysis of panel data* (4th ed.). New York, NY: John Wiley & Sons.

Baron, R. B. (2013). Can we achieve public accountability for graduate medical education outcomes?. *Academic Medicine, 88*(9), 1199-1201.

Barringer, S. N. (2016). The changing finances of public higher education organizations: Diversity, change, and discontinuity. In E. P. Berman & C. Paradeise (eds). *The University Under Pressure (Research in the Sociology of Organizations, Volume 46)* Bingley, UK: Emerald Group.

Baum, C. F. (2001). Residual diagnostics for cross-section time series regression models. *Stata Journal, 1*(1), 101-104.

Becker, H. F., Geer, B., Hughes, E. C., & Strauss, A. L. (1962). *Boys in white: Student culture in medical school.* New Brunswick, NJ: Transaction Books.

Bok, D. (2003). *Universities in the marketplace: The commercialization of higher education.* Princeton, NJ: Princeton University Press.

Bowen, H. R., & Servelle, P. (1972). *Who benefits from higher education--and who should pay?*. Washington, DC: American Association for Higher Education.

Breneman, D. W. (1982). Strategies for the 1980's. In J. R. Mingle (ed.) *Challenges of Retrenchment*. San Francisco, CA: Jossey-Bass.

Brinkman, P. T., & Leslie, L. L. (1986). Economies of scale in higher education: Sixty years of research*. The Review of Higher Education, 10*(1), 1.

Brode, E. C., Petterson, S. M., & Bazemore, A. W. (2013). Is NIH research funding to medical schools associated with more family physicians?. *American Family Physician, 87*(3), 214.

Burfield, W. B., Hough, D. E., & Marder, W. D. (1986). Location of medical education and choice of location of practice. *Academic Medicine, 61*(7), 545-54.

Cantwell, B. (2015). Laboratory management, academic production, and the building blocks of academic capitalism. *Higher Education, 70*(3), 487-502.

Cantwell, B., & Taylor, B. J. (2015). Rise of the science and engineering postdoctorate and the restructuring of academic research. *The Journal of Higher Education, 86*(5), 667-696.

Carrier, E. R., Yee, T., & Stark, L. (2011). Matching supply to demand: addressing the US primary care workforce shortage. *National Institute for Health Care Reform Policy Analysis*, 7, 1.

Centers for Medicare and Medicaid Services (2014). *Direct graduate medical education (DGME).* Retrieved from: https://www.cms.gov/medicare/medicare-fee-for-service-payment/acuteinpatientpps/dgme.html

Centers for Medicare and Medicaid Services (2015). *Hospital Form 2552-96*. Retrieved from: https://www.cms.gov/Research-Statistics-Data-and-Systems/Downloadable-Public-Use-Files/Cost-Reports/Hospital-1996-form.html

Clark, B. R. (1978). Academic differentiation in national systems of higher education. *Comparative Education Review, 22*(2), 242-258.

Clark, B. R. (1986). *The higher education system: Academic organization in cross-national perspective.* Berkeley, CA: University of California Press.

Clark, B. R. (1995). The deepening problem of university integration. In D.D. Dill & B. Sporn (eds.) *Emerging patterns of social demand and university reform: Through a glass darkly.* New York, NY: IAU Press.

Clark, B. R. (1995b). *Places of inquiry: Research and advanced education in modern universities.* Berkeley, CA: University of California Press.

Clark, B. R. (1998). *Creating entrepreneurial universities: Organizational pathways of transformation*. Oxford, UK: IAU Press.

Clark, B. R. (2002). University transformation: Primary pathways to university autonomy and achievement. In S. J. Brint (Ed.), *The Future of the City of Intellect: The Changing American Universit*y, pp. 322–342. Palo Alto, CA: Stanford University Press.

Cohen, J. J., Cruess, S., & Davidson, C. (2007). Alliance between society and medicine: the public's stake in medical professionalism. *The Journal of the American Medical Association, JAMA, 298*(6), 670-673.

Cohn, E., Rhine, S. L., & Santos, M. C. (1989). Institutions of higher education as multi-product firms: Economies of scale and scope. *The review of economics and statistics*, 284-290.

Cooke, M., Irby, D. M., & O'Brien, B. C. (2010). *Educating physicians: a call for reform of medical school and residency.* San Francisco, CA: Jossey-Bass.

Cooper, R. A., Getzen, T. E., McKee, H. J., & Laud, P. (2002). Economic and demographic trends signal an impending physician shortage. *Health Affairs, 21*(1), 140-154.

Cooper, R. A. (2007). It's time to address the problem of physician shortages: graduate medical education is the key. *Annals of surgery, 246*(4), 527-534.

Council on Graduate Medical Education (COGME), (1995). *Sixth report: Managed health care: implications for the physician workforce and medical education.* Rockville, MD: U.S. Department of Health and Human Services.

Council on Graduate Medical Education (COGME), (2000). *Financing Graduate Medical Education in a Changing Health Care Environment.* Rockville, MD: U.S. Department of Health and Human Services.

Council on Graduate Medical Education (COGME). (2014). *Twenty-second report: The role of graduate medical education in the new health care paradigm*. Rockville, MD: U.S. Department of Health and Human Services.

Dall, T., West T., Chakrabarti, R. & Iacobuci, W. (2015). *The complexities of physician supply and demand: Projections from 2013 to 2015.* Washington, D.C.: IHS Inc. Retrieved from: https://www.aamc.org/download/426242/data/ihsreportdownload.pdf

Department of Health and Human Services (2009). *FY 2009 agency financial report.* Washington, DC: Department of Health and Human Services. Retrieved from: https://www.hhs.gov/afr/

Dill, D. D. & Sporn, B. (1995). The implications of a postindustrial environment In D.D. Dill & B. Sporn (eds.) *Emerging patterns of social demand and university reform: Through a glass darkly.* New York, NY: IAU Press.

Dill, D. D. (1997). Higher education markets and public policy. *Higher Education Policy, 10*(3/4), 167-186.

Dill, M. J. & Salsberg, E. S. (2008). *The complexities of physician supply and demand: Projections through 2025.* Washington, DC: American Association of Medical Colleges.

Dorner, F. H., Burr, R. M., & Tucker, S. L. (1991). The geographic relationships between physicians' residency sites and the locations of their first practices. *Academic Medicine, 66*(9), 540-544.

Dower, C. (2012). Health policy brief: Graduate medical education. *Health Affairs*. Retrieved from http://www.healthaffairs.org/healthpolicybriefs/brief.php?brief_id=75

Doyle, W. R. (2007). Challenges to designing cross-state measures of state resources for higher education. In K. M. Shaw & D. E. Heller (Eds.), *State postsecondary education research.* Sterling, VA: Stylus.

Driscoll, J., & Kraay, A. C. (1998). Consistent covariance matrix estimation with spatially dependent data. *Review of Economics and Statistics, 80*, 549–560.

Drukker, D. M. (2003). Testing for serial correlation in linear panel-data models. *Stata Journal, 3*, 168-177.

Ehrenberg, R. G. (2006). The perfect storm and the privatization of public higher education. *Change: The Magazine of Higher Learning, 38*(1), 46-53.

Ehrenberg, R. G., Rizzo, M. J., & Jakubson, G. H. (2003). *Who Bears the Growing Cost of Science at Universities?(CHERI Working Paper #35).* Ithaca, NY: Cornell University.

Etzkowitz, H. (1997). The entrepreneurial university and the emergence of democratic corporatism. In. H. Etzkowitz & L. A. Leydesdorff (eds.). *Universities and the global knowledge economy*. London, England: Pinter.

Etzkowitz, H., & Leydesdorff, L. A. (1997). *Universities and the global knowledge economy.* London, England: Pinter.

Feldman, A. M. (2009). *Pursuing excellence in healthcare: Preserving America's academic medical centers.* Boca Raton, FL: CRC Press.

Flexner, A. (1910). *Medical education in the United States and Canada bulletin number four (The Flexner Report).* New York, NY: The Carnegie Foundation for the Advancement of Teaching.

Frankenbach, S. J. (2014). Graduate medical education financing basics. Association of Osteopathic Directors and Medical Educators. Retrieved from: http://aodme.org/wp-content/uploads/GME_Financing_Basics.pdf

Froelich, K. A. (1999). Diversification of revenue strategies. *Nonprofit and Voluntary Sector Quarterly, 40*(4), 246–268.

Gbadebo, A. L., & Reinhardt, U. E. (2001). Economists on academic medicine: elephants in a porcelain shop?. *Health Affairs, 20*(2), 148-152.

Geiger, R. L. (1993). *Research and relevant knowledge: American research universities since World War II*. New York, NY: Oxford University Press.

Geiger, R. L. (Ed.). (2000). *The American college in the nineteenth century.* Nashville, TN: Vanderbilt University Press.

Gil, J. A., Park, S. H., & Daniels, A. H. (2015). Variability in United States allopathic medical school tuition. *The American Journal of Medicine, 128*(11), 1257-1262.

Glennerster, H. (1991). Quasi-markets for education?. *The Economic Journal, 101*(408), 1268-1276.

Goldrick-Rab, S. & Shaw, K. M. (2007). Tracking how ideas become higher education policy and practice: The challenges of gathering comparative state policy implementation data. In K. M. Shaw & D. E. Heller (Eds.), *State postsecondary education research.* Sterling, VA: Stylus.

Goldstein, H., Maier, G. & Luger, M. (1995). The university as an instrument for economic and business development: U.S. and European comparisons. In D.D. Dill & B. Sporn (eds.) *Emerging patterns of social demand and university reform: Through a glass darkly.* New York, NY: IAU Press.

Gornitzka, Å., Kyvik, S., & Stensaker, B. (2002). Implementation analysis in higher education. In J.C. Smart (Ed.), *Higher education: handbook of theory and research* (pp. 381-423). New York: Agathon Press.

Greene, W. H. (2008). *Econometric analysis* (6th ed.). Upper Saddle River, N.J. : Prentice Hall.

Grumbach, K., & Bodenheimer, T. (2004). Can health care teams improve primary care practice?. *The Journal of the American Medical Association, 291*(10), 1246-1251.

Harloe, M., & Perry, B. (2009). Rethinking or hollowing out the university?. Higher Education Management and Policy, 17(2), 29-41.

Hartman, M., Martin, A., Nuccio, O., Catlin, A., & National Health Expenditure Accounts Team. (2010). Health spending growth at a historic low in 2008. *Health Affairs, 29*(1), 147-155.

Health Affairs (2012). *Health policy brief: Graduate Medical Education*. Retrieved from: http://www.healthaffairs.org/healthpolicybriefs/brief.php?brief_id=75

Hearn, J. C. (2003). *Diversifying campus revenue streams: Opportunities and risks.* Washington, DC: American Council on Education.

Heller, D. E. (2006). The changing nature of public support for higher education in the United States. In P.N. Teixeira, D.B. Johnstone, M.J. Rosa, & H. Vossensteyn (Eds.) *Cost-Sharing and Accessibility in Higher Education: A Fairer Deal?* (pp. 133-158). Netherlands: Springer.

Hellerstein, J. K. (1998). Public funds, private funds, and medical innovation: How managed care affects public funds for clinical research. *The American Economic Review, 88*(2), 112-116.

Hing, E. & Uddin, S. (2011). *Physician assistant and advance practice nurse care in hospital outpatient departments: United States, 2008-2009. NCHS Data Brief.* Washington, DC: US Department of Health and Human Services.

Hoechle, D. (2007). Robust standard errors for panel regressions with cross-sectional dependence. *Stata Journal, 7*(3), 281-312.

Iglehart, J. K. (2013). The residency mismatch. *New England Journal of Medicine, 369*, pp. 297-299. doi:10.1056/NEJMp1306445

Institute of Medicine (IOM) (2014). *Graduate medical education that meets the nation's health needs.* Washington, DC: National Academies Press.

IPEDS (n.d.). *Changes to IPEDS data collections*. Retrieved from: http://nces.ed.gov/ipeds/surveys/datacollection2003-04.asp

Jaeger, A. J., & Thornton, C. H. (2005). Moving toward the market and away from public service? Effects of resource dependency and academic capitalism*. Journal of Higher Education Outreach and Engagement, 10*(3), 53-67.

Jaquette, O., & Parra, E. E. (2014). Using IPEDS for panel analyses: Core concepts, data challenges, and empirical applications. In M.B. Paulsen (ed). *Higher education: Handbook of theory and research* (pp. 467-533). Springer Netherlands.

Johnston, S. C., Desmond-Hellmann, S., Hauser, S., Vermillion, E., & Mia, N. (2015). Predictors of negotiated NIH indirect rates at US institutions. *PloS one, 10*(3), e0121273.

Johnstone, B. (2002). Challenges of financial austerity: Imperatives and limitations of revenue diversification in higher education. *Welsh Journal of Education, 11*(1), 18-36.

Jones, R. F., & Sanderson, S. C. (1996). Clinical revenues used to support the academic mission of medical schools, 1992-93. *Academic Medicine, 71*(3), 299-307.

Kaufman, M. (1980). American Medical Education. In R. L. Numbers, (Ed.) *The education of American physicians: historical essays*. Berkeley, CA: University of California Press.

Kelly, S. P., Tibbles, C., Barnett, S. R., Schwartzstein, R. M. (2012). *The ‘‘Hidden Costs’’ of Graduate Medical Education in the United States. Journal of Graduate Medical Education,* p 267-268. DOI: http://dx.doi.org/10.4300/JGME-D-12-00038.1

Kennedy, D. W., Johnston, E., & Arnold, E. (2007). Aligning academic and clinical missions through an integrated funds-flow allocation process. *Academic Medicine, 82*(12), 1172-1177.

Klein, R. (2012). A new paradigm for funding medical research. *Stem Cells Translational Medicine, 30*(3), 360-362.

Korn, M. (2015). Once cash cows, University hospitals now source of worry for schools. *Wall Street Journal* (online). Retrieved from: https://www.wsj.com/articles/universities-get-second-opinion-on-their-hospitals-1429725107

Kutscher, B. (2014). Fewer hospitals have positive margins as they face financial squeeze. *Modern Healthcare.* Retrieved from: http://www.modernhealthcare.com/article/20140621/MAGAZINE/306219968/1135

Labaree, D. F. (1997). Public goods, private goods: The American struggle over educational goals. *American Educational Research Journal, 34*(1), 39-81.

Larson, R. C., Ghaffarzadegan, N., & Diaz, M. G. (2012). Magnified effects of changes in NIH research funding levels. *Service science, 4*(4), 382-395.

LCME (2015). *Frequently asked questions*. Retrieved from: http://www.lcme.org/faq.htm

LCME (2016). *Functions and structure of a medical school: Standards for accreditation of medical education programs leading to the M.D. degree.* Retrieved from: http://lcme.org/publications/#Standards

Leford, H. (2014). Indirect costs: Keeping the lights on. *Nature, 515*(7527). Retrieved from: http://www.nature.com/news/indirect-costs-keeping-the-lights-on-1.16376

Lepori, B., Usher, J., & Montauti, M. (2013). Budgetary allocation and organizational characteristics of higher education institutions: a review of existing studies and a framework for future research. *Higher Education, 65*(1), 59-78.

Leslie, L. L., & Johnson, G. P. (1974). The market model and higher education. *The Journal of Higher Education, 45*(1), 1-20.

Leslie, L. L., Slaughter, S., Taylor, B. J., & Zhang, L. (2012). How do revenue variations affect expenditures within US research universities?. *Research in Higher Education, 53*(6), 614-639.

Ludmerer, K. (1985). *Learning to heal: The development of American medical education*. New York, NY: Basic.

Ludmerer, K. M. (1999). *Time to heal: American medical education from the turn of the century to the era of managed care*. New York, NY: Oxford University Press.

Ludmerer, K. M. (2015). *Let me heal: The development of residency training in the United States and the struggle to preserve excellence in American medicine.* New York, NY: Oxford University Press.

Marginson, S. (2013). The impossibility of capitalist markets in higher education. *Journal of Education Policy, 28*(3), 353–370.

McGill, N. (2016). US rankings: Adult smoking, sedentary behavior decline: Hawaii tops list of healthiest states. *The Nation's Health, 46*(1), 1-18.

McLendon, M. K., Hearn, J. C., & Mokher, C. G. (2009). Partisans, professionals, and power: The role of political factors in state higher education funding. *The Journal of Higher Education, 80*(6), 686-713.

McMahon, W. W. (2009). *Higher learning, greater good: The private and social benefits of higher education.* Baltimore, MD: Johns Hopkins.

Mechanic, R., Coleman, K., & Dobson, A. (1998). Teaching hospital costs: Implications for academic missions in a competitive market. *Journal of the American Medical Association, 280*(11), 1015-1019.

Medicare (n.d.). *What's medicare?* Retrieved from: https://www.medicare.gov/sign-up-change-plans/decide-how-to-get-medicare/whats-medicare/what-is-medicare.html

Medicare Payment Advisory Commission (2010). *Report to the congress: Aligning incentive in Medicare.* Washington, DC: MedPAC.

Medscape. (2015). *Residents salary and debt report 2015.* Retrieved from: http://www.medscape.com/features/slideshow/public/residents-salary-and-debt-report-2015

Mettler, S. (2011). *The submerged state: How invisible government policies undermine American democracy*. Chicago, IL: University of Chicago Press.

Milhalich-Levin, L. (2012). Letters to the editor: Residents should know about medicare funding for their training programs. *Academic Medicine, 87*(7), 834.

Mirowski, P., & Sent, E. M. (Eds.). (2002). *Science bought and sold: Essays in the economics of science*. Chicago, IL: University of Chicago Press.

Mitka, M. (2010). Recession helped put brakes on growth in US health care spending for 2008. *JAMA, 303*(8), 715-715.

Morphew, C. C. (2002). " A rose by any other name": Which colleges became universities. *The Review of Higher Education, 25*(2), 207-223.

Moy, E., Griner, P. F., Challoner, D. R., & Perry, D. R. (2000). Distribution of research awards from the National Institutes of Health among medical schools. *New England Journal of Medicine, 342*(4), 250-255.

Moy, E., Valente Jr., E., Levin, R. J., & Griner, P. F. (1996). Academic medical centers and the care of underserved populations. *Academic Medicine, 71*(12), 1370-7.

National Institutes of Health (2014). *NIH awards by location and organization. NIH Research Portfolio Online Reporting Tools (RePORT).* Retrieved from: https://report.nih.gov/award/index.cfm?ot=DH,27,47,4,52,64,10000,MS,20,16,6,13,10,49,53,86,OTHDH&fy=2016&state=&ic=&fm=&orgid=&distr=&rfa=&om=n&pid=

National Institutes of Health (2015). The NIH almanac: Chronology of events. Retrieved from: http://www.nih.gov/about-nih/what-we-do/nih-almanac/chronology-events

National Institutes of Health (n.d.). *Research portfolio online reporting tools: NIH awards by location and organization.* Retrieved from: https://report.nih.gov/award/index.cfm

National Matching Services AOA Intern Resident Registration Program. (n.d.). *Match statistics.* Retrieved from: https://www.natmatch.com/aoairp/aboutstats.html

National Resident Matching Program (n.d.). *NRMP historical report*s. Retrieved from: http://www.nrmp.org/match-data/nrmp-historical-reports/

National Science Board (2000). *Science and engineering indicators 2000: Volume 1 (NSB-00-1)*. Arlington, VA: National Science Foundation.

National Science Board (2016). *Science and engineering indicators 2016 (NSB-2016-2).* Arlington, VA: National Science Foundation. Retrieved from: http://nsf.gov/statistics/2016/nsb20161/uploads/1/nsb20161.pdf

National Science Foundation (NSF) (2014). InfoBriefs: *Universities report continuing decline in federal R&D funding in FY 2014.* Retrieved from: https://www.nsf.gov/statistics/2016/nsf16302/

National Science Foundation (2014). *Data Source: NSF survey of research and development expenditures at universities and colleges/higher education research and development survey.* Retrieved from: https://ncsesdata.nsf.gov/webcaspar/Help/dataMapHelpDisplay.jsp?subHeader=DataSourceBySubject&type=DS&abbr=RDEXP&noHeader=1&JS=No

National Science Foundation (n.d.). *Higher education research and development survey (HERD): About the survey.* Retrieved from: http://www.nsf.gov/statistics/srvyherd/#sd

National Resident Matching Program (2014). *Results of the 2014 NRMP program director survey.* Washington, D.C.: National Resident Matching Program Retrieved from: http://www.nrmp.org/wp-content/uploads/2014/09/PD-Survey-Report-2014.pdf

National Residency Matching Program (2015). *2015 residency match largest on record with more than 41,000 applicants vying for over 30,000 residency positions in 4,756 programs.* Retrieved from: http://www.nrmp.org/match-data/main-residency-match-data/

National Residency Matching Program (NRMP) (n.d.). *The match, A to Z.* Retrieved from: www.nrmp.org/match-a-to-z/

Newfield, C. (2009). Ending the budget wars: Funding the humanities during a crisis in higher education. *Profession,* 270-284.

Newhouse, J. P., & Wilensky, G. R. (2001). Paying for graduate medical education: the debate goes on. *Health Affairs, 20*(2), 136-147.

Office of Program Policy Analysis and Government Accountability (OPPAGA) (2008). *Medical education funding is complex; Better expenditure data are needed. Report No. 08-36.* Retrieved from: http://www.oppaga.state.fl.us/reports/pdf/0836rpt.pdf

Petterson, S. M., Liaw, W. R., Phillips, R. L., Rabin, D. L., Meyers, D. S., & Bazemore, A. W. (2012). Projecting U.S. primary care physician workforce needs: 2010-2025. *The Annals of Family Medicine, 10*(6), 503-509. doi: 10.1370/afm.1431

Pfeffer, J., & Salancik, G. (1978). *The external control of organizations.* Palo Alto, CA: Stanford.

Pike, G. R., Kuh, G. D., McCormick, A. C., Ethington, C. A., & Smart, J. C. (2011). If and when money matters: The relationships among educational expenditures, student engagement and students' learning outcomes. *Research in Higher Education, 52*(1), 81–106

Porter, M. (1980). *Competitive strategy*. New York, NY: Free Press.

Relman, A. S. (2008). Industry support of medical education. *JAMA, 300*(9), 1071-1073.

Rich, E. C., Liebow, M., Srinivasan, M., Parish, D., Wolliscroft, J. O., Fein, O., & Blaser, R. (2002). Medicare financing of graduate medical education: Intractable problems, elusive solutions. *Journal of General Internal Medicine*, *17*(4), 283-292.

Rosinger, K. O., Taylor, B. J., Coco, L., & Slaughter, S. (2016). Organizational segmentation and the prestige economy: Deprofessionalization in high-and low-resource departments. *The Journal of Higher Education, 87*(1), 27-54.

Roth, N. (2009). *The costs and returns to medical education.* Unpublished manuscript. Department of Economics, University of California-Berkeley, Berkeley, CA. Retrieved from: https://www.econ.berkeley.edu/sites/default/files/roth_nicholas.pdf

Rousselot, L. M. (1973). Graduate medical education. *Bulletin of the New York Academy of Medicine, 49*(4), pp. 319-323. Retrieved from: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1806984/pdf/bullnyacadmed00182-0083.pdf

Ryan, J. F. (2004). The relationship between institutional expenditures and degree attainment at baccalaureate colleges. *Research in Higher Education, 45*(2), 97–114.

Salsberg, E., & Grover, A. (2006). Physician workforce shortages: implications and issues for academic health centers and policymakers. *Academic Medicine, 81*(9), 782-787.

Scheffler, R. M. (2008). *Is there a doctor in the house?: Market signals and tomorrow's supply of doctors*. Stanford, CA: Stanford University Press.

Schwartz, M. D. (2012). The US primary care workforce and graduate medical education policy. *Journal of American Medical Association, 308*(21), pp. 2252-3.

Senf, J. H., Campos-Outcalt, D., Watkins, A. J., Bastacky, S., & Killian, C. (1997). A systematic analysis of how medical school characteristics relate to graduates' choices of primary care specialties. *Academic Medicine, 72*(6), 524-33.

Sklar, D. P. (2013). How many doctors will we need? A special issue on the physician workforce. *Academic Medicine, 88*, 1785–1787.

Slaughter, S., & Cantwell, B. (2012). Transatlantic moves to the market: The United States and the European Union. *Higher Education, 63*(5), 583-606.

Slaughter, S., & Leslie, L. L. (1997). *Academic capitalism: Politics, policies, and the entrepreneurial university.* Baltimore, MD: Johns Hopkins.

Slaughter, S., & Rhoades, G. (1996). The emergence of a competitiveness research and development policy coalition and the commercialization of academic science and technology. *Science, Technology & Human Values, 21*(3), 303-339.

Slaughter, S. & Rhoades, G. (2004). *Academic capitalism and the new economy: Markets, state, and higher education*. Baltimore, MD: Johns Hopkins.

Slaughter, S. & Taylor, B. J. (2015). *Higher education, stratification, and workforce development.* The Netherlands: Springer.

Sloan, F. A. (1998). Commercialism in nonprofit hospitals. *Journal of Policy Analysis and Management, 17*(2), 151-68.

Smith, P. W. (2006). The National Institutes of Health (NIH): Organization, funding, and congressional issues. *CRS Report for Congress RL33695*, Washington, DC: Library of Congress. Retrieved from: www.nih.gov/about/director/crsrept.pdf

Smythe, C. M. (1967). Developing medical schools: an interim report. *Academic Medicine, 42*(11), 991-1004.

Starr, P. (1982). *The social transformation of American medicine.* New York, NY: Basic Books.

Stephan, P. E. (2012). *How economics shapes science*. Cambridge, MA: Harvard University Press.

Stevens, R. (1989). *In sickness and in wealth: American hospitals in the twentieth century*. Baltimore, MD: Johns Hopkins.

Sutz, J, (1997). The new role of the university in the productive center. In. H. Etzkowitz & L. A. Leydesdorff (eds.). *Universities and the global knowledge economy*. London, England: Pinter.

Taylor, B. J. (2015). The field dynamics of stratification among US research universities: The expansion of federal support for academic research, 2000-2008. In B.J. Taylor and S. Slaughter (eds). *Higher education, stratification, and workforce development* (pp. 59-79). The Netherlands: Springer.

Taylor, B. J., & Cantwell, B. (2016). Research universities and the American recovery and reinvestment act: Competition, resource concentration, and the 'Great Recession' in the United States. *Higher Education Policy, 29*(2), 199-217.

Taylor, B. J., Cantwell, B., & Slaughter, S. (2013). Quasi-markets in US higher education: The humanities and institutional revenues. *The Journal of Higher Education*, *84*(5), 675-707.

Taylor, B. J., Slaughter, S., & Rosinger, K. O. (2015). A critical reframing of human capital theory in US higher education. In Martínez-Alemán, A. M., Pusser, B., & Bensimon, E. M. (Eds.). *Critical approaches to the study of higher education: A practical introduction*. Baltimore, MD: JHU Press.

Texas Higher Education Coordinating Board (2014). *An assessment of opportunities for graduates of Texas medical schools to enter graduate medical education in Texas.* Retrieved from: http://www.thecb.state.tx.us/reports/pdf/6238.pdf?CFID=29312784&CFTOKEN=25436250

Tuckman, H. P. (1998). Competition, commercialization, and the evolution of nonprofit organizational structures. *Journal of Policy Analysis and Management, 17*(2), 175-194.

US Census Bureau (2016). *Regions and divisions*. Retrieved from: http://www.census.gov/econ/census/help/geography/regions_and_divisions.html

US Department of Education (2012). *New state-by-state college attainment numbers show progress toward 2020 goal.* Retrieved from: https://www.ed.gov/news/press-releases/new-state-state-college-attainment-numbers-show-progress-toward-2020-goal

US Department of Health and Human Services. (2006). *Physician supply and demand: Projections to 2020.* Washington, DC: HRSA Bureau of Health Professionals. Retrieved from: http://bhpr.hrsa.gov/healthworkforce/reports/physiciansupplydemand/default.htm

US Government Accountability Office (2013). *NIH should assess the impact of growth in indirect costs on Its mission.* Report to the Ranking Member, Committee on the Budget, U.S. Senate. Retrieved from: http://www.gao.gov/assets/660/658087.pdf

Weber, M. (1946). Science as a vocation. From H.H. Gerth & C. Wright Mills (Translated and edited), From *Max Weber: Essays in Sociology*, pp. 129-156, New York: Oxford University Press.

Weisbrod, B.A. (1988). *The Nonprofit economy*. Harvard University Press, Cambridge, MA.

Weisbrod, B. A. (1998). The nonprofit mission and its financing. *Journal of Policy Analysis and Management, 17*(2), 165–174.

Weisbrod, B. A. (2000*). To profit or not to profit: The commercial transformation of the nonprofit sector.* Cambridge, England: Cambridge University Press.

Weisbrod, B. A., Ballou, J. P., & Asch, E. D. (2008). *Mission and money: Understanding the university*. New York, NY: Cambridge University Press.

Williams G. (1991). Markets and higher education. *Higher Education Management, 3*, 214-2015.

Williams, G. L. (1992) *Changing patterns of finance in higher education*. Bristol, PA: SRHE and Open University Press.

Williams, G. L. (1995) Reforms and potential reforms in higher education finance. In D.D. Dill & B. Sporn (eds.) *Emerging patterns of social demand and university reform: Through a glass darkly*. New York, NY: IAU Press.

Wooldridge, J. M. (2002). *Economic analysis of cross-section and panel data*. Cambridge, MA: MIT Press.

Wynn, B. O., Smalley, R., & Cordasco, K. M. (2013). *Does it cost more to train residents or to replace them? A look at the costs and benefits of operating graduate medical education programs.* Washington, DC: RAND Corporation.

Young, K. Garfield, R., Clemans-Cope, L., Lawton, E. & Holahan, J. (2013). *Enrollment-driven expenditure growth: Medicaid spending during the economic downturn, FY 2007-2011.* Washington, DC: The Kaiser Commission on Medicaid and the Uninsured. Retrieved from: https://kaiserfamilyfoundation.files.wordpress.com/2013/05/8309-02.pdf

Zhang, L. (2010). The use of panel data models in higher education policy studies. In J.C. Smart (ed.) *Higher education: Handbook of theory and research, 25,* pp. 307-349. Netherlands: Springer.

Zinner, D. E., & Campbell, E. G. (2009). Life-science research within US academic medical centers. *JAMA, 302*(9), 969-976.